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5th INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

"KINESIOLOGY RESEARCH TRENDS AND APPLICATIONS"

September 10 – 14, 2008

Faculty of Kinesiology, Zagreb, Croatia

Proceedings Book

Editors-in-Chief:

Dragan Milanović and Franjo Prot

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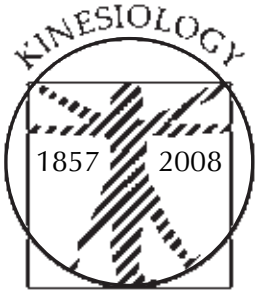

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Dear participants,

Approaching the time of the 50th anniversary of the successful work in the mission of high education and research of the Faculty of Kinesiology, University of Zagreb, we are exceptionally happy and satisfied that all the organisational and programme tasks and goals of the 5th International Scientific Conference on Kinesiology have been accomplished. Although our University is a large and among the oldest in the area, our Faculty is a relatively young, small institution of academic education from a small country in transition, which is facing and struggling with typical problems of the era and specific social processes. However, all previous efforts of our predecessors, even as far back as the 19th century, but especially of dear doyennes an doyens of kinesiology, as well as the establishing and organisation of the Conference, no matter how inexperienced it might have seemed in the beginning, back in the year 1997 in Dubrovnik, enables us nowadays to be peer members of the circle of internationally recognized and well-known institutions and organizations of sport/exercise science, or kinesiology. With no false modesty, it is a considerable achievement of our scholars, researchers, associates, other employees and last, but by no means the least important, our partners - students. A great contribution of our foreign colleagues should be recognized and accentuated here – nothing of the previously mentioned would have been possible without their good will, open minds and enormous interest in our work and advances. We cannot exclude a contribution of our famous athletes and their sport achievements. This is the right place to express our deepest appreciation and gratitude to them all and our wishes for continuation and expansion of the cooperation in many fields.

The science field we are interested in is so diverse, broad, complex; it investigates the very essence of life – the **movement** and everything needed for its realisation – its purpose, its origins, conditions, its means - from the molecular level to the level of anatomy, synergy of hundreds processes within a being, even to social proportions and effects of moving or not moving.

All the previous conferences were exceptional opportunities for broadening of scientific insights into this miraculous, beautiful phenomenon of physical activity and its effects – its perfection when performed by sport artists, as seen at the XXIX Olympic Games, its joyfulness when happy children enjoy being competent to be in motion, or when we see eager people who enjoy life and nature because they have enough energy and they are healthy thanks to an active lifestyle.

Ever better positioning of our science worldwide is obvious – the last example is from Croatia – in any sense, from the legislative to financial, in the Croatian structure of sciences, kinesiology has become equal to physics, economics, medicine, biology, law, sociology and many others. Such a position facilitates inter- and crossdisciplinarity and mobility of scientists and students within Croatia and abroad.

The rationale of the 5th meeting on kinesiology is "Kinesiology research trends and applications" ascends from the very heart of kinesiology, which embraces numerous theoretical, developmental and applicative research issues. Namely, the ultimate purposes of that research is to know and understand human beings and to apply the findings in everyday practice of education, sports, health promotion, recreation, tourism, and kinesitherapy.

The Conference will work in usual plenary and parallel sessions addressing fourteen comprehensive kinesiological topics: adapted physical activity and sport for the disabled; biology and medicine of sport and exercise; biomechanics and motor control; history of sport and the Olympic movement; management of sport; tourism and sport; members of the armed forces kinesiology; physical conditioning and fitness; physical education; psychology of sport; research methodology; sociology of sport; philosophy of sport; Sport for all and health-related activities; and top-level sport. Certain areas will be addressed at the Conference for the first time, like philosophy of sport, Olympic movement and kinesiology applied to armed forces. In these Proceedings all the positively reviewed contributions are published: communications and poster presentations.

We are very happy and proud because of the response of the invited 42 lecturers, worldwide famous experts in their areas of scientific interests who will undoubtedly throw new light on only seemingly already investigated issues, on the one hand, an on the other, bring the latest advances in research and theory, thus inspiring, especially young, researchers to learn and go ever further. After all, who knows where the frontier is?

Proceedings Book contains 239 contributions, which were submitted by the submission deadline, written by 421 authors from 40 countries from all the continents. Besides the presenters, we also expect participants without contributions, among them a lot of graduate, doctoral and postdoctoral students from Croatia and abroad for whom the Pre-Conference School of Kinesiology for Postgraduate and Doctoral Students has been also organised prior to the Conference.

Many thanks go to the members of the Organising and Programme Committees who did not spare their effort to prepare and realize the Conference and the Proceedings. Deep gratitude also goes to the team of reviewers, fifty five of them who carefully evaluated the contributions.

The Croatian Academy of Sciences and Arts is for the fourth time the patron of the Conference that is quite in line with the respectable position kinesiology/sport science has earned in the very meticulous scientific community

The Faculty wishes to express gratitude to the cooperative institutions: the Faculty of Sport, University of Ljubljana, Slovenia, the Faculty of PE and Sport, University of Sarajevo, Bosnia and Herzegovina, and the Faculty of PE and Sport, University of Comenius, Bratislava, Slovakia.

Several government institutions supported the organisation of the Conference. We are grateful to: the Ministry of Science, Education and Sport of the Republic of Croatia, the Croatian Olympic Committee and the Croatian University Sport Association.

After Dubrovnik and Opatija, dear participants, you have the opportunity to get acquainted with the Croatian capital – Zagreb, and our institution of higher education – with its facilities, its surroundings, other people working in it, our students, our laboratories, lecture rooms, library, etc. This opportunity to really know us will probably increase exchange rates among scholars and students.

We wish you feel welcome and come back many times!

Editors

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5th INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

"KINESIOLOGY RESEARCH TRENDS AND APPLICATIONS"

KINESIOLOGY IN EUROPE AND UNITED STATES OF AMERICA – DIFFERENCES IN NUMBER AND NAMES OF EUROPEAN AND USA HIGHER EDUCATION INSTITUTIONS

Dragan Milanović, Zrinko Čustonja and Goran Sporiš

Faculty of Kinesiology, University of Zagreb, Croatia

Abstract

The purpose of this study was to determe the differences between Europe and United States of America in the number of departmants, faculties or universities that offers degree in human movement science according to their names. Eight hundred and fifty eight (n=858) different university departments in the broad field of human movement study programmes from United States of America and one hundred and twelve (n=112) departments from Europe was embraced. All of them were found using internet as the main source of information. The list of higher education study programmes in USA was obtained from the web page of the American Kinesiology Association (www.americankinesiology.org). There are large differences in number of higher education study programmes in USA (n=858) compared to Europe (n=122). Most frequently, the terms used for human movement study programes in USA are health (n=261), physical education (n=172) and kinesiology (n=145). In Europe the most frequently used terms in names of the departments and faculties are sport (n=54), physical education (n=29) and exercise (n=10). In Europe there is only one departmant whose names included the term health. By using the Chi-test following statistically significant differences between USA and Europe in the number of departments named physical education, kinesiology and exercise were determined. The differences between USA and Europes regarding the number and names of sport studies are based on social, economic and historical differences between USA and Europe. When comparing the term kinesiology to other names of human movement departmants, faculties or universities it can be concluded that term kinesiology in rarely used in Europe but widely in USA. Nevertheless kinesiology is unified name for the whole academic area of the study of human movement. Kinesiology as the fundamental scientific field is applied in different areas such as sport, physical education, health, recreation, physical therapy (kinesitherapy), sport management, etc. and it is superordinate to them. It embraces the principals that are fundamental to all applied fields of kinesiology.

Key words: *Kinesiology, Europe, United States of America, higher education institutions*

Introduction

The term "kinesiology" was created more than 150 years ago. It is generally accepted that it was the Frenchman Nicolas Dally who was the first to use this term in 1857 "to denote the science of movement in its relationship with education, hygiene and therapy" (Dally, 1857; Prot, 1997; Renson, 2000). The word "kinesiology" originates from two Greek words: kinesis meaning movement and logos meaning science and if translated literally, it means "the study of movement."

Nowadays, the term kinesiology is used in the modern sense as a unified name for the whole academic and scientific area of the study of human movement. In Croatia we understand kinesiology as the science that studies the patterns of controlled processes of physical exercise/activity and their impacts on human organism (Mraković, 1992). Kinesiology as a fundamental scientific field is applied in different areas such as sports, physical education, health, physical recreation, sport management and kinesitherapy and it is superordinate to them. It encompasses the principles which are fundamental to all applied fields of kinesiology.

Although the word kinesiology was created in Europe, its first appearance in Europe and official use occured in 1967 in Croatia with the establishment of the Institute for Kinesiology at the University of Zagreb, Faculty of Physical Culture (since 2001, Faculty of Kinesiology). Currently, there is only one department in Belgium (Catholic University of Leuven, Department for Kinesiology and Rehabilitation sciences) and two departments in Croatia (University of Zagreb, Faculty of Kinesiology and University of Split, Faculty of Kinesiology) that fully accepted the term kinesiology.

The term kinesiology appeared in the United States of America in 1886 and became known when Baron Nils Posse published "The Special Kinesiology of Education Gymnastics" in Boston in 1894 (Renson, 2002). The modern era of kinesiology as an academic discipline began in North America around 50 years ago when the first high school departments began using the word kinesiology in their names. The American Academy of Physical Education changed its name to

the American Academy of Kinesiology and Physical Education (AAKPE) in 1993 (www.aakpe.org) acknowledging the importance and fundamental values of kinesiology as a multidisciplinary and crossdisciplinary science of human movement. Previously, the term kinesiology was often combined or even used interehangeabby with the term biomechanics. During the 1990s, North America witnessed the bifurcation in the kinesiology paradigm (Renson, 2002). The American Kinesiology Association was established in 2007 to promote and enhance kinesiology as a unified field of study within a higher education system of America and advance its many applications (www.americankinesiology.org)

Kinesiology is not the only term currently in use for the academic field in Europe and America. Over the last few decades, many names and combinations of names for academic disciplines, university departments and faculties, professional organizations and societies or scientific journals in the field of human movement studies emerged. There is no unified or mutually recognized name in use. A global academic convention on that matter does not exist.

Sport, Sport Science, Exercise Science, Human Performance, Movement Science, Human Kinetics, Kinesiology, Kinanthropology, Anthropomotorics, Anthropokinetics, Anthropokinesiology, Health, Physical Education, Physical Culture, Recreation, Leisure studies, Coaching and other terms or their combinations are currently in use. It is understandable that one scientific field can and does exist even if it has more than one name in use. But the diversity in terminology can sometimes cause confusion and lack of understanding in academic community.

What is the name of our profession and can we promote a, globally accepted name for our science? It is academically correct and productive to open or provoke any terminological discussions in our profession because there are a lot of terminological dilemmas in it.

As a contribution to terminological discussions in our academic field in this paper we will determine the differences in usage frequencies of different terms in Europe and America in higher education institutions in the field of human movement studies with the emphasis on the term kinesiology.

Methods

Subjects

The study encompassed eight hundred and fifty eight (n=858) different higher education study programmes in the broad field of human movement studies from the United States of America and one hundred and twelve (n=112) higher education study programmes from Europe. All of them were found using the internet as the main source of information. The list of departments in America was taken from the web page of the American Kinesiology Association (www.ameri cankinesiology.org). The higher education study programmes were grouped according to the most frequently used terms in their names. If there was more than one term in the higher education study programmes name the first term was chosen as dominant and the department was allocated accordingly. As for the USA, seven different groups of higher education study programmes (sport, physical education, movement science(s), kinesiology, health, exercise and other) were formed according to their names. In Europe, six different groups were formed (sport, physical education, movement science(s), kinesiology, exercise and other). In comparison to America, the term “health” is only once used as the first name in higher education study programmes name in Europe and we allocate that department in other.

Statistical analyses

The non-parametric statistic Chi–square test was used to analyse the differences within and between American and European higher education study programmes. The differences were determined by the number and the most frequently used term in the names of higher education study programmes in America and Europe.

Results

Table 1. Human movement studies in America, grouped by most frequently used terms

Sport	Sport Science	6	**46**
	Sport and Exercise Sciences	5	
	Sport Studies	5	
	Sport, Wellness, Fitness, Recreation Management	30	
Physical education	Physical Education	100	**172**
	Physical Education and Exercise Science	18	
	Physical Education and Health	18	
	Physical Education and Recreation, Wellness	11	
	Physical Education and Sport Studies	6	
	Physical Education and Human Performance	6	
	Physical Education and Sport Management	3	
	Physical Education, Athletic Training, Coaching, Health and Recreation	4	
	Physical Education and Health Education, Management, Promotion	4	
	Physical Education and Kinesiology	1	
	Physical Education and Sport	1	
Movement science(s)	Movement science(s)	2	**8**
	Movement Arts, Health Promotion and Leisure Studies	2	
	Movement Science and Education/Kinesiology	1	
	Movement Science and Sport	3	
Kinesiology	Kinesiology	108	**145**
	Kinesiology and Health, Health Education, Health Promotion...	18	
	Kinesiology and Physical Education	8	
	Kinesiology and Recreation, Leisure	6	
	Kinesiology and Exercise Science/Studies	4	
	Kinesiology and Nutritional Science	1	
Health	Health and Physical Education, Kinesiology, Recreation, Management, Sport Science, Human Performance	89	**261**
	Health and Physical Education	48	
	Health and Human Performance, Science, Kinetics	40	
	Health Sciences/Studies	28	
	Health and Exercise/Sport Science	27	
	Health and Kinesiology	12	
	Health and Human Services, Development	7	
	Health and Wellness/Fitness, Management	7	
	Health, Nutrition and Exercise Sciences	2	
	Health and Applied Human Science	1	
Exercise	Exercise and Sport Science	39	**112**
	Exercise Science	36	
	Exercise, Sport, Leisure, Health, Recreation, Movement Science	12	
	Exercise Science and Physical Education	8	
	Exercise Science and Sport Studies	7	
	Exercise Science and Health	3	
	Exercise and Nutritional Sciences	2	
	Exercise Science and Sports Medicine	2	
	Exercise Physiology/Biology	3	
Other	Human Performance and Sport/Exercise Science, Sport, Leisure, Dance, Athletic Training	18	**114**
	Physical Therapy	17	
	Athletic Training and Management, Exercise Science, Sports Medicine	11	
	Sports Medicine and Nutrition	5	
	Wellness and Sport/Exercise Sciences, Recreation	5	
	Sports Administration	2	
	Human Studies	1	
	Other	55	
Summary		858	**858**

Table 2. Human movement studies in Europe, grouped by most frequently used terms

Sport	Sport Science(s)	31	**54**
	Sport Studies	5	
	Sport, Exercise, Health, Leisure (science)	5	
	Sport	5	
	Sport pedagogic/Sport education	2	
	Sport, Humanities, Society, Social science, Performing arts	6	
Physical education	Physical Education and Sport	12	**29**
	Physical Education and Sport Science(s)	10	
	Physical Education	5	
	Physical Education and Leisure Studies	1	
	Physical Education and Physiotherapy	1	
Movement science(s)	Movement science(s)	4	**5**
	Sport and Movement Science	1	
Kinesiology	Kinesiology	2	**3**
	Kinesiology and Rehabilitation Sciences	1	
Exercise	Exercise and Sport Science(s)	10	**10**
Other	Science and Techniques of Physical and Sporting Activities	10	**21**
	Human Kinetics	1	
	Physical Recreation and Sport	1	
	Coaches Faculty	1	
	Recreation and Sport Management	1	
	Sport Biomedicine	1	
	Physical culture	1	
	Human Performance	1	
	Sport Medicine and Exercise Science	1	
	Kinesitherapy Faculty	1	
	Health and Education	1	
	Teachers Faculty	1	
Summary		122	**122**

Table 3. Differences between America and Europe in frequency of used terms

Name groups define by frequently used terms in there name	USA	Europe	Chi	p- level
Sport	46	54	2,62	0,15
Physical education	172	29	100,32	0,0001
Movement science(s)	8	5	0,33	0,58
Kinesiology	145	3	134,44	0,0001
Exercise	112	10	55.89	0,0001
Other	114	21	90,23	0,0001
Summary	597	122	184,48	0,0001

Looking at the results there are obvious differences between America and Europe in the number and names of departments (Table 3). There are large differences in the number of departments in America (n=858) compared to Europe (n=122). Most frequently, the term used in the names of depatments in America are health (n=261), physical education (n=172) and kinesiology (n=145). In Europe the most frequently used terms are sport (n=54), physical education (n=29) and exercise (n=10). In Europe there is only one higher education department that use term health (Table 2). By using the Chi-square test following statistically significant differences between America and Europe in number of departments named physical education, kinesiology and exercise were determined.

Discussion and conclusion

Some of the generally accepted things about America and Europe higher education systems are: The USA higher education system has many advantages – a flexible curriculum, a variety of courses, transfer choices, study abroad opportunities and many other. European higher education system was developted individualy in almost every country. Just 20 years ago so called 'Bologna process' of harmonization of European higher education systems started. But nevertheless 'Bologna process' has made it clear that European nations, no matter how much they emphasize their individuality, are in fact more similar to each other than they are to USA and allow some generalizations to be made.

New ways of studying made it possible for students to have large number of possibilities what courses are they going to take and for university or department authorities how those courses are going to be named. Field of human movement studies is very different in terms usage when comparing USA and Europe. In USA, to authors knowledge, there is lager number of higher education institutions (n=858) that offer courses in the field of human movement studies. When looking at a percentage Europe has only 14,21% of university departments when comparing to USA. We can conclude that the human movement studies in USA are much more popular and than in Europe.

Opposite to USA in Europe most frequently used term is sport (sport science(s), sport studies…) followed by physical education. In Europe there is only one higher education institution that use term health in there official name and there are only three higher education institutions that use term kinesiology in their official name. At the same time in USA there are 261 higher education institutions which in there names have term health and 145 that use term kinesiology (Table 1). Generally we can say that physical education is the only term that is widely shared between Europe and USA. But physical education is just one applied area of our science.

It is understandable that names of the departments or courses have to be attractive to be able to recruit larger number of student. Domination of term sport (sport science(s), sport studies) in Europe is probably product of social, economical and historical significance of term sport in Europe. Sport is word used in almost all European languages, it is widely recognized and common in every day use. European culture and history has made it less flexible to accept different term. For mentioned reasons term sport probably prevail in European higher education institutions names. But sport is just another applied area of our science.

USA higher education contrary to European is widely open and connected to market and economy. This is one of the reasons why health is the most frequently used term in USA. Health is one of the larges problems of modern society. The economic costs of physical inactivity affect national economies, as shown by the following examples taken from studies of particular policy interest. In one United States study, costs associated with inactivity were between US $24.3 billion (2.4% of total health care costs) and US $37.2 billion (3.7%) for direct health care (Colditz, 1999). When obesity costs are included (Colditz, 1999) a minimum of 9.4% of all direct costs incurred in delivering health care in the U.S. are attributable to insufficient energy expenditure which directly leads to medical conditions or alternatively the accumulation of adiposity which then contributes to excess morbidity and mortality. Conversely, the potential reduction in the costs of treating heart disease if sedentary adults walked regularly has been calculated in the United States (Jones, Eaton, 1994); US $5.6 billion would be saved annually if 10% of adults began a regular walking programme. Physical activity is probably one of public healths "best buys" (Morris, 1994). Health, health care and prevention have big market in USA and respecting market demands health entered at universities. But health which can be connected with recreation, leisure, fitness, wellness, physical therapy or general exercise is just another applied area of our science.

The term kinesiology is much more used in higher education institutions names in USA than in Europe. When comparing term kinesiology to other terms used we can conclude that term kinesiology together with health and physical education is the most frequently used term in the USA. There are at least two organizations in USA that promote kinesiology as academic field and scientific discipline. American Kinesiology Association (AKA) was established in 2007 to promote and enhance kinesiology as a unified field of study at higher education system of USA and advance its many applications. American Kinesiology Association define kinesiology as the academic discipline which involves the study of physical activity and its impact on health, society, and quality of life. American Kinesiology Association was established to represent and advocate for kinesiology at academic, governmental, and professional events, both nationally and internationally. (www.americankinesiology.org) American Academy of Kinesiolgy and Physical Education (AAKPE) encourage and promote the study and educational applications of the art and science of human movement and physical activity. According to AAKPE kinesiology is a common name for college and university academic departments that include many specialized areas of study in which the causes and consequences of physical activity are examined from different perspectives. (www.aakpe.org)

First offical use of term kinesiology in Europe was in 1967 in Croatia when Institute for Kinesiology was established at the University of Zagreb, Faculty of Physical Culture (since 2001 Faculty of Kinesiology) and since than Croatia is a leading nation in Europe in promotion and popularization of term kinesiology. During this year kinesiology was recognized by Ministry of science, education and sport of the Republic of Croatia as scientific disciplines and it is listed in the official nomenclature of scientific disciplines in Croatia.

Although there are only three higher education institutions in Europe that use term kinesiology in their official names term kinesiology is present in European scientific community and today kinesiology appears as a name of scientific

journals, scientific associations, scientific institutions, organizational units of higher education institutions and curriculum subjects in number of cases. (Table 4)

Table 4. Kinesiology in Europe

UNIVERSITY DEPARTMENTS AND FACULTIES	Country
Faculty of Kinesiology (University of Zagreb)	Croatia
Faculty of Kinesiology (University of Split)	Croatia
Faculty of Kinesiology and Rehabilitation Sciences (Katholieke University Leuven)	Belgium
SCIENTIFIC JOURNALS	
Kinesiology – International Journal of Fundamental and Applied Kinesiology (since 1971)	Croatia
Kinesiologia Slovenica	Slovenia
Acta Kinesiologiae Universitatis Tartuensis	Estonia
Acta Kinesiologica	BIH
Chinesiologia	Italy
SCIENTIFIC INSTITUTIONS OR ORGANIZATIONAL UNITS OF HIGHER EDUCATION INSTITUTIONS	
Institute of Kinesiology (University of Ljubljana, Faculty of Sport)	Slovenia
Department of Kinesiology (Institute of Sport, Warsaw)	Poland
Institute of Kinesiology (University of Pécs, Faculty of Medicine)	Hungary
Department of Kinesiology (University of Tartu, Faculty of Exercise and Sport Sciences)	Estonia
Department of Sport Science and Kinesiology (University of Salzburg)	Austria

Respecting the fact that at the moment we don't have one globally accepted name for our science we tried to determin differences in usage frequencies of different terms in Europe and United States of America in higher education institutions name in the field of human movement studies. At the end we can conclude that today term kinesiology is definitely much more recognized and accepted as adequate term for basic science that deals with broad area of human movement studies. As it is shown in Table 1 'Departmen of Kinesiology' is currently the most frequently used name for depatments in USA At the same time term kinesiology is not yet so spreaded in Europe, although it is in use in various ways in at least 9 European countries.

If we can accept that kinesiology as fundamental science finds it's applications in many different fields such as sport, physical education, health, recreation, exercise, physical therapy, sport management, etc. and that kinesiology embrace principals that are fundamental to all of them it is only a matter of academic and scientific convention to accept term kinesiology as a global and universal term for our science and profession.

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10. www.aakpe.org
11. www.americankinesiology.org

Key-note Lectures

5th INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

"KINESIOLOGY RESEARCH TRENDS AND APPLICATIONS"

Opening ceremony lectures

Plenary sessions lectures

SPORT SCIENCE IN EUROPE – HISTORY AND PERSPECTIVES

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Abstract

The history of sport science is based on different movements and initiatives and in the European context it refers particularly to the spreading of the modern sport of the 19th century. However, the necessity of an extensive physical exercise for the improvement of athletic performance as well as the promotion of health, were decisive impulses for the study of human movement. These ideas arouse in the ancient world and were clearly defined in modern times. At the turn of the century and in the first two decades of the 20th century several scientific papers on hygiene, physical activities and pedagogy were published and initial attempts of a theory of physical education were discernible. An explicit "theory of physical education" was not formed until the end of World War Two.

Since the middle of the sixties sport science, based on the theory of physical education, has become an organisational (structural) and systematic scientific consolidation. However, a theory of sport science as an interdisciplinary theoretical basis of sport did not exist. The question of the status and the integration of single disciplines like the theory of movement and training or sport medicine and sport pedagogy became the decisive scientific problems of the seventies.

Unstoppable changes in social conditions and the increasing social importance of organised sport led to the implementation of chairs for sport science at the universities in German speaking countries and partly in other European countries. These developments caused a continuous process of differentiation which led to the creation of a theoretical field of topics as well as to sport science research with interdisciplinary character in the 1980ies (nineteen eighties). From the European point of view sport science was a national science until the beginning of the nineties of the last century. Transfer of knowledge all over Europe in scientific journals or on international conventions hardly ever happened. A decisive change was caused by the foundation of international societies of biomechanics, sociology, psychology etc. who increasingly dealt with questions concerning sport and movement. From the perspective of the whole sport science, however, the foundation of the European College of Sport Science in 1995 was a decisive step in the process of making sport science an international discipline. 14 internationally well known scientists from 11 different European countries, the so called founding members, established this scientific society and held their first international convention in Nice, France, in 1996. The most important task of this society is to organize an international and multidisciplinary congress on sport science annually. Moreover, this organization publishes its own scientific journal, the "European Journal of Sport Science" and supports concerns of sport science with "position statements" on central questions concerning sport science. This society has been very successful since it was founded 13 years ago. This year the 13th congress was held and the number of participants has increased from 430 in Nice to more than 1500 in Cologne (2001) and 2100 in Lisbon (2008). From the European point of view it is a great benefit that colleagues from over 65 nations meet and share their knowledge within all disciplines of sport science. Within the last 10 years more than 1500 scientific papers on average were handed in. The distribution of the single papers on the various fields of sport science differs but on the whole there are far more natural scientific papers compared with papers dealing with humanities or sociology. Supposedly this trend is going to be expected in the future and sport science will only be seen and accepted in an international context. Individual disciplines will be successful only if they are internationally carried out.

Key words: *sport science, history, perspectives*

MAXIMIZING ATHLETIC PERFORMANCE: OBSERVATIONS ON PERIODIZATION AND VARIATION

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Abstract

Although it is well accepted that periodization strategies are critical in maximizing athletic performance, there is still debate as to which periodization model is most appropriate. This will likely be impacted by the training demands of the athlete, experience level of the athlete, the duration of the training program and the training frequency that will be used. Incorporation of Olympic and ballistic training appears to have significant impacts in strength and power performance of experienced resistance trained strength/power athletes. The inclusion of these exercises during specific training cycles may result in significantly greater training adaptations.

Key words: *athletic performance, observations, periodization, variation*

Introduction

In the past half-century a number of studies have examined how manipulation of training intensity and volume of training can influence strength improvements. Early investigations suggested that an optimal training intensity (i.e. load) should be used to maximize strength gains (Berger, 1962; O'Shea, 1966). Subsequent studies have indicated that when training intensity and volume are altered within a training cycle, strength performance can be enhanced to a significantly greater extent than when these training variables are maintained consistent during the training period (Harris et al., 2000; Kraemer, 1997; Kraemer et al., 2003; Marx et al., 2001; Stone et al., 1982; 2000; Stowers et al., 1983; Willoughby et al., 1993). The step-like alteration of training intensity and volume is commonly referred to as the traditional model of periodization (Baker et al., 1994; Hoffman, 2002; Poliquin, 1988; Rhea et al., 2002). It is also referred to as linear periodization in which each phase of the training program emphasizes a specific training goal (i.e., hypertrophy, strength or power). Linear periodization is typically characterized by an inverse relationship between intensity and volume of training. During the beginning of the training cycle training volume is high and training intensity is low. As the training cycle progresses training intensity will increase, while training volume declines. This is typical for the training program emphasizing increases in strength performance. However, for many athletes the goal may be to simultaneously emphasize both power and hypertrophy development. As a result alterations in daily program emphasis would provide the ability for athletes to train for both at the same time. This periodized training model is often referred to as nonlinear or an undulating training model (Fleck, 1999; Kraemer, 1997).

Studies examining nonlinear periodized training programs have demonstrated that daily program manipulation is more beneficial in eliciting strength gains than non-periodized training (Kraemer, 1997; Kraemer et al., 2003; Marx et al., 2001; Rhea et al., 2002). However, comparisons between traditional linear and nonlinear periodization models are quite limited. It has been reported that a nonlinear periodized resistance training program was more effective in stimulating strength gains than linear periodization following 12 weeks of training (Rhea et al., 2002). In contrast, other investigators were unable to see any significant differences in strength gains between these two periodization models following up to 9-weeks of training (Baker et al., 1994; Buford et al., 2007). However, the majority of research examining the efficacy of periodized resistance training programs has not been conducted on competitive strength/power athletes. In the few studies examining competitive athletes, significant benefits of a nonlinear training model compared to no periodization have been reported in college tennis players (Kraemer et al., 2003) and American football players (Kraemer, 1997). Recently, a study by Hoffman and colleagues (2008) compared periodized linear, periodized nonlinear, and non-periodized training programs during a 15-week offseason resistance training program in experienced resistance trained American college football players. Results were unable to demonstrate any clear evidence that one training program was more effective than the other. However, the investigators suggested that the results of the study were impacted by the prolonged active rest period (7 weeks) that had preceded the start of the study. In such a scenario (typical of many lower division American College football programs), any of the training programs would have resulted in significant strength improvements. It is likely that a longer period of training would be needed to delineate any differences between the training paradigms.

The development of yearly training programs includes specific emphasis on inseason training regimens. The inseason program, also known as a maintenance program is designed to primarily maintain the gains made during the offseason

training program. However, depending upon the training experience of the athlete or the design of the training program, it does appear possible to not only maintain strength and power, but to improve these variables during a season of competition. There have been several studies that have examined the efficacy of various off-season training programs in strength/power athletes.

Inseason training programs

Both upper and lower body strength (one repetition maximum [1RM] bench press and Squat, respectively) have been shown to be maintained during both competitive football (Hoffman and Kang, 2001) and basketball (Hoffman et al., 1991a) seasons. Interestingly, not only can strength be maintained but it has been shown to be improved as well. Increases in strength in football players have been seen in the 1RM squat (Hoffman and Kang, 2001), while improvements in upper body strength have been reported in basketball players (Hoffman et al., 1991b). The differences between these studies are likely related to the demands of each sport. Basketball players have a greater emphasis on lower body training during practice and games that may limit lower body strength improvements during the season. The increase in lower body strength compared to upper body strength in American football players is thought to be related to the player's resistance training experience. Most American college football players generally have been resistance training for at least two years prior to entering college. However, we have found that many of these athletes had limited experience in the squat exercise. It is probable that the greatest window of adaptation in the younger (freshmen) players is in lower body strength attainment.

Improvements in strength during the season also appear to be related to the intensity of training used during the inseason resistance training program. When training intensity exceeds 80% of the players 1RM the ability to stimulate strength improvements is significantly greater than when training intensity is below 80% (Hoffman and Kang, 2001). This appears to be more prevalent in first year players than in the older, more experienced resistance trained athletes. It is likely that the accumulated fatigue occurring in players that have greater playing time limit the extent of muscle adaptation occurring during the season.

A comparison of linear to nonlinear training has also been examined during the inseason training program. Hoffman and colleagues (2003) examining American freshman college football players reported that both linear and nonlinear models of training are able to maintain strength during the competitive football season in freshman college football players. Further, subjects performing the linear training program model showed significant improvements in 1-RM squat strength, while no significant strength changes were observed in subjects training with the nonlinear model of training.

The subjects in the nonlinear group were required to train at approximately 70% of their preseason 1RM during the first training session of the week, and use a resistance approximating 90% during the second training session. The subjects in the linear group were required to train at 80% of their 1RM during both weekly training sessions. Subjects in both groups were encouraged to aggressively increase the resistance used when they were able to complete the required number of repetitions for two straight training sessions. Examination of training logs at the end of the study showed that the average training intensity during the high intensity training day for subjects in the nonlinear group was less than 90% in both the squat and bench press exercises and greater than 75% on the light intensity training days. Although the average intensity of training per week was similar between the nonlinear and linear groups (80.75% and 83.95% in the squat exercise) and (81.3% and 83.3% in the bench press exercise), the subjects in linear training group were able to train at an intensity averaging better than 80% for both training sessions. Thus, it is likely that the subjects in the linear training group were provided a greater stimulus to elicit strength improvement compared to the subjects in the nonlinear training group.

Training program variation during off-season conditioning programs

The traditional power lifting program may not provide the optimal training stimulus in football players. We have demonstrated that by including Olympic lifting exercises in the training program of these athletes we can enhance leg strength and running speed to a greater extent (Hoffman et al., 2004). Although improvements in both upper and lower body strength measures were not significantly different between strength/power athletes using an Olympic exercise routine and a traditional power lifting training program, there did appear to be a trend toward specific strength adaptations that were related to the subjects' specific training program. Subjects in the power lifting group experienced a two-fold greater improvement in upper body strength ($p>0.05$), while the subjects in the Olympic lifting group experienced an 18% greater improvement in lower body strength ($p>0.05$). These differences in strength improvement were likely the result of the inclusion of specific assistance exercises that were part of the subjects' training programs. The greater number of assistance exercises of the upper body incorporated into the training program of the power lifting group likely impacted the strength gains of the upper body, while the greater number of multi-joint structural exercises utilizing the lower body musculature that comprised the training program of OL may have had a greater impact on lower body strength development.

The high number of pulling exercises (i.e. cleans, snatches and pulls) seen in the training program of the Olympic lifting group likely impacted the significantly greater vertical jump improvement seen in this group compared to the

power lifting group. These exercises are mechanically similar to the vertical jump and the motor unit firing patterns that are improved during training of these exercises would likely enhance the firing pattern of these motor units during the vertical jump as well.

Training programs that involve high velocity movements, such as that seen with Olympic training, are thought to be superior for eliciting gains in power output and speed. This is based primarily on the high rates of force development and improved contractile speed associated with high force, high velocity resistance training. Although differences in sprint and agility performance was not statistically significant, there did appear to be a tendency for a greater improvement in sprint times in the Olympic training group compared to power lifting group. The sprint and agility training program that was incorporated into the training program of both groups likely had a significant impact on speed and agility improvement in all subjects. Other studies have reported that combination training may be more effective than training programs that focus primarily on either high force or high power only (Harris et al., 2000; Wilson et al., 1993). Training programs of high force only appear to improve force at the high end of the force-velocity curve, while the inclusion of high power or high velocity exercises appears to emphasize greater improvements of force at the high velocity end (Hakkinen, 1994, Hoffman, 2002). A combination of high force and high power training would appear to result in adaptation occurring at a greater part of the force-velocity curve and have a greater impact on athletic performance (Hakkinen et al., 1986).

Recent research has indicated that the inclusion of ballistic exercises (i.e. jump squats and bench press throws) may further augment the training response in these players (Hoffman et al., 2005). In a study of experience, resistance trained strength/power athletes these investigators incorporated jump squat exercises into the 5-week strength/power phase of the offseason conditioning program. The jump squat exercise appeared to significantly enhance the strength performance in the squat and power clean exercises in those athletes performing the ballistic movements compared to those athletes that did not. However, no significant differences power performance was seen. It is likely that in a group of well-trained athletes a greater duration of training with ballistic exercise is needed to impact speed and agility performance. This would be consistent with other studies that have demonstrated significantly greater improvements in power performance when ballistic exercises are incorporated into the training program (Newton et al., 1999: Wilson et al., 1993).

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SCHOOL PHYSICAL EDUCATION CURRICULUM CHANGES IN SLOVAKIA IN INTERNATIONAL CONTEXT

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Abstract

Nowadays the school PE in Slovakia meets following problems – decreasing amount of compulsory PE, decreasing quality of education, high amount of non – exercising pupils, exempted pupils from PE classes, stagnate physical fitness and motor productivity of youth, insufficient solicitude of disabled pupils, lack of control of PE education, weak of social and financial honour of PE teachers and low interest of graduates, especially of teaching specialization to work in their own profession. To the change of this status should contribute a new project of education. It is established on the basis of educational domains – human and nature, human and technique, an Individual, Society, Culture, Mathematical and logical thinking, Language and Communication, Health and movement. Educational area "Health and movement" is elaborated in subject "physical and sport education" into the 4 modules: health and its impairment, healthly life style, physical fittnes and motor performance, sport activities of movement regime.

Key words: *physical education, curriculum*

Domain of school physical education is one of the fields that in world engage heightened attention in the last decades. On one side it is on the level of ministries of sport and the highest governmental officials for physical education and sport as well as on the level of international non-governmental organisations. In last 30 years were approved many international documents that for given evolutionary period determined aim and position of physical education (P.E.) at schools. From the most important counted first of all International Charter of Physical Education and Sport published by UNESCO in 1978, Declaration from Madrid published by EUPEA in 1991, European Sports Charter from the Conference of ministries of sport in 1992, Charter of children sport laws published by PANAHLON in 1995, Declaration from Punta del Este from Conference of ministries in 1999 and World manifest of physical education FIEP 2000 approved by FIEP in 2000. P.E. at schools belonged to main topics also on two World summits of physical education in Berlin 1999 and in Magglingen 2005.

Like in world, also in Slovakia P.E. in last three decades went through by intensive development and many changes. In spite of try of P.E. professionals, P.E. teachers, pupils and parents still struggle, sometimes more, sometimes less successfully with lot of problems. We present at least some of them:

- **decreasing amount of compulsory P.E.** – officialy on secondary schools had decreased the amount of compulsory P.E. from 3 to 2 lessons per week (table 1), non – officially also at the other levels and types of schools – in fact many P.E. lessons are not realised at all; for last decade had significantly decreased the amount of schools, which have 3 P.E. lessons per week (table 2); P.E. canceling on many universities and faculties.

Table 1. Amounts of compulsory P.E.

Schools	1990 Amount of lessons per week	1997 Amount of lessons per week	2008 Amount of lessons per week
Primary schools	3	3	2 + School educ. program
Secondary schools	3	2	2 + School educ. program
High schools	2 - 3	2 - 3	2 + School educ. program

Table 2. Amount of schools (in %) with 1, 2 and 3 P.E. lessons in 1995 and 2005 (Melicher, 2006)

Amount of lessons per week	3 P.E. lessons	2 P.E. lessons	1 P.E. lesson
1995	78,5 %	22,2 %	0 %
2005	45,5 %	44,8 %	9,7 %

- **Often decreasing quality of education** – there is low level of teaching process on many schools, it has only recreational character; big shortage mostly on primary schools, where P.E. is thought by class – teachers;
- **Too high amount of pupils on P.E. and work with them is getting worse** – for the last 10 years had increased the average of pupil's amount on P.E. – approximately 30 % of schools present overrun of amount of 25 pupils determined by the Ministry of education of Slovak republic to be divided (classes) into groups (Melicher, 2006); what is more, on lessons teachers are solving more often educational problems, because children and youth are more and more vivid;
- **Great number of not participating and released pupils from P.E. lessons** – number of these pupils can reach in many schools 5 – 16 %. Amounts of pupils permanently released from P.E. are significantly decreasing, mostly on high schools. It is concerning mostly (16 %) to girls on high schools and on vocational schools (figure 1).

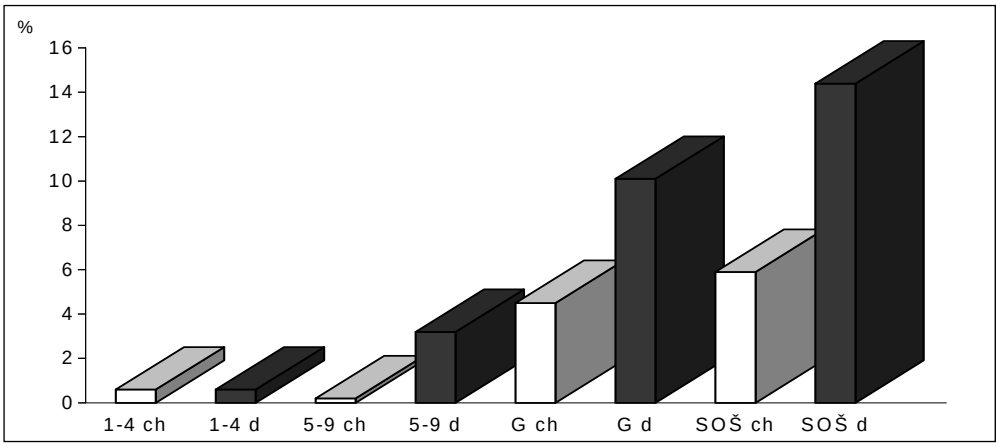

Figure 1. Year-round released pupils from P.E. (Melicher – Slezák, 2007, group of 14 000 pupils).

- **Stagnating physical fitness and performance of youths** – in the development of motor abilities is stagnation, the level of endurance abilities decreases; there is a tendency of turn secular trend direction in indicators of motor efficiency from constant to negative. That is certified by researches of Moravec – Kampmiller – Sedláček (1996), Lednický – Doležajová (2007), Moravec (2008) etc.;
- **Care of pupils with disability** – average rate is 10 – 20 %, but only 3 % of pupils participate on adapted physical educations lessons, generally are these pupils integrated in normal education, but there is lack of special care (Labudová, 2003);
- **Bad state of P.E. arrangements, lack of P.E. facilities** – almost 50 % of directors and representatives consider conditions for P.E. on their schools as insufficient; now-a-days effort to attract great firms to complete school sport objects, only little progress in programme "Give back sport to schools"
- **Increasing of P.E. teachers' age average and low interest of young graduates to work in the field of P.E.**; teachers are getting older and older, the average age of P.E. teachers are increasing – in 2006 it was 43,1 year old (Lákoová, 2006); after graduation only 37,3 % work in the profession of P.E. teacher. Others are working in sport clubs, sport organisations or private sector. 36,4 % are working out of school and sport sector (figure 2).

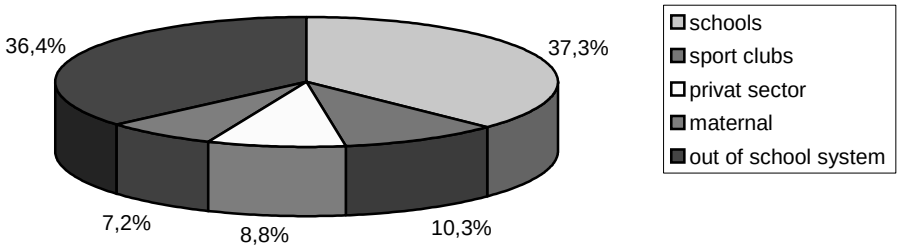

Figure 2. Present employment of P.E. graduates in 2001 – 2005 (Tóthová - Labudová, 2007, group of 315 graduates).

- **Weak social and financial award of P.E. teachers** – Slovak teachers' salaries are the lowest in EU; amount of dissatisfied P.E. teachers is still increasing, they are unhappy with their financial and social assessment – in 1992 it was 75 % teachers (Baginova - Antala – Sedláček 1992), nowadays it is 94,1 % P.E. teachers Lákoova (2006);
- **Often ease of work of P.E. teachers**, that results from insufficient evaluation of their work
- **Low representation of P.E. teachers in schools' management positions** – only 18,2 % school managers are P.E. teachers (figure 3), which are decreasing the chance to get ahead the requests of physical education in schools' leadership.

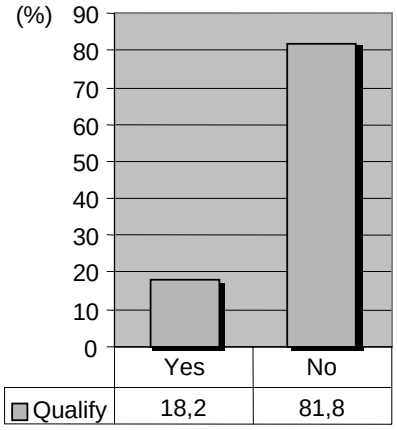

Figure 3. Percentage whack of managers with P.E. qualification and without P.E. qualification (Antala – Dančíková, 2008, group of 231 high school managers).

- **Absence of control of P.E. teaching** – limited number of inspectors, less frequent control of school directors – 42 % school managers make inspections on P.E. lessons only 1 time per half year, 13 % only 1 time per whole school year and 17 % don't make this process at all (figure 4).

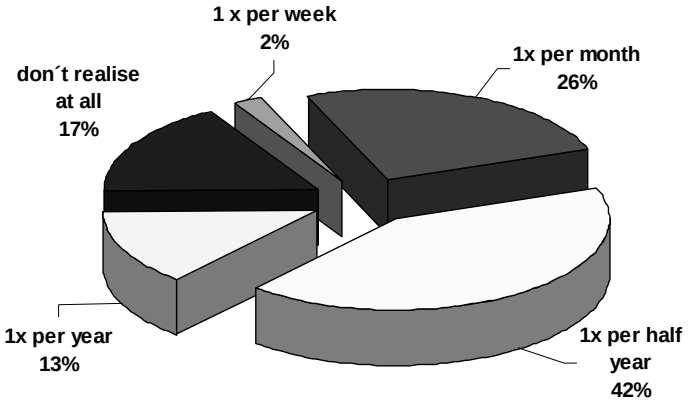

Figure 4. Inspection process of school managers on P.E. lessons (Antala – Dančíková, 2008, group of 231 high school managers).

- **Weak organisation P.E. teachers** – lack of real professional organisation, that could effectively promote P.E. teachers' interests;
- **Shortages in pre-graduate teachers' preparation** – in spite of change effort, universities often reside on traditional methods, there is very slow new trends and knowledge implementation into the teacher's preparation;
- **Unfinished system of lifelong P.E. teachers' education** – a universities' small interest of graduates after their attendance; insufficient universities' involvement into the further teachers' education; weak motivation stimulus for teachers' involvement;
- **Lack of financial source for science in the field of physical education and sport** – insufficient co-ordinated scientific research; insufficient knowledge transformation from scientific research into the practice (vocational or teacher training); limited opportunities of scientific research publications; smaller interest of researchers and pedagogical employees at the universities in the field of school physical education.

School physical education meets many similar problems all around the world. Hardman and Marschal (2005) on the 2nd World summit in Maglingen have presented the results of audit of teaching process in P.E. in world. They observed, that situation in teaching process of compulsory P.E. range in schools' curriculum had worsened against 1999 (Hardman – Marschall, 1999) cca in 6 %. Nowadays P.E. is as an obligatory part of curriculum on 81 % of primary schools and 82 % of secondary schools in whole world. On primary schools (in world) P.E. lessons take in average 94 minutes per week (in 1999 it was around 116 minutes). On secondary schools is the average 101 minutes (in 1999 it was around 143 minutes). Differences exist between continents and countries. Positive in it are some east European countries, where amount of compulsory P.E. lessons had increased (for example Poland – form 2 lessons to 4 lessons per week, Ukraine a Slovenia – from 2 lessons to 3 lessons per week). Totally during the period 1999 – 2005 amount of lessons didn't change in 60 % of countries, increased in 16 % of countries and decreased in 24 % of countries.

In 40 % of countries will be probably lessons of P.E. cancelled as well as lessons of other teaching subjects. Total status of P.E. as a teaching subject is in 44 % of countries perceived as a lower compare past time. P.E. teacher status is perceived in 70 % of countries as same, in 3 % of countries as higher and in 27 % of countries as lower.

The quality of P.E. teaching process is limited by material and facility conditions that were assessed like excellent only in 8 % of countries. The most were assessed as limited (cca 32%) and as appropriate (cca 31 %). In cca 18 % of countries were assessed as inconvenient. Also in this areas are big differences between continents and also within continents. For instance in Europe in economical prosper countries of west and north Europe were conditions assessed mostly like appropriate and often also like excellent compare countries of central and eastern Europe, where condition were assessed as inappropriate.

To solving problem in Slovakia should contribute educational transformation, also in physical education. Since 1st of September 2008 in Slovakia came into force new law about education, that substitutes almost 30 years old school law. That should reform an existing system of education and try to avoid from many above-mentioned problems concerning not only physical education, but also many other teaching subjects.

Inspiration for new school reforme in Slovakia was developing trends of steering of educational policy in school systems mostly in EU countries (England, Nederland, Finland, Austria, Sweden). Coming out of mentioned European trends, basic ideas of new law about education are mostly:

- Decentralization and bigger schools' autonomy, its bigger share on decide about educational content;
- Establishment of educational domains and partial topics and integration of teaching subjects into it;
- Bigger activity and teachers' responsibility and their bigger competencies;
- An accent to educational work v pedagogical process aimed to pupils' competencies development.

In this spirit, the compulsory part is divided on state educational program and school educational programs. State educational program present approximately 70 % of total educational content and it is obligated for schools. School educational programs are presenting approx. 30 % of educational content and creation of it is fully up to schools on the basis of its conditions, aim, tradition, personal possibilities and pupils' interest. In creation of this program, the main role will play managements of different schools, school boards, but also teachers of different subjects including P.E. teachers.

Aims of teaching process will be filled in within new educational areas, where separate area is area "Health and movement". "Physical and sport education" as a teaching subject is part of this area (table 3).

Table 3. Educational areas and teaching subjects in ISCED 3

Educational area	ISCED 3
Language and Communication	Slovak language and literature
	1. Foreign language
	2. Foreign language
Mathematics and work with information	Mathematics
	Informatics
Human and Nature	Physics and experiment
	Chemistry and experiment
	Biology and experiment
Human and Society	History
	Geography
	Civics
Human and priorities	Ethics / Religion
	Psychosocial training
Art and Culture	Art and culture
Health and Movement	**Physical and sport education**

Aims filling of different educational areas and teaching subjects will be realised in school environment through key and subject competencies of pupils, which is simultaneously developing. Pupils should develop these competencies in appropriate age category though content, educational methods and activities.

European Commission defined 8 areas of key competencies for basic educational phase that should be developed in different teaching subjects, including physical and sport education:

1. Communication in mother language,
2. Communication in foreign language,
3. Mathematical literacy and competencies in area of natural sciences and technologies
4. Competencies in area of information and communication technology,

5. Competence of learning to study
6. Social and citizen's competencies
7. Business competencies, competencies of active approach
8. Culture competencies / view

On 4th European FIEP Congress held in Bratislava from 29th until 31st of August 2007, were participants from 25 countries from all around the world suggested to European commission to widen mentioned competencies of 9th competence – movement competence. Movement competence should be improved first of all though school physical education. Congress defined a movement competence as follows: "Movement competence is a combination of applicable multifunctional knowledge, motor skills, motor abilities and attitudes of human, which are necessary for a movement growth, physical, psychological and motor development, motor performance, personal fulfilment, overall health and successful employment." Indicators of movement competence - mobility of every day life, manual skills, life style and its quality, attitude to life and community, prevention of civilization diseases, postural health, specific sport activities and professional and personal skills.

Physical education did not evade innovation within new school law. The most important changes are following:

1. The name of teaching subject was corrected from physical education to "physical and sport education" on the level of ISCED 2 and 3;
2. In physical and sport education focus is demonstrate more significant diversion from performance-oriented education to development of pupil's competence and to formation of attitudes and values. The aim of physical and sport education as a teaching subject is allow to familiarise, acquire, improve and maintain correct motor habits and skills, increase a motor literacy, develop physical fitness and coordination, improve general physical performance and efficiency, increase health care activities, obtain knowledge about kinesiology, from physical education and sport by appropriate way (sport in appreciation of any physical activity following European Sport Charter 1992). There is much more need of creation and formation lasting lifelong relationship to physical activity, to physical education and sport related to their interests and individual needs as part of their healthy life style and presumption of ability to lifelong health care as well as their well – being.
3. In aims there are more significant connection to health care and generate healthy life style – physical and sport education should put together knowledge, habits, attitudes, abilities and skills about movement, sport, health and healthy life style. Those are created through realised forms of teaching a physical and sport education, adapted physical education or by form of physical and sport education integration.
4. The educational content openness – content presents wide scale of knowledge and physical and sport activities offered to pupils. The content is divided into the following 4 modules:
   - Health and its impairments
   - Healthy life style
   - Physical fitness and motor performance
   - Sport activities of movement regime

Offered motor content of different modules:

- **Health and its impairments**

  Basic gymnastics, health – related activities, relaxation and breathing gymnastics, posture exercise, technique of basic locomotion, starting positions, bench exercises, dancing steps and skips, specific exercises for different health impairments, stretching, exercises with bar, etc.

- **Healthy life style**

  Exercises for general development, system of exercises Salutation to sun, 5 Tibetans, massage, total relaxation, jogging, running and walking, seasonal activities, exercises in nature, motor games, didactical games, eye gymnastics, psychomotorics, target shots, hurdlers' tracks, etc.

- **Physical fitness and motor performance**

  Sport activities mobilizing energetic sources and optimal zing its impact. It is possible to measure it in space, time or time and space in standard conditions. To use exercises and tools of athletics, skiing, skating, swimming, shooting, minigolf, golf, etc. Physical activities that contribute to physical abilities development and to physical fitness increase. Different physical and sport activities of 'keep-fit' gymnastics (power training in fitness club, power training with own body weight, exercises with tools or on different gymnastic equipment), aerobics, body styling, rope skipping, cycling etc.

- Sport activities of movement regime
  - ❖ Sport activities where by rules come to clash between individuals. Where is requirement of movement's technique control related to opposite, envision ability and will to win. Activity selection from different contact sports mostly impact, grip and wrestling systems: judo, wrestling, aikido, karate and other martial arts and individual sports without direct contact with opposite, like tennis, table tennis and badminton.
  - ❖ Sport activities realised in team, following given rules. Typical sign is fighting between groups. Where is requirement of team co-operation, impinge for anticipation development of individuals as well as groups and will to win. Selection is realized from sport and non-traditional games: basketball, handball, volleyball, football, rugby, water polo, netball, hockey, floor ball, frisbee ultimate, futsal, indiaca, korfball, beach volleyball, ringo, softball, tee ball, street – basketball, baseball, boccia, bowling, petanque etc.
  - ❖ Sport activities typical for creativity development and having skills for moving form on sport gear, with and without equipment, where different esthetical expressions and rhythm perceptions are emphasized. Selection of physical and sport activities comprise: dance, sport gymnastics, modern gymnastics, basic gymnastics, swimming, synchronized swimming, yoga, pilates, figure skating, trampoline jumping, rope skipping, psychomotor exercises, adapted physical activities, tai-chi, aqua fitness and aqua aerobics. Competitive activities like: gym-team, creating a choreography, platform exhibition, etc.
  - ❖ Outdoors sport activities, which are characteristic by moving in nature, by adapting for changes of this environment. From natural environment are impinging to human being: air, water, earth, snow, rocks, mountains, beaches, etc. In these are physical activities realised. In selection are sports like: cross-country skiing, alpine skiing, snowboarding, canoeing, orienteering, paddling, swimming, hiking, roller skating, Nordic walking, biathlon, jogging, climbing, camping, cycling, rappel, etc.

5. Possibility to adapt the teaching content to school conditions, to pupils' interest and bigger teachers' responsibility for formation of teaching program for different groups of pupils – the task of each P.E. teacher is to come out from main aims with taking account to pupils' competencies development as well as their preconditions, interests and school conditions, P.E. teacher should create the programs of P.E. process for different groups of pupils by him or her selves. Commission for physical education authorizes these programs. Teacher tries to respect an order of following modules:

   Health and its impairments – knowledge are intermediate to pupils continuously during lessons. Teacher can use for that in each grade also 1 or 2 theoretical lessons. Physical activities of this module constitute approx. 10 % from total educational content.

   Healthy life style – knowledge are intermediate to pupils continuously during lessons. Teacher can use for that in each grade also 1 or 2 theoretical lessons. Physical activities of this module constitute approx. 10 % from total educational content.

   Physical fitness and motor performance – is realised continuously or concentrated, recommended range is up to 30 % from total hour subsidy in each grade. During 4-year study should improve gradually all physical abilities, but for their development can be used different sport activities of 4th module.

   Sport activities of movement regime – represent approximately 50 % from total hour subsidy. Teacher is choosing in each grade at least 2, from offered areas from this module. Under the domains, he or she is choosing those sport activities, which are accessible in schools, when pupils are interested in it or are traditional for given school, or teacher is specialising in it. Domain: outdoors sport activities should be involved at least 2 times during 4 years (for instance like ski course or snowboarding course, improving swimming course, etc.). In 4 years they have to go through all 4 domains. We recommend differencing content in 1st and 2nd half year; mostly in 1st grade include wide scale of physical activities.

6. Support and leadership of teachers to lifelong education – teacher can implement into the program only those sport activities, which were as a part of his or her pre-graduate university preparation or which he or she had obtained in trainer's qualification by any forms teacher's and trainer's further education. The interest of each P.E. and sport teacher should be participation on further education and gradual acquirement of needed qualification for planned sport activities.

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SOME MYTHS, AND MISUNDERSTANDINGS IN *TEST RELIABILITY*: METHODOLOGICAL FOUNDATIONS

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Practical assessments of reliability, its reporting in articles, and even explanations in textbooks are confounded by many false myths, and, even fundamental mistakes. Typically, it happens due to misunderstanding of the methodological, logical, and mathematical background of the classical reliability theory, test theory, and latent variable models and also their relationships to the precision of physical/technological measurement. Practical problems are illustrated by fifteen examples (a - o) and followed by explanations. As a conclusion of theoretical analysis the author suggests a solution to the problem whether reliability should be related to the test itself and/or to its score. For practical purpose it results in recommendation to identify each test, questionnaire or any diagnostic procedure by two sets of specifications: (i) list of content specifications, conditions, and instructions for its administration, (ii) by detailed description of the population / sub-population for which the test was constructed and on which it was calibrated.

Key words: *Classical test theory, true score, Cronbach´s alpha, McDonald´s omega, test equivalence, reliability, precision, uncertainty, measurement, calibration, laboratory accreditation*

First: A representative sample of the confusions

There are many confusions whose probably incomplete but typical sample should contain following:

a) Test is reliable if it yields the same or similar scores when repeated under the same conditions - thus reliability is related to *repeatability*, hence can be evaluated by *test-retest correlation.*

b) If the test-retest correlation is statistically significant we may conclude that the test is "significantly reliable" (the same for any other coefficient of reliability).

c) Cronbach´s Alpha is a *measure* of reliability.

d) If we have a heterogeneous battery of tests, say Eurofit, Unifit etc., then Cronbach´s Alpha represents reliability of the whole battery.

e) Reliability is a concept which is basically *different from precision* in technological measurement *and / or* reliability is somehow intuitively *the same* as the precision.

f) "Replication" of testing / measurement is a repetition in time while all conditions stay constant.

g) Test-retest correlation expresses "stability" of test scores in time.

h) Test-retest correlation serves for prediction of the later measured retest scores from the knowledge of preceding test scores.

i) Whether reliability is good or not may be sufficiently assessed by the value of reliability coefficient.

j) Square of the test-retest reliability coefficient gives coefficient of determination, this multiplied by 100 gives you "percents explained by reliability" of measurement / testing.

k) Reliability .80 may be accepted as an orientation value for approximate distinguishing between "good / bad" level.

l) The value .80 may be interpreted on the basis of coefficient of determination: $.80^2 = .64$ is above 50 % while $.70^2 = .49$ is below 50 %, hence reliability .80 shows that our test scores are numbers which are more correct than incorrect.

m) If you test the same subject repeatedly by the same test then a best value is the mean of his/her repeated scores.

n) If experts say that two tests are "equivalent", then reliability can be assessed by *correlation of the equivalent tests.*

o) We should not speak about "reliability of a test" but it is correct to speak only about "reliability of test scores".

Et c.

Important distinction between specific vs. generic reliability - almost forgotten

The distinction could not be mentioned in the list above as it is usually forgotten, even in most textbooks, becoming thus an unspoken and hidden misunderstanding, often due to a common ignorance of existence of the problem. Hence, it is usually not clearly stated which kind of the two is under scope when reliability of a test battery or questionnaire is being reported.

Specific reliability deals with reliability of *specific true score*, it means ideally precise score of the given test without any other possible test or further generalization - the test is taken as an insulated idiosyncratic element "on its own" ("an sich" by Hegel). In the well-known monograph Lord, & Novick 1968 distinguish the two very early (p. 43), and having accepted the so called expectation conception they define the *specific true score* as "the expected value ... taken over the (hypothetical) set of parallel measurements" (p. 173), i.e. thought of the "same instrument". On the other hand, "The generic true score is defined in terms of a whole family of *different* test forms ..." (ibid., p. 174, italics added), say different items measuring the same ability - they present an example of "spelling ability" (ibid. p. 174). As an example of specific true score and its specific reliability in kinesiology /kinanthropology we can imagine an insulated test consisting of a complex sensomotor task, whose score is expressed in time by seconds. Then we may be interested solely in a possible error of its resulting score due to its specific unreliability (i.e. including influence of weather, psychological instability etc.). It means that we want to now just information related solely to this test, say whether the standard error is ± 2 [seconds], or ± 15 [seconds] or so, but nothing more.

Generic reliability means that we intend to interpret the score in context with further tests measuring the same *theoretical concept - "construct" which is unobservable* (at least observable not directly). Then, we are not interested in the test alone, as above, but we conceptualize test as an *observable indicator* of the "construct", say of a level of sensomotor coordination ability. For this purpose we need a cluster of several further indicators. These have to be homogeneous with respect to the same *semantic content* of "sensomotor coordination" - i.e. tests whose specific true scores are targeted on a wider context of the same kind, of "the same genus". Then we can try to construct their common composite score - a *generic score*, which would somehow represent the level of unobservable "construct". The composite score is usually expressed by a computation formula, it is the so-called *formula score*, among whose different variants the unweighted simple sum score of z-standardized partial specific scores is typical, but a very bad one (due to equal importance of separate tests).

The semantic content validity of indicators (stated by experts) together with *semantic content homogeneity of the test cluster* is then usually verified by a use of certain appropriate model with latent variables, either confirmatory Latent Common Factor model (LCF), or the IRT Latent Ogive, or so. McDonald 1982, p. 214, stresses the importance of using this latent modeling approach:

> "A Spearman factor analysis can therefore be made the basis for generic reliability ... that is of generalizability in the sense of Cronbach et al. (1972). (See McDonald, 1978a.)
>
> If ...the factor loadings ... are equal, the tests are essentially tau-equivalent, ... and the common factor differs only trivially from a specific true score. The factor analysis then supplies a basis for the assessment of reliability in the classical sense of measurement error"

Then the mathematical *unidimensionality* of the cluster is accepted as a modeling confirmation of the semantic content homogeneity hypothesized by the experts. If the cluster is not unidimensional the hypothesis about content homogeneity should be rejected - perhaps the tests are indicating more than "one ability", say the domain of "coordination" is found multidimensional. Then, it would not have any sense to compute an agglomerated one-number composite score - there is no "one genus" of the tests and the composite score would become a strange mixture but not representing anything common, and "generic". Nevertheless, if the unidimensionality is successfully fitted - say by the confirmatory LCF model - then the best generic formula score to be used is the weighted sum according to Bartlett´s formula for maximum likelihood estimator of *latent factor score, f.*

If the cluster of the "tests measuring the same thing" is unidimensional, we still should be interested every time in the generic reliability, i.e.

the *error of measurement of the "construct"* - say level of an "ability".

For that purpose we have in our disposal the *direct measure of generic reliability*, ω - the McDonald´s *Omega* coefficient (McDonald 1970, 1978, 1985, 1999, also Zinbarg et al. 2005, etc.). In a certain sense also the Cronbach´s Alpha, sometimes called Guttman-Cronbach Alpha, may be helpful even though it is not a *measure* of reliability in general but usually it is only its lower bound (Guttman 1945, Cronbach 1951).

Precision and uncertainty in physical / technological measurement standards

All standardization requirements in various kinds of measurements distinguish different types of measurement errors. One of the most important distinction is between systematic error - bias, and the random errors, cf. Federer 1973, p. 23. Random errors can be expressed in terms of their standard deviation around the mean of the instances of measurement - this standard deviation represents *precision*. However, high precision itself need not mean *accuracy* yet, as the mean may be systematically shifted below or above the unknown true value which is the desired target. Quite often the systematic errors of a certain measurement instrument and procedure are either known, or it is possible to establish them and take them into account. Moreover, sometimes we may not be interested in the absolute value, the level of an attribute, but primarily we focus on discrimination between values. This may be the case of testing in behavioral research, say if we

are interested in *interindividual position of subjects in the sample*, then *precision* becomes most important. This is often the case in physical/technological measurement, too, for example the European official accreditation of a measurement laboratory requires that uncertainty be established after "corrections and correction factors for systematic effects" have been done (EAL 1997, p. 6; ČSNI 1996, p. 2). Consequently, the imprecision due to random errors - just statistically treated - is now called

"Type A *standard uncertainty*".

A typical way of expressing precision is in the form of *relative error*, between 0 and 1, or *in percents.* This may be established as ratio of absolute maximum error ε_{max} to the given measured value (Sprusil, & Zieleniecova 1989, p. 15; EAL 1997, p. 7) or to the range R of scale of the measurement instrument and/or to $½R$, it means by $\varepsilon_{max} / ½R$. In practical realization, a rather large number of instances of measurement by the technical device are applied to a given

fixed value τ^* of the target variable called *measurand*

(EAL 1997, p. 4, symbols modified). It is interesting to notice the similarity between this terminology and the terms of test theory, it seems that

"measurand"of EAL and "criterion" / "predictand" of test theory are synonyms.

The instances of measurement procedure yield separate measured values $x_{j|\tau^*}$, j = 1, 2, ..., n_p. Then, under moderate statistical postulates the mean of these values converges to the unknown given value τ^*, and their variance $s^2_{x|\tau^*}$ may be used as an estimate of the *variance of errors* $s^2_{\varepsilon|\tau^*}$. These well known statistical postulates are explicitly expressed in EAL 1997, p. 13:

> "5.2. The assumption of a normal distribution ... derived from well-behaved probability distributions of independent quantities, e.g. normal distributions or rectangular distributions, contribute to ... the conditions of the Central Limit Theorem are met and it can be assumed to a high degree of approximation that the distribution of the output quantity is normal."

Thus, corresponding standard deviation s_ε can be recognized as standard error of measurement in an older terminology, now called by EAL 1997

standard uncertainty of measurement, *u.*

(When this is applied to accreditation process of different laboratories according to their measurement capability to calibration then EAL uses a concept based on uncertainty defined by $s_\varepsilon / \sqrt{n_p}$, which is actually sampling error - standard error of mean, in fact.) According to EAL 1997, p. 13, "It has been decided that laboratories accredited by members of the EAL shall state" so called

expanded uncertainty $U = k\,u$, with k=2 ,

with "coverage factor" k , which expands their so called "coverage probability" up to 95%, actually due to the above indicated postulates leading to normal distribution. There are no reasons presented why (!) it was "not decided" to choose k=3 with "coverage" 99% (to follow the well known approximate Gaussian rule ± 3 SD). In any case, it is obvious that the older concept of

imprecision expressed by *relative standard error*, and the *relative standard uncertainty* would become equivalent by the following considerations.

The range R of the measurement scale is common for all possibly selected different fixed τ^* of the "measurand"/ "criterion" τ as well as for their corresponding possible observable instances x, $R = R_\tau = R_x$. The separate instances $x_{j|\tau^*}$ of measuring the same τ^* are assumed random and independent, therefore by standard statistical theorems their mean converges to τ^*, and their conditional standard deviations $s_{x|\tau^*}$ converges to the standard deviation of individual errors $s_{\varepsilon|\tau^*}$ which is assumed constant over different fixed τ^* hence may be written just as s_ε. Thus the well known "rule of ± 3 SD" may be used to estimate the maximum error ε_{max} by $3s_\varepsilon$. If an analogy is applied to the range of measurement scale then $½R = 3s_x$. Then the above introduced relative error $\varepsilon_{max} / ½R$, actually the relative *Imprecision* (!) may be expressed by $3s_\varepsilon / 3s_x$, i.e. by the definition as a ratio

$\mathrm{Imprec}\,(x) \equiv s_\varepsilon / s_x$,

or usually multiplied by 100%,

which is the same as the Type A *relative standard uncertainty*

of EAL, presented above. The fixed value τ^*, however unknown absolutely precisely, is firmly given, not necessarily as a numerical value of a "golden standard" but, possibly in a materialized way, say as distance from one wall of a room to the other wall, and it is assumed to be constant. (However, it actually varies a little, e.g. there is a certain influence of oscillation and vibration of the walls due to the street traffic, there is instability of foundations of the building etc.) Nevertheless, a better example for our forthcoming purpose is the idea of stable temperatureτ^* in a perfectly insulated room.

Replication as an abstract mathematical concept

In reality, the above presented "instances" of application of the same measurement procedure do not fulfill perfectly the mathematical postulates under which the complex of inferences yielded by theory of measurement errors is derived. If the instances were ideally accomplishing the mathematical requirements then they may be called replications. The conditional just used is necessary to stress that a *replication* is an *abstract mathematical concept*, a purely formal *model*

whose perfect empirical counterpart is generally impossible to find in reality.

Replications are postulated as stochastically independent realizations of random variables with identical distribution (e.g. Lord, & Novick 1968, p. 46). These postulates enable mathematicians / statisticians to apply some of the variants of the central limit theorem about convergence of expectation (or mean, in discrete variables) of $x_{j|\tau^*}$ to the unknown value τ^*. It makes the unknown value *statistically estimable*, to obtain an unbiased, consistent, and efficient estimator yielding desired point estimates in practical situations, and calculate corresponding standard error of the estimates, and their confidence intervals. From a slightly different point of

view replications $x_{j|\tau^*}$ are values of a random variable x_j observed in elements of a *random sample*

with sample size n_p drawn from infinite population with the unknown *population mean* τ^*.

As indicated in the former section these assumptions were used in the derivation of the concepts and definitions by EAL 1997.

Under a variant of such postulates and assumptions, e.g. that the errors ε are additively combined with the exact value etc., it is possible to formulate a *measurement model*, here typically the Gaussian model of the *theory of measurement errors*:

$x_{j|\tau^*} = \tau^* + \varepsilon_j$.

Note that an important postulate for the model is the postulate of

randomness of errors of replications.

In the real measurement situations it is treated by trying to keep all external as well as internal conditions constant. In an idealistic case the constant conditions might approach identity, while in real-world situations the identity may be only approximated by certain unification of the conditions - note that among the mathematical postulates there is no mention about replication as a special case of "repetition". An intuitive identification of the real world "repetitions" with the abstract mathematical "replications" thus becomes problematic. The ideal of keeping all important conditions constant need not be approached through the researcher's effort to approximate "identity in time" but it is also possible to approximate an "identity" by keeping constant *space*, and *material* conditions.

For example, one need not conceptualize the above presented "instances" of measurement as replications by repetitions under conditions that are constant over time, i.e. as *diachronic replications.* In some situations it is possible, and still better accomplished, to approximate the mathematical postulates for replications quite closely by treating the empirical conditions of measurement in terms of

simultaneously but still *materially approached constant* conditions.

It would represent a kind of *synchronic replications* where the mathematical requirements are fulfilled by empirical approximation through manipulating the space and material aspects of a measurement procedure. Thus, in an example with measuring of temperature in a well insulated room we may imagine two different situations:

1. To establish imprecision of measurement of a certain kind and make of thermometer we may measure the hopefully constant temperature 50 times repeatedly by the same piece of thermometer. Then we hope that diachronically applied "instances" of measurement represent replications in the mathematical sense. However, in practice there are many uncontrollable factors that would be breaking the assumption of constant conditions.
2. Contrary, we may use 50 thermometers of the same kind, of the same make, produced by the same factory in the same series of production on the same day, etc. Then, if we expose them into the room close to each other we would have the case of synchronic instances of measurements with our hope that the differences in quality of the produced thermometers will not break the mathematical conditions for replications.

It means that

replications should not (*!*) be *automatically considered "repetitions" only*,

i.e. only as diachronic replications however the "re" in the name suggests it intuitively.

Classical test theory - CTT model with Platonic true score conception: Reliability vs. precision

Currently, there is a different, more modern and more elegant derivation of the CTT model than the Platonic conception by Spearman 1904, 1910, and Brown 1911, first time criticized already by Sutcliffe in 1965. Nevertheless, the

new approach, mathematically crystallized in works by Zimmerman (1975, 1976), Lord (1980), and Steyer (1989, 2001) is still based on a little different formulation of its built in *randomness principle*, which actually produces most of the practically usable mathematical properties of the model. To reach its desired empirically testable consequences it is still necessary to add some assumptions originally posed in the traditional Platonic conception (namely the A3, A4 below). For a comparison of Gauss and CTT models it is necessary to see how the randomness principle is dealt with in each of them. On one hand, the mathematical requirements for deriving the plausible properties of Gaussian measurement model are encoded in the postulates desired for the

randomness of replications.

In the CTT model, on the other hand, the randomness is specified in a form of the so-called four *axioms of CTT model.* Among those the especially mathematically important axiom, which fundamentally treats randomness in CTT model and makes it comparable with the Gauss model, is the parallelness axiom (A4) on

randomness of errors of *parallel* tests (or test measurements, or test forms).

The principle of randomness is formulated in a special way in the CTT model due to the tradition of using linear correlation and regression theory joined with its model

$x_j = \tau + \varepsilon_j$.

The Platonic conceptions means that true score τ is explicitly assumed to be completely inaccessible to our knowledge, in a certain way conceptualized as a transcendent entity, like the ideal objects of Plato's philosophy are assumed to be hidden in his cave. However this model looks formally similar to the Gaussian there are several important differences. Now τ is a variable (*!*), which takes on different values in a sample of N subjects, $i = 1, 2, ..., N$. Further, instead of n_p replications we have n_t different tests (or test measurements or forms) indexed by j, $k = 1, 2, ..., n_t$, while in many applications the number is rather typically just $n_t = 2$. In each of the subjects the tests (measurements, forms) are testing the unknown perfectly precise value τ , which is called *true score* of a subject in the test. This unknown true score remains the same in each of the different tests (forms etc.) $x_1, x_2, ..., x_{nt}$ therefore no index j is attached to τ .

While the Gaussian model asked for randomness and mutual independence of errors over replications here it is specified in terms of randomness and correlational independence of errors by the four axioms (e.g. Gulliksen 1950, Novick 1966, cf. also by Blahuš 1981, 1988) using symbol E for expectation and / or mean:

(A1) errors are counter-balanced, there is no systematic error, $\mathsf{E}(\varepsilon_j) = 0$ for each of the n_t tests (forms),

(A2) errors are independent on the true scores, $r_{\varepsilon_j \tau} = 0$, $r_{\varepsilon_k \tau} = 0$ for any test,

(A3) errors of any pair of different tests are mutually independent $r_{\varepsilon_j \varepsilon_k} = 0$,

(A4) all parallel tests have the same variance of errors $s^2_{\varepsilon_j} = s^2_{\varepsilon_k}$, i.e. the same standard error $s_{\varepsilon_j} = s_{\varepsilon_k}$.

Using these basic concepts of CT Theory the variance of errors is used for its fundamental definitions,

reliability: $\mathsf{Rel}\ (x) \equiv s_\tau{}^2 / s_x{}^2$ and *unreliability*: $\mathsf{Unrel}\ (x) \equiv s_\varepsilon{}^2 / s_x{}^2$.

It is very important to be aware that the CTT fundamental theorem may work in practice only *as far as the axioms hold* (*!*). Therefore

reliability may be only *approximated*,

it never can be "established". The quality of the approximation depends on how well the four axioms about replications are met by the real-world condition in the research practice of testing / measurement. In addition, I would recommend strongly that we should not say that reliability is "estimated" as such a layman's notion might be confused with the notion of estimation in inferential statistics, regression estimate or so on.

If the axioms A1 - A4 hold, it is possible to derive the classical and well known result of the CT

Theory, namely that observed computable covariance of two parallel tests, $s^2_{\varepsilon_j \varepsilon_k}$, equals to the sought unknown variance of true scores, i.e.

$s_\tau{}^2 = s^2_{x_j x_k}$, and that $r^2{}_{x\tau} = s_\tau{}^2 / s_x{}^2$.

Hence the correlation $r_{x\tau}$ between observable x and unobservable τ, actually a validity, becomes $\sqrt{r^2{}_{x\tau}}$,

it means square root of the reliability

$r_{x\tau} = \sqrt{\mathsf{Rel}\ (x)}$.

Thus, based on a similar *principle, namely principle of randomness in a general sense*, there are two different however analogical basic concepts:

replicated measurement in the Gaussian and / *or parallel* measurement in CTT models.

Another important similarity deals with the operationalization of parallelness:

the parallel measurements *need not* (*!*) be in a form of *repetitions, only.*

Again, such repetitions may be intuitively - and often falsely - understood as an approximation of the ideal of replications., but in many situations the "test-retest" method for estimation of reliability may be a very bad one. In

addition, at least in some situations those diachronic parallel measurements can be substituted by synchronic, as in the case with measuring temperature simultaneously by several thermometers. An example would be skin fold measurements for establishing body fat by several equally trained laboratory assistants, a case of (almost) simultaneous, i.e.

"synchronic replications" in a frame of *inter-rater reliability.*

In addition, from the point of view of generalizability theory (e.g. Cronbach et al. 1972),

categories of any *facet* in a generalizability study

are assumed to represent replications and be parallel, actually in any multifaceted design. Further, it has to be underscored that the parallelness is not a matter of an expert opinion on mutual content similarity of different measurements of a test or its modified forms. Again, as with replications,

parallelness is an *abstract mathematical postulate* of equality of error variances (A4).

It has nothing to do with possible semantic "equivalence" of the content of the different tests.

Further distinction, but a distinction prompting also a certain degree of similarity, is connected with the following topic. Due to different conceptions - τ^* as fixed through n_p replications vs. τ as variable over N subjects but constant in each subject through n_t measurements - the terms s_ε^2, s_x^2 (or s_ε, s_x) are also conceptualized in different ways in each of the Gauss and or CTT models. Nevertheless, if we still compare the two basic notions side by side - viz. $\mathrm{Unrel}\,(x) \equiv 1 - s_\varepsilon^2 / s_x^2$ vs. $\mathrm{Imprec}(x) \equiv s_\varepsilon / s_x$ - we can see their similarity and their relationship, see also Fig. 1:

$$\mathrm{Imprec}\,(x) = \sqrt{\mathrm{Unrel}\,(x)} = \sqrt{1 - \mathrm{Rel}\,(x)}\,.$$

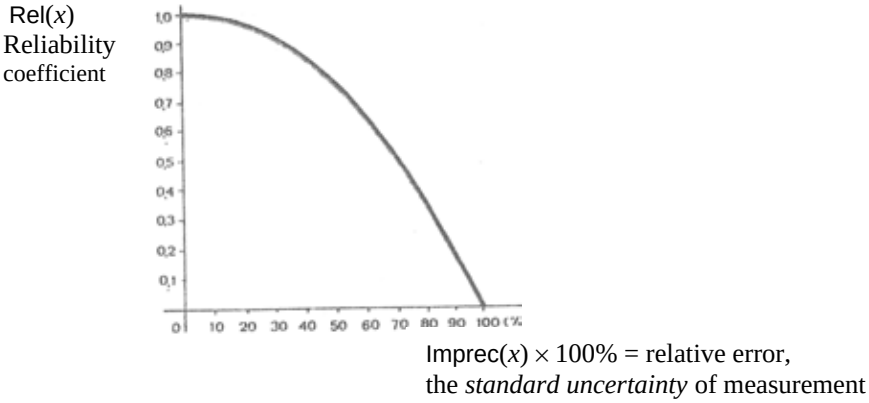

Fig. 1. Relationship between reliability and precision

A measurement model - its measurement and construction functions

The Gaussian model as well as CTT model are special cases of more general types of measurement models. A rather very general one is used for the procedure of indirect measurement which is called *associative measurement.* Then the observed x_j are connected with τ via more or less complicated relationships, either by an exact mathematical function and/or by a physical or another substantive law (whose exact mathematical function may be unknown). Sometimes the associating functions are just in a form of empirically confirmed material or behavioral regularities, say as extensibility of mercury column is linearly related to temperature, or degree of behavioral response is related to intensity of stimulus in a form of logarithmic function. Moreover, in some cases the associating function is intentionally chosen just on a rather weak theoretical hypothesis with a hope that it will work reasonably in applications (associative measurement "by fiat"). Models for specific true scores are very simple, their associating functions are almost trivial. Nevertheless, for our purpose it is important that each measurement model has two versions of associating functions (Blahuš 1999, 2000), namely

the mapping $\tau \rightarrow x$ is the *measurement* version / function, while

the mapping $x \rightarrow \tau$ is the *construction* version / function.

In Latent Common Factors model a construction function is sometimes called "construction formula" (Guttman 1955), or "construction rule" (Maraun 1996). In general, a formally optimal construnction function is a regression function (McDonald, & Mulaik1979, Mulaik 2005) to be used for constructing appropriate estimates of latent factors scores from observed scores of indicators. Such a construction function definitely is not trivial. However, in case of Gauss model, the function for constructing a best estimate of τ^* from the known observed x is formally trivial, though its wider mathematical conceptual background has certain special features and consequences that are important for its comparison with CTT model.

In Gaussian case the *measurement function* ($\tau \rightarrow x$) is a mathematical linear function collapsed into simple sum, the very Gauss model itself, $x_{j|\tau^*} = \tau^* + \varepsilon_j$. However, from a statistical point of view it may be seen as a *stochastic identity*: the measurements $x_{j|\tau^*}$ may be conceptualized as identical with τ^* up to capability of our senses, up to measurement errors. Tolerating the fact that τ^* is not a variable (or considering that there are many different such fixed precise values over the range *R*, each related to their replicated observations by the same function) we might say that this stochastic identity takes on a special form of *linear regression - identity regression.* It means that *if (!)* we were in position of knowing τ^* our regression estimate of *x* would be based on regression equation with zero intercept (no bias), and with slope coefficient 1. On the other hand, the Gaussian construction function ($x \rightarrow \tau$) should tell us *how to "construct" an approximation* of the precise value when we know its several, n_p, replicated measurements - it is done by their arithmetic mean. Mathematically, it is a linear function, now in several (n_p) measured values, which is used to construct the approximation τ^*_{constr} of τ^* by linear combination which collapsed into a simple, unweighted mean (expectation E in discrete case):

$\tau^*_{constr} = \mathsf{E}(x_{\tau^*}) = 1/n_p \Sigma x_{j|\tau^*}$, while $\tau^*_{constr} = \hat{\tau}^*$.

Simultaneously, from the statistical point of view this "method of construction" has very plausible properties, it is *the statistically best estimator* $\hat{\tau}^*$ of τ^*.

It is unbiased, consistent, and most efficient, it means it yields no systematic error, it converges to τ^* as the number n_p of replications increases, and its individual "constructions", i.e. estimates, have the minimum variance of their errors. (Rather surprisingly, these plausible properties are not mentioned in the EAL 1997 standards.)

Of course, all these things are commonly very well known - but now, finally, we are in position to present the main topic, which is based on them:

What are the possible consequences of the "construction" if we have *just one* measurement x_{τ^*}

at our disposal, what are possible properties of such a case of constructed approximation of τ^* ?

Now all the statistically plausible properties are lost - since we have not even the statistically necessary minimum n_p = 2 replications. Nevertheless, in practical situation we still "construct" the approximation according to the same construction function, namely by the mean of just one number, as intuitively best construction function, a non-statistical but approximate identity construction function: $\tau^*_{constr} = x_{\tau^*}$.

There is a moral in three points - however commonly well known it has to be presented here for its comparison with the quite different situation in CTT model - namely that in the Gaussian model:

1. The statistically *best* construction or estimate of τ^* is the mean of its replicated measurements $x_{j|\tau^*}$, especially because it is *unbiased.*
2. In case of having just *one x* of the measurements at disposal the best constructed approximation of the precise τ^* is this measured value *x itself.*

Comparison of the construction functions of Gauss and CTT models in case *n* = 1

As already shown, the formula for computing mean of n_p replicated measurements x_j represents the *construction function* of the very simple version of associative function in terms of Gauss model (which is a model of direct measurement, therefore). Now, what happens to a use of this function if there is only n_p=1 measurement? What would be the constructed/ estimated value of τ ? Then the "*best constructed*" approximation τ_{constr} of the unknown , i.e. its best would-like-to-be point estimate - is *x itself,* of course (*!*). Hence the practical construction τ_{constr} of the sought τ is $\tau_{constr} = x$. Actually, what makes the Gauss model appropriate for direct measurement is that its measurement version as well as construction version of its *association function collapsed into identity* functions, however a stochastic identity, "identity regression". Thus, the Gaussian construction function is a special case of a general mathematical linear function, and simultaneously regression linear function, namely

$\tau_{constr} = \hat{\tau} = a + bx$, specified as $\hat{\tau} = 0 + 1\,x$, i.e. $\hat{\tau} = x$.

On the other hand, the *conceptual basis specific to CT Theory* may be understood intuitively on the grounds that CTT is primarily oriented to diagnostics and therefore it also focuses on an *individuals position in the frame of a sample* or population. Its model, $x \equiv \tau + \varepsilon$, is also a case of stochastic identity, and as we have seen at the beginning of this section, it is a special regression, which has its slope coefficient 1, and intercept zero forming thus the *measurement function* as identity regression

$\hat{X} \equiv 0 + \beta_{x|\tau}\tau = 0 + 1\tau$.

Contrary, its *construction* function, the *regression* of τ on *x*, becomes specified from $\hat{\tau} = 0 + r_{x\tau}x$:

$\hat{\tau} = \beta_{\tau|x}x = r_{x\tau}x$,

where $\beta_{\tau|x} = r_{x\tau}$, which regression coefficient can be established by $r_{x\tau} = \sqrt{\mathsf{Rel}(x)}$ of the preceding section (if we assume *z*-standardized variables). Nevertheless, the regression inevitably produces estimates $\hat{\tau}$ that are influenced by the effect of the well known "regression toward the mean". Here, the effect is especially obvious for $\mathsf{Rel}(.)$ is every time smaller than 1 in reality, as is therefore $r_{x\tau}$.

Example

Let an individual have the *z*-standardized observed score x = 1 (1SD above the mean of the sample). If the test reliability were $\mathrm{Rel}(x) = .81$ then $r_{x\tau} = \sqrt{\mathrm{Rel}(x)} = .9$, and the regression estimate of his/her true score becomes $\hat{\tau} = r_{x\tau} x = .9 \times 1 = .9$, it means *closer to the mean* (0) *than the observed score.* However, if the test reliability were worse, say $\mathrm{Rel}(x) = .49$, then $\hat{\tau} = r_{x\tau} x = .7 \times 1 = .7$, it means much closer to the mean. In the frame of CTT model, generally,

if test has bad reliability the CTT model gives more weight to the mean of sample of N subjects.

Intuitively, we may feel that we should not diagnose a subject to be to much distinct from the Quételet´s "*l´homme moyen*" if the diagnostic tool is unreliable. If the test had dramatically bad reliability the CTT model would estimate the true scores τ of all N subjects being almost equal to the mean of their sample. In this sense the CT Theory includes also the intra-sample position of the scores into its specific conception of reliability.

Due to the same reason, using say the "diachronic replications", i.e. repeated n_t parallel measurements, would not bring their mean closer to the desired true value of τ . Such a mean might be considered a crossvalidated regression estimate but still would stay a *biased estimate of* τ , shifted by the "regression toward the mean" effect.

Concluding reactions to the introductory list of myths

(a) - By the CTT model test can have excellent reliability even if it yields very different results over several "repetitions". It follows from the reliability definition as a ratio of two variances - variance does not depend on level or mean, hence if all N subjects improve by 100 cm from test to the retest the reliability is the same. Or, taking the test-retest correlation into account, it is well known fact that correlation coefficient is invariant (insensitive) to the linear change of measurement scale, hence it stays the same even if one changes thermometer scale from Celsius to Fahrenheit, or centimeters into inches. What should stay "the same or similar" is the *relative position of the score in the frame of sample* - but only under randomness assumptions of A1 - A4. Namely, by chance it might happen that the reliability is falsely high due to the fact that the axioms have been broken. Moreover there is no mention about "repetition" in the definition, the crucial is that the tests and / or test measurements be parallel while the case that "repeated measurement" were parallel is very special case, moreover not and frequently found. It is a strange and striking fact that the above mentioned errors may be found even in textbooks. Especially, it reaches behind any understandable explanation if one finds the following assertion by a really distinguished scholar in a currently edited monograph:

"If the test scores are reliable, the scores are unchanging within a day or between 2 days,

which are relatively close together." (Baumgartner 2007, p. 27, while in the former book

by Baumgartner, & Jackson 1975 nothing like that could be found,)

Why, there are many tests, say measuring actual psychological state of an athlete or so, which were constructed explicitly to represent changes in couple of hours or minutes, say before and after the competition etc. On the other hand, we may find test with very stable test scores: Testing kindergarten girls using pull-ups you very probably find most of them having "unchanging" score for many days, namely zero score - not due to the reliability, but because of inappropriate difficulty of the test.

(b) - Another very bad misunderstanding deals with statistical testing whether *reliability is significant*. Statistical test of significance of correlation means: a) to have a representative randomized sample from a clearly predefined population to which one wants to make a generalization (inference) from the sample, b) to have statistical null hypothesis which states that if the entire population were measured then the correlation would be exactly 0 - and to try to reject it with a small risk (say less than .05) on the basis of the correlation found in the sample. Hence, to say "my correlation coefficient is statistically significant" means the same as "in population the correlation is not exactly zero". Thus, if the correlation was used to approximate reliability, say by test-retest, then this claim means "Reliability of the test in this population is not absolutely 0". To interpret this in a way like by

saying "reliability of the test is *significantly good*" would be a tragic mistake !

Statistical significance increases substantially with sample size N. Therefore already with $N = 100$ the correlation coefficient .20 is statistically significant on the usual p-level 5% - it means with 5% risk it is different from 0 in the population from which you managed to make the randomized sample. Certainly, reliability .20 is not "good". (For $N = 1000$ the corresponding significant value of r is already .06 !) It would be a prototypal example of misunderstanding of what the statistical significance means and does not mean. Instead, if we were interested about how far we may generalize the sample coefficient of reliability to the whole population for which the test is calibrated then the best way is to establish the confidence interval of the sample reliability coefficient.

(c) - Generally, Cronbach´s (1951) *coefficient of consistency Alpha* is *not a measure* of reliability. (By the way, it is not too widely known that its first formulation comes already from Kuder, & Richardson 1937, and Guttman 1945.) Its possible use in context with reliability is tied to the following conditions or requirements:

(*i*) Let´s assume that a set of tests/items has been assessed by experts to be homogeneous from the point of view of semantic *content validity*, it means the test/items represent a *cluster of indicators measuring the same "construct"* (say an ability). (*ii*) Further, let's assume that for a verification of the hypothesis that the indicators really do measure the same "construct" a model with latent variable was used, namely the linear confirmatory Latent Common Factor model with a single latent *f*, and the factorial *unidimensionality* of the cluster has been confirmed as a support for the evidence.

Then and only then (McDonald 1970, 1978, 1999), coefficient Alpha is a *lower bound* with respect to the *generic (!) reliability* of the latent *factor score f*, which is supposed to represent formally the level of the "construct" (ability or so). Thus, still, *Alpha is just a limit*, but not a measure. On the other hand, McDonald´s (1970, 1978) coefficient *Omega is a measure* of the generic reliability of *f* provided the conditions hold. Only if an additional condition is fulfilled, namely if (*iii*) all indicators have *the same factorial validity* (factor loadings), then Alpha becomes a measure of the reliability of *f.*

(d) - The former paragraph clearly states that Alpha has the lower bound property only if the set of indicators (subtests, items) is unidimensional in the sense of confirmatory Latent Common Factor model. In addition, if the indicators have the same semantic content, i. e. they are semantically homogeneous with respect to the same "construct", only then it is meaningful to ask about the *generic reliability* of measuring the level of this "construct". Then the generic reliability may be either measured by Omega and/or limited from below by Alpha. In a case when a composite score is a multidimensional mixture of heterogeneous tests/items with various semantic content, then the tests/items cannot be recognized to work as indicators of their "common construct" and it is meaningless to ask about generic reliability. Then coefficient of consistency Alpha may be low not due to unreliability but because of "inconsistency" (whatever the notion may mean). Moreover, in such a case *with multidimensional composite* mixing "apples and oranges" Alpha may have a rather strange behavior - it may take on *negative values*, even less than -1.0 (cf. the examples by Thompson 2003b, Blahus, & Machek 1975).

(e) - As was shown at the beginning, the conceptualization of CT theory of reliability is partly different from the theory of precision and uncertainty in physical/technological measurement but has several directly comparable practical features, especially the relationship pictured in Fig. 1. Both approaches are based on the very general common principle of randomness of errors.

(f) - As was discussed above, rather in detail, replication is an abstract statistical / probabilistic concept. Special instances of measurement may by recognized replications if there is a randomization procedure in the real world, which would approximate the formal properties of the replications. These need not be approximated by repetitions in a diachronic way, but also synchronically say by simultaneous assessment, say in case of inter-rater reliability.

(g) - Test-retest correlation coefficient does not measure stability of scores as explained above, it follows from the very definition of correlation.

(h) - Test-retest correlation might be formally used for prediction of retest in the role of dependent variable (criterion, predictand) by a regression equation with the formerly measured test in position of independent variable, say in a little bit strange longitudinal study. Then no assumption about parallelness etc. are needed. However, such a prediction problem is totally out of the topic of reliability. In a reliability study, we are interested in making an approximation of the variance s^2 of true scores, the denominator in $s_\tau^2 / s_x^2 \equiv \mathsf{Rel}\,(x)$. If a test x_j and retest x_k fulfill the axioms of parallelness sufficiently closely in the real data then their correlation coefficient approximates reliability also acceptable well: $r_{x_j x_k} = s_\tau^2 / s_x^2 \equiv \mathsf{Rel}\,(x)$. This is the target, and not a prediction of retest scores.

(i) - The reliability coefficient alone is not a sufficiently informative index of reliability of the test since it is only relative measure, moreover, it depends on a type of given population, and especially on the variability in this population. It is every time useful to establish at least further two characteristics as an end characteristics of reliability for the practical use:

1. Absolute *standard error* s_ε of the test, I would stress that it is "standard error *due to complex unreliability*", i.e. unreliability of the whole diagnostic procedure - to distinguish it from the physical "error of measurement". If a technological measuring instrument is involved, its error of measurement contained in the overall unreliability usually contributes to it just negligibly. This s_ε is directly connected with the approximate

maximum error $\pm 2\, s_\varepsilon$, corresponding to the *standard uncertainty*, *u*

in the sense of European Cooperation for Accreditation of Laboratories mentioned in EAL (1997). Actually, it is 95% confidence interval. For illustration, if $\bar{x} = 200$, $s_x = 10$ [cm], and $\mathsf{Rel}\,(x) = .91$ were found in a representative sample of young girls in broad jump test, then $\mathsf{Unrel}\,(x) = .09$, and according to the classical well known formula $s_\varepsilon = s_x \sqrt{\mathsf{Unrel}\,(x)} = 10 \sqrt{.09} = 3$ [cm], hence the maximum error, or standard uncertainty *u*, is ± 6[cm] . This definitely gives much more informative idea from the practical point of view.

2. The so called *critical difference* between two values expresses the minimum necessary difference, which exceeds the uncertainty due to unreliability, if one seeks to compare two values. For instance, we may be interested in either comparing two persons to learn who of the two is better, and or whether an intraindividual difference represents an increment or improvement, which exceeds the errors of the diagnostic method used. For the 95% confidence this difference is $D_{\text{crit}} \approx 2.8\, s_\varepsilon$. In the example it means that only if a girl improves her performance in the jump by more than 8.4 [cm]

we may say that she really has improved over the unreliability of the test, i. e. that there has been a nonzero change in her true score τ .

(j) - *Squaring* the test-retest coefficient of correlation in a reliability study is a *nonsense*. However, you still may find it done even in statistical books written by distinguished professors of mathematics - who, unfortunately, have no knowledge about psychometric test theory and related principles of reliability (e.g. Wang 1993, p. 131-2). As was shown above the correlation of parallel measurements $r_{x_j x_k}$ as an approximation of the definition of reliability by $\mathsf{Rel}\,(x) \equiv s_\tau{}^2 / s_x{}^2$ is also a coefficient of determination, simultaneously. *It already is square of correlation coefficient*, namely correlation of x with τ, since $r^2{}_{x\tau} = \mathsf{Rel}\,(x) = s_\tau{}^2 / s_x{}^2$. Then, its square $(r^2{}_{x\tau})^2$ becomes $r^4{}_{x\tau} = s_\tau{}^4 / s_x{}^4$ while

neither $[\mathsf{Rel}\,(x)]^2$, nor $r^4{}_{x\tau}$

have any reasonable interpretation to be preferred to those original $\mathsf{Rel}\,(x)$ or $r^2{}_{x\tau}$.

(The only possible meaningful interpretation of $r^2_{x_j x_k}$ might lie *outside a reliability study*: In the

formerly presented longitudinal regression study of predicting retest x_k as a dependent variable from

the knowledge of original test x_k in a role of independent variable - but this has nothing to do with reliability.)

(k, l) - Since it is a nonsense to compute square of $\mathsf{Rel}\,(x)$ it follows that the argumentation related to the confused interpretation that $.80^2 = .64$ is above 50 % while $.70^2 = .49$ is below 50 % is just due to a terrible misunderstanding of the fundamental concepts of reliability theory.

(m) - If you test the same subject repeatedly - and the repetitions could be recognized as (diachronic) parallel measurements x_j - then, according to the CTT model, the mean $\bar{x}$ of his/her several x_j is not the best construction or estimation of his/her true value τ , but the mean $\bar{\hat{\tau}}$ of those several regression estimates $\hat{\tau} = r_{x\tau} x_j$ (which is the same as computing $\bar{x}$ first, and $\bar{\hat{\tau}} = r_{x\tau}\,\bar{x}$ afterwards). Hence the result is every time influenced by the effect of regression toward the mean.

(n) - The "equivalent" tests should be rather called alternate forms of a test and in the area of motor behavior it is difficult to find them (while it is easier for didactic tests of knowledge in areas like tests of mathematics, biology etc.). However, the "equivalency" still should be evaluated by latent variable models, typically by Latent Common Factor model, because the notion is purely abstract mathematical concept, and the well known levels of equivalency in terms of the LCF model are group of tests known as parallel, tau-ekvivalent, kvasi-tau-ekvivalent, congeneric, and also unidimensionality may be considered to be the weakest level of the test, which measure the same mathematical latent variable (common factor). In the context of CTT model, only the strongest level of equivalency, viz. parallelness, is available. It is defined by the axioms A1 - A4 purely mathematically, it does not deal with any semantic content, content validity, or construct validity. Therefore it is possible to find by chance tests that are "equivalent" by this mathematical definition, but they do not measure anything, which could be interpreted in any meaningful way. The misunderstanding of mixing mathematical notions with the substantive semantic notions, i.e. mixing formal models with the object that are to be modeled, is not rare, unfortunately.

A note on the reliability of test vs. reliability of test score

(o) - A special topic, which is rather close to philosophy and general methodology of science, deals with the question: "What is ´reliable´? Is it the test and/or its score?" Or the same, just in a little more based on Aristotelian dichotomy:

"To which entity the attribute (called ´reliability´) should be attached ?"

The opinion that we should not attach the attribute to a test, but to its score, arose in context of the unsatisfying situation of standardization quality of tests used in different studies, as found especially by Vacha-Haase 1998, Thompson, B., & Vacha-Haase 2003, and further authors. Too often some authors were (and still are) reporting their research finding accompanied by information on reliability of the applied methods of measurement (tests, questionnaires) even though the study had been carried out on different population, in different environment etc. than the former original standardization / calibration study. This situation led the group of researchers (partly members of the Task force under APA, NCME, and AERA) to formulate the desired characteristics of reliability, which should be reported jointly with research findings. They asked that also some specific conditions were reported under which the reliability was established, including the type of sample etc. - for, so to speak,

the "same test" may produce "score of different reliability" under different conditions.

The opinion that one should not speak about reliability of test but only about "reliability of test score" has been accepted and recommended by Baumgartner 2007 (p. 27) without any explanation:

"People used to say, ´the test is reliable´, but this is no longer considered correct ...".

Here - in the term "same" test - is the core of the rather philosophical problem, viz.

identity of a test:

If I shave my beard I am still the same person, but not for the immigrant officer at the US airport. If the rule for playing tennis are literally kept but the tennis game is played by astronauts on the Moon this is not a genuine tennis. The problem also depends on the strictness of the standardization conditions of the "variants of the same" test - but only seemingly, superficially "the same". If rigorously stated conditions are asked then we have quite different test than in case of "the same" test used just as a field test. Consider the following standing broad jump test under conditions like: Preliminary 10 minute overall body warm up, test carried out in a gym, bare foot, temperature between 18 and 22 °C, after 2 not measured attempts for corrections by an instructor according to manual, with 2 measured jumps of whose the better is recorded. Is it " the same broad jump test" as that one carried out during a class on a playground when the pupils are told to do it somehow and they measure the jump distance one to each other? Thus, even though two tests are seemingly "the same test" since the substantive part of their semantic content is the same (the sensomotor task), although they were targeted and constructed to have validity to the "same construct", those are still two different tests.

The "test identity" also depends heavily on the type of calibrating population. IQ test standardized for 10 y. old children is not an IQ test for adults. Two nice examples presented by Sawilowsky, 2003, p. 153:

"... exposition of the Mandarin Vocabulary Test (MVT), which was applied to a group

that was unlike the norm group."

Or the second one, the more dramatic illustration of the problem whether a test is the same:

"... the testing expert who administered ″visually-presented progressive matrices tasks″

to ″blind adults″ should consult ... the ethical standards of the profession." (Ibid.)

I would say the "expert" should consult his/her psychiatrist ... . However, note that if administered repeatedly to the same group of blind people the test scores would be perfectly stable - fulfilling thus the definition by Baumgartner 2007.

Operationalization of the identity is the issue, here. If a test is to be recognized as a scientific tool and source of research empirical data then there have to be clear and univocal *criteria* for its *standardization as a background for decision about identity* of the test as a scientific method. The criteria have to be based on appropriate *resolution level* of their details for distinguishing between *similar but different* tests by their content validity to the same "construct", otherwise there would be a danger that just a negligible difference in standardization conditions would make the research findings incomparable. Hence, the resolution level and the list of criteria for identification of which test is which is the only solution. This can be done by combining two approaches simultaneously:

- In a detail, analytical way, put down an agreed list of fundamental "sine qua non" conditions,

and if even one is broken then two tests are different by content.,

- Using the "salva veritate" or functioning equivalency principle of classical logic: the two test are

identical if we may substitute one for the other for a certain population without any difference in

consequences.

If these operationalized criteria of identity are met then I do not find any substantial difference between the two conceptions (score vs. test) for comparability of research findings as well as for many different uses in practical situations. Contrary, compare if there is a different meaning of each of the two formulations:

1. Imagine a hypothetical situation with a virtual test called "Twenty-throw Basketball Test", and imagine further that it was found that the test's *scores were less reliable* in 6 year old pupils of elementary school than *of the same test* in 20 year old players participating in a higher level competitions, in whose the scores were more reliable.
2. The "Twenty-throw Basketball Test", used in a research study in the category of 6 y. pupils, was found to be quite *unreliable test.* However, a different test, accidentally known under the same name, viz. "Twenty-throw Basketball Test", is used regularly by the well known basketball coach A.B. to check players; A.B. says he found it to be very *reliable test.*

Then, a journalist was surprised when he learned that the sensomotor task given by the test instructions is identical in both of the two tests, namely to throw the ball aiming at the basket. Later on, the thing became clear when the researcher explained that he was using the "Twenty-throw Basketball Test" in 6 y. boys with a lighter ball (volleyball one), while the identical test conditions as well as the name of the test were chosen to stimulate motivation of the boys who then felt themselves to be simulating the top-level players.

However, probably the basic argument for resolving the antagony is based on a fundamental statistical theorem given by Pearson, 1912 (cf. McDonald 2008) in his effort focused on genetics and natural selection effect, which was motivated by his cooperation with Galton and his interest in Darwin's theory. The core of the theorem is that (under weak statistical conditions) regression error stays invariant under selection, though variance and correlation may change, e.g. it is stable in selected subpopulations etc. Its application to reliability theory means that

Rel(.) changes over populations but s_e should stay invariant.

By McDonald (1985), p. 215:

"It is therefore important to recognize that under mild assumptions the error variance of a test

will be independent on the population on which the test is calibrated ..."

And, McDonald (1999), p. 128:

"... the true-score variance is the accident of the populations of interest, whereas

the error variance ... can be expected to be invariant over populations."

Hence, the *error variance is the attribute of the test*, while reliability coefficient Rel(.) then depends on the populations. Then, it is clear by the definition of Rel(.) as a ratio of the two variances that reliability depends on true-score variance in a given population, in a certain group of subjects or any specific set of subjects (testees) although the error variance, and the *standard error of measurement stays the same*. Therefore,

the *standard error* s_ε should be *preferred as the most important product* of a reliability study.

Therefore, it is possible to agree with Vacha-Haase 1998, Thompson, & Vacha-Haase 2003, and Fan, & Thompson 2003 that reliabilities Rel(.) and their *confidence intervals* should be estimated) - but it seems to be reasonable only (McDonald, 1985, p. 216):

"...in the context of a *normed* test, calibrated on a large scale, representative group whose mean

and standard deviation supply the origin and unit for the measurement of future examinees." In addition, this is exactly the way how to approach the problem of "*test identity*", and problem "whose attribute" the reliability is:

1. From the point of reliability coefficient (relative reliability, relative error of measurement)
   test identity is given by two aspects :
   (i) by detailed list of *content specifications, conditions, and instructions for its administration*,
   (ii) by detailed *description of the population / sub-population for which the tests was constructed*
   and on which it was calibrated.
2. A) If a test has been identified in the sense above, then *"reliability in general, broader sense" is attribute of the test* - it means *both relative reliability coefficient* Rel(.) as well as *absolute error* s_ε , are properties of the test if the requirement (i), and (ii) jointly hold.
   B) If a *test is specified just by fulfillment of the requirement* (i), maybe even pseudo-identified just by name, *then only the absolute error* s_ε can be expected to be a *property of the test*, and therefore stable (in a frame of stochastic oscilllations), while *reliability coefficient* Rel(.) depends on populations.

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WHY WE DO NOT DETECT CALORIES EXPENDED IN EXERCISE: AN ENDOCRINE PERSPECTIVE

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Abstract

An extensive body of knowledge has grown during the past two decades largely derived from genetically obese and transgenic rodent models in support of the hypothesis that hormones exert both a short-term appetite control guiding meal taking, and a longer term influence for adjusting meal frequency and size depending on the state of body energy reserves. The hormonal model of energy regulation posits that short-term changes in energy availability regulate energy balance through hormonal negative feedback loops that affect psychophysical sensations of hunger, satiation, and satiety, metabolism, and spontaneous physical activity. Longer-term changes in the level of storage fuels, glycogen and fat are brought within the regulated range through hormonal negative feedback over metabolism of liver glycogen and adipose tissue stores.

Exercise energy expenditure presents an interesting and challenging problem. A number of studies have repeatedly shown that exercise transiently suppresses sensation of hunger and increases sensation of fullness.

In both of the foregoing studies, we examined the potential role of several hormones with known influences on short-term and intermediate-term regulation of energy balance. We found in both studies that exercise was, as expected, associated with reduced concentrations of insulin. It is well known that activation of sympathetic nerves suppresses insulin secretion from the pancreas. Therefore plasma insulin could not have influenced exercise-associated suppression of hunger since its concentration changed in the opposite direction from that expected of an anorexigenic hormone.

This analysis of the possible hormonal and autonomic factors in exercise-associated appetite suppression, and hypothesis about the etiology of exercise-induced appetite suppression, are amenable to further experimental testing. If our speculative hypothesis is confirmed, new therapeutic agents aimed at hepatic glucose output could be developed to curb hunger sensation and aid in weight loss. The encouraging information for the lay person is that our body tracks exercise energy expenditure and, instead of increasing hunger and food consumption, suppresses appetite and blocks compensatory eating. These facts can be useful in weight control even in the absence of complete understanding of the underlying mechanism.

Key words: *calories expended in exercise, endocrine, normal control of appetite*

Introduction

The mechanism by which we detect energy expenditure of exercise and other caloric transactions within our body is of great interest for both academic and practical reasons. From the academic perspective, this question is at the heart of energy regulatory mechanism. Our appetite must be linked to energy balance for us to maintain weight and survive in an environment of varying energy expenditure and changing energy availability. Currently, the prevailing view is that several hormones play a central role in appetite. From a lay person's perspective, a better understanding of how exercise influences our appetite is also very important as many individuals want to use physical activity for weight control. In this paper, we briefly review (1) current hypotheses regarding the hormonal control of appetite, (2) data on the effects of exercise on appetite and consummatory behavior, and (3) lack of support for the role of major appetite-controlling hormones in exercise effects on hunger, satiety, and consummatory behavior.

Current hypotheses regarding the hormonal control of appetite

An extensive body of knowledge has grown during the past two decades largely derived from genetically obese and transgenic rodent models in support of the hypothesis that hormones exert both a short-term appetite control guiding meal taking, and a longer term influence for adjusting meal frequency and size depending on the state of body energy reserves. The hormonal model of energy regulation posits that short-term changes in energy availability regulate energy balance through hormonal negative feedback loops that affect psychophysical sensations of hunger, satiation, and satiety, metabolism, and spontaneous physical activity. Longer-term changes in the level of storage fuels, glycogen and fat are brought within the regulated range through hormonal negative feedback over metabolism of liver glycogen and adipose

tissue stores. Thus, current thinking is that energy shortage caused by either inadequate nutrient intake or increased exercise-associated energy expenditure, stimulates orexigenic (appetite-stimulating) hormones, and decreases metabolic energy expenditure and levels of spontaneous physical activity, and this leads to increased energy budget and fat and glycogen stores. Conversely, excess energy intake and excessive fat stores in obesity, stimulate anorexigenic (appetite-suppressing) hormones, metabolic energy expenditure, and expenditure of energy through increased spontaneous physical activity. This concept is demonstrated clearly by the phenotype of ob/ob mouse that lacks the capacity to produce the putative anorexigenic (appetite-suppressing) hormone leptin from its adipose tissue. Ob/ob mice overeat and are hypoactive. This results in three-fold greater body fat depots compared to wild-type mice (1). After intraperitoneal leptin replacement, both food intake and body fat were reduced in ob/ob mice, although it was not clear whether reported increases in physical activity resulted directly from leptin injections or were secondary to the loss of body fat (2).

Hormones thought to participate in short-term regulation of energy balance are ghrelin, released by stomach during fasting (3) that is believed to increase food intake and reduce metabolic rate and levels of physical activity (4), and several satiety hormones released by the intestine, chief among which are cholecystokinin (CCK), secreted from duodenum, and peptide YY (PYY) arising from ileum. Although ghrelin concentrations change in parallel with human sensations of hunger, deletion of the ghrelin gene does not impair normal eating in mice (5).Evidence for the effects of these hormones on human sensations of hunger and satiation is most convincing for CCK (6). Infusion of pharmacological concentrations of PYY induces satiation in humans (7) but at physiologic al concentrations, PYY does not affect appetite (8). Most gut hormones are thought to influence the brain by binding to receptors on the afferent parasympathetic vagus nerve which imports these hormonal influences into the brain through its brainstem nucleus (9). Others, like insulin and leptin can access the hypothalamus directly from the blood through the median eminence (10). In the arcuate nucleus, ghrelin was shown to stimulate neurons that secrete orexigenic hormones neuropeptide Y (NPY) and agouti-related peptide (AgRP) and to inhibit neurons that secrete anorexigenic hormones αMSH and CART (11) (see Figure 1). In addition to gut hormones, catecholamines could play a role in appetite suppression. Amphetamines have been used as appetite suppressing drugs and have been shown to act both in the central nervous system (12) and on receptors in the viscera (13).

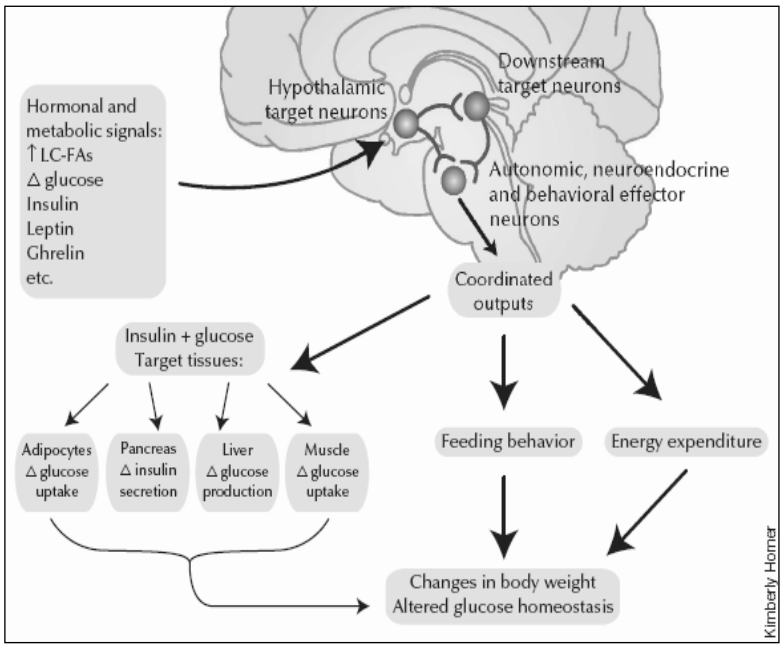

Figure 1 legend: Hypothalamic neurons are targets of hormones such as insulin, leptin and ghrelin as well as nutrients such as glucose and long-chain fatty acids. These neurons then influence autonomic and neuroendocrine functions, and are thought to affect appetite and feeding behavior. Figure from Elmquist & Marcus (14).

Hormones thought to participate in intermediate or longer-term regulation of energy balance are leptin, released by adipocytes, and the pancreatic hormone insulin (10). Both hormones have receptors on adipose tissue and their plasma concentrations are proportional to size of the adipose tissue (10). Both hormones have circulatory access to the central nervous system (CNS) through the median eminence and have been shown to exert their anorexigenic influences after CNS administration (10). Although insulin concentration increases after a meal, leptin concentration does not do so, so neither hormone is thought to act on satiation and termination of a meal (15). Instead they are thought to influence appetite and food intake by causing satiety over longer epochs (hours to days) and relative to the amount of energy expended or an increase in body fat level (1).

Effects of exercise on appetite and consummatory behavior

Exercise energy expenditure presents an interesting and challenging problem. A number of studies have repeatedly shown that exercise transiently suppresses sensation of hunger and increases sensation of fullness. An example is shown in Figure 2, from one of the several studies by John Blundell and his collaborators (16).

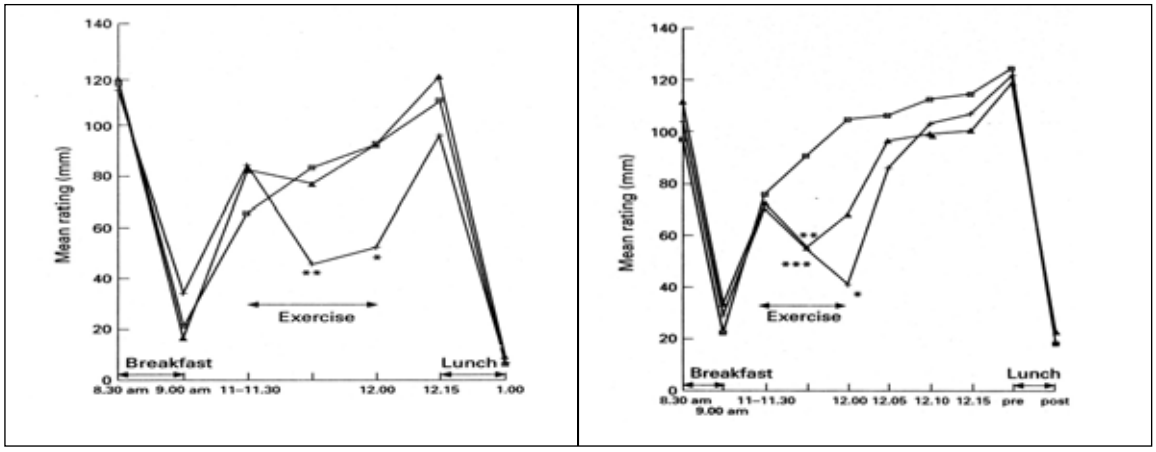

Figure 2 legend: Expenditure of about 350 Kcal during one hour of cycling at 30% of maximal effort (solid triangles) did not alter hunger ratings while expenditure of the same number of calories over 30 minutes of cycling at 70% of VO2 max caused about 45 % lower hunger ratings (left). Expenditure of 540 Kcal during 52 min of cycling at about 75% of maximal effort produced about 60% lower hunger ratings, while expenditure of 300 Kcal at the same intensity over 30 minutes produced only 40% hunger suppression (right). (Figures from 16).

As shown in the left panel of figure 2, expenditure of 300 Kcal on a bicycle ergometer at low effort of 30% of VO2 max (triangles) had no effect on the ratings of hunger before the mid-day meal, while expenditure of the same number of calories at 70% of maximal effort led to a significant but transient suppression of hunger. In the right panel, the same authors show that expenditure of twice as many calories at 75% of maximal effort (500 Kcal) caused greater suppression of appetite than expenditure of 250 Kcal at the same exercise intensity. From these studies it appears that above some threshold exercise intensity, exercise energy expenditure causes proportional reductions in hunger sensation.

We confirmed in our laboratory that exercise caused short-term suppression of hunger and increased sensation of fullness in a series of studies (17). These add further detail to conditions leading to exercise-induced suppression of hunger since in one study we adjusted exercise duration to produce equal energy expenditure at two different intensities, 40% and 80% of maximal effort, and in the other we replaced intravenously the energy cost of exercise.

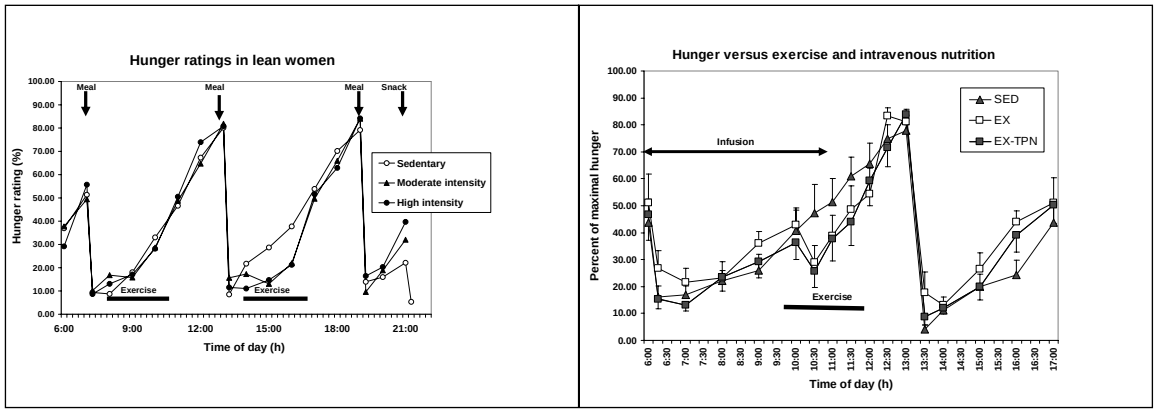

Figure 3 legend: Appetite is suppressed by about 50% at both 40% and 80% of maximal effort after expenditure of 435 Kcal during afternoon, but not after morning exercise (left). It was suppressed by about the same amount during two hours of exercise at 50% relative intensity and expending 430 Kcal with (shaded rectangles) and without (open rectangles) intravenous nutrient replacement of 400 Kcal (right) (17).

As can be seen in Figure 3 left, exercise producing expenditure of about 435 Kcal during each exercise bout and at either intensity produced equivalent suppression of hunger. This indicates that some aspect of exercise-associated energy expenditure, and not exercise intensity per se, is responsible for the suppression of hunger ratings. The right portion of figure 3 shows results from the second study which entailed 2 hours of morning exercise that generated 430 Kcal of energy expenditure. In one trial in that study, exercise energy expenditure was replaced through intravenous infusion of nutrient energy (400 Kcal), and in the other exercise trial and sedentary trial, saline was infused. Figure 3, right, shows that exercise produces equal appetite suppression after exercise energy expenditure of 430 Kcal that is unaffected when 400 of expended calories are replaced by intravenous nutrients. This suggests that an endogenous process associated with exercise energy expenditure at intensity above 30%, and requiring more than 300 Kcalories, is responsible for appetite suppression. With a 430 Kcal exercise energy expenditure, the magnitude of hunger suppression ranged between 43% (16) and 50% (17). It should, however, be noted that exercise-associated appetite suppression is not automatic as it appears to operate within some circadian constraints. We saw no appetite suppression during morning exercise (8 to 10 h). Both ours and Blundell data show appetite suppression when exercise was performed between 11 and 16 h.

What about consummatory behavior after exercise? Based on the energy regulatory models outlined above, energy expenditure should lead to either an increased appetite or increased food consumption. In the Blundell studies, energy intake was measured during a post-exercise meal and during two subsequent days (16). They found that, during 24 hours of exercise day, and after the expenditure of 250 Kcal or 500 Kcal, food intake was indistinguishable from intake on a sedentary day (Figure 4).

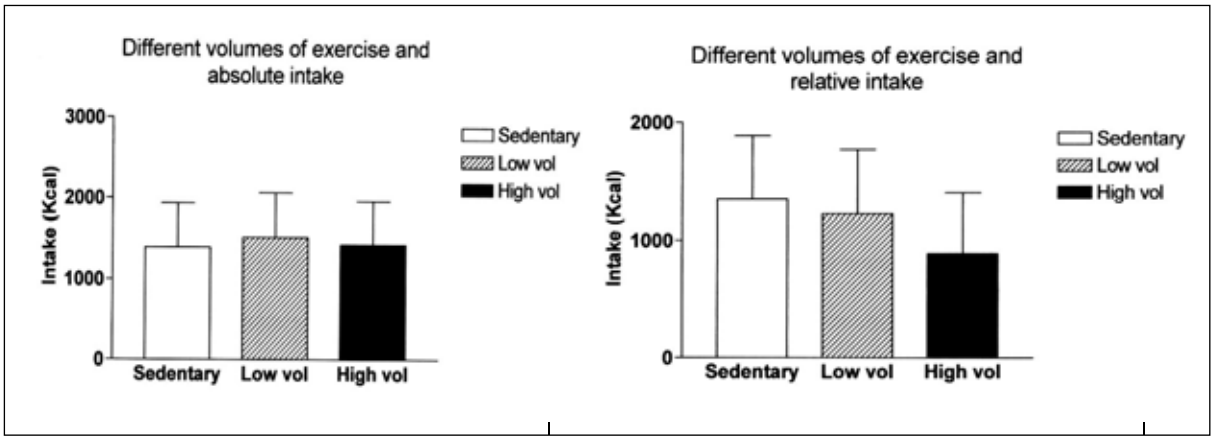

Figure 4 legend: Daily energy intake during the exercise experiment described in the Figure 2 legend (left). Actual energy availability (right) reflects exercise energy expenditure subtracted from the daily energy intake in the same study (16).

In our exercise intensity study (Figure 5), three meals shown by arrows in Figure 3 left, were designed to be weight maintaining. However at 21 h, subjects were provided with the opportunity to eat unlimited amounts of food. The total energy intake including the ad libitum snack was indistinguishable between two exercise days and a sedentary day. The food eaten during snack time was equal in the three trials. When calories expended were subtracted from calories eaten during the trial day, exercise clearly did not lead to compensatory increase in energy intake to make up for the calories lost during exercise.

The energy expenditure during two exercise periods resulted in uncompensated daily negative energy state during the exercise day.

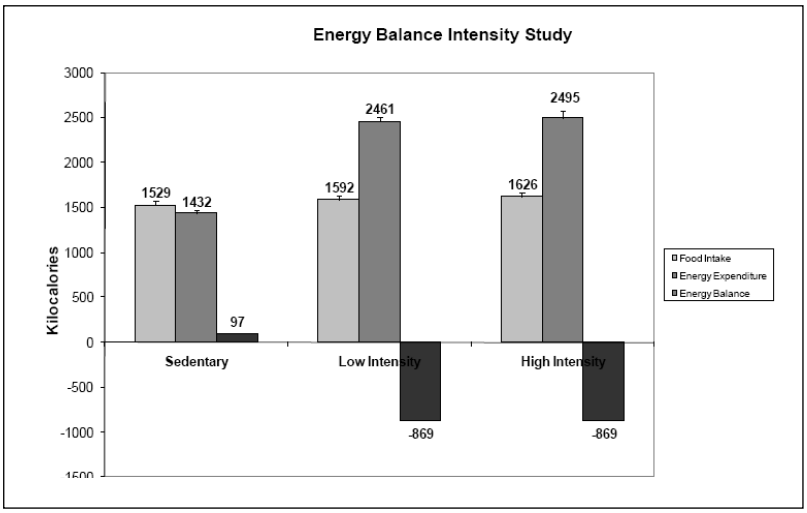

Figure 5 legend: Daily energy intake during a sedentary day and low and high intensity exercise trials (lightest shading). The total energy expenditure (resting metabolism plus exercise) in the three trials is shown as medium-shade bars. The energy balance for the day (intake minus expenditure) is shown as solid bars (17).

Hormonal role in exercise-associated appetite suppression

In both of the foregoing studies, we examined the potential role of several hormones with known influences on short-term and intermediate-term regulation of energy balance. We found in both studies that exercise was, as expected, associated with reduced concentrations of insulin. It is well known that activation of sympathetic nerves suppresses insulin secretion from the pancreas. Therefore plasma insulin could not have influenced exercise-associated suppression of hunger (Figure 3) since its concentration changed in the opposite direction from that expected of an anorexigenic hormone (10). We also measured plasma concentrations of ghrelin and leptin in both studies and used a ghrelin/leptin ratio as a more reliable index of hormonal control of hunger and response to negative energy balance than either of the two hormones alone (18, Figure 6).

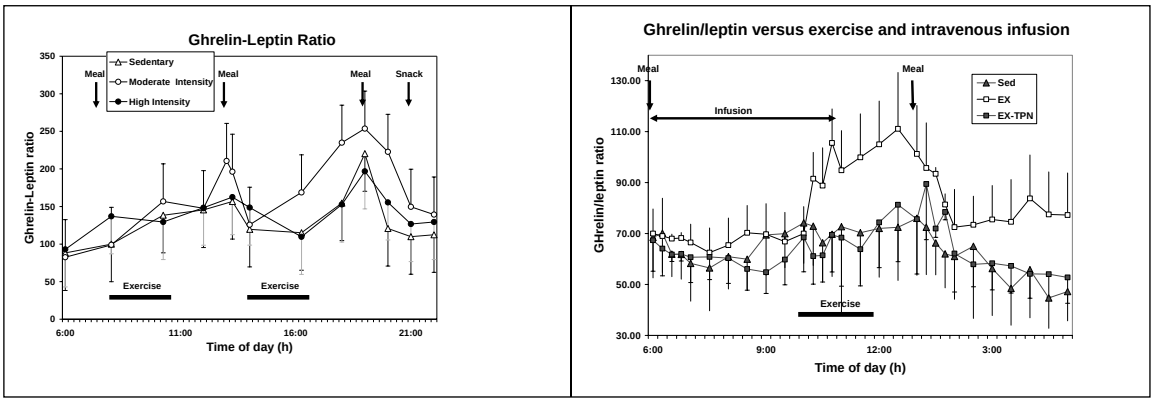

Figure 6 legend: Ghrelin/leptin ratio in the exercise intensity study (left) and intravenous nutrient replacement study (right). The ratio was increased after the second bout of exercise during the moderate intensity exercise trial in the first study (19) and during exercise and post-exercise period when no intravenous nutrients were infused in the second study (20).

As can be seen in Figure 6, the ghrelin-leptin ratio is increased after a second bout of exercise carried out at 40% relative effort in the first study (left), and also in response to 430 Kcal exercise energy expenditure when the energy cost of exercise was not replaced with intravenous calories in the second study (right). Comparison with figure 3 makes it obvious that there was a significant disagreement between perception of hunger and hormonal responses to the manipulations in our studies. Exercise, at both relative intensities, and regardless of presence or absence of intravenous nutrient replacement, resulted in equal appetite suppression. The ghrelin/leptin ratio, on the other hand accurately tracked the energy status in one of the two studies (Figure 6, right), where the ratio was increased in response to exercise energy expenditure but not in the other two conditions where the energy balance was maintained or intravenously restored. The ghrelin/leptin ratio also accurately reflected negative energy balance generated by low intensity exercise (40% of relative effort) but not the same energy expenditure accrued through high-intensity (80% VO2 max) exercise (figure 6, left).

Though neither changes in plasma insulin, or ghrelin/leptin ratio could account for appetite suppression during exercise, we also examined the possibility that the catecholamines may be responsible for the anorectic effect. Concentrations of epinephrine and norpeinephrine were measured in the exercise intensity study (17).

As shown in Figure 7, exercise intensity had a significant dose-dependent effect on plasma norepinephrine (right), but not on plasma epinephrine (left).

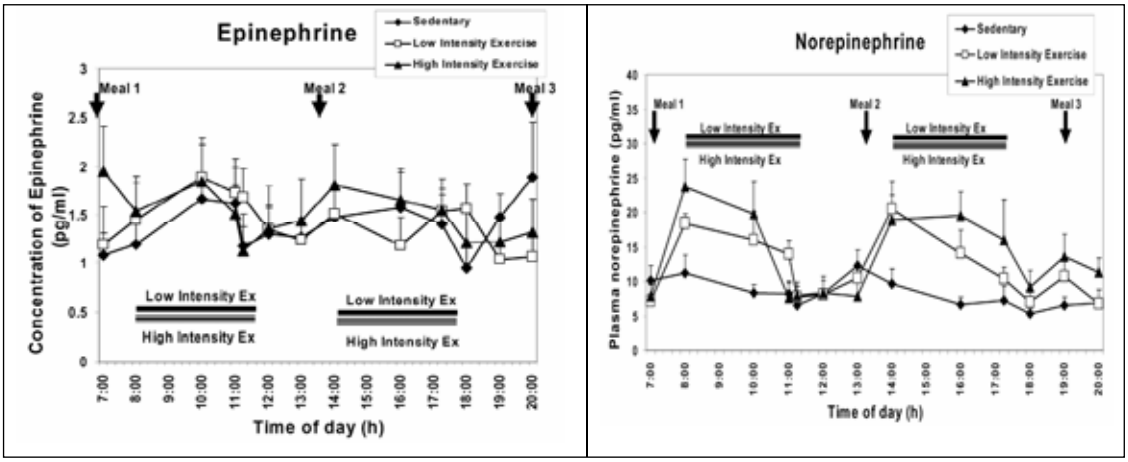

Figure 7 legend: The effect of exercise at two intensities, 40% and 80% of maximal effort, on plasma concentrations of epinephrine and norepinephrine (17).

In view of dose-dependent relationship between norepinephrine response and exercise intensity, and no intensity effect of hunger suppression, it is unlikely that catecholamines directly influenced hunger in this study.

While none of the candidate hormones under consideration influenced exercise-induced hunger suppression, our studies have given us useful clues as to possible signals that may be responsible for this phenomenon. Our data, outlined above, show that hunger suppression occurs in response to calories expended during exercise, but not to exercise intensity per se, or to intravenous nutrient replacement. This suggests that some process associated with nutrient usage during exercise tracks calorie expenditure and is not influenced by nutrients introduced intravenously. Metabolic hormones insulin, leptin, and ghrelin, on the other hand, track accurately expended calories as well as intravenous calories. Among the catecholamines, norepinephrine responds to exercise intensity rather than calorie expenditure.

In making a speculative hypothesis as to the probable cause of exercise-induced appetite suppression, we take our clue from amphetamine anorexia. Amphetamines have central (12) as well as peripheral (13) sites of action through which they cause anorexia by stimulating adrenergic as well as dopamine receptors. Interestingly, amphetamine anorexia is blocked by visceral sympathetic denervation of the celiac ganglion that relays sympathetic messages to the liver and other viscera (13). Sympathetic activation of the liver facilitates hepatic glucose output (21). Information about the concentration of glucose in hepatic portal circulation is relayed to the central nervous system via the afferent vagus (22) within the fibers that travel in the esophageal branch and pass through the celiac ganglion (23). Lesion of this branch of the vagus nerve attenuates anorexia caused by epinephrine and amphetamine (23).

Hepatic glucose sensing and its role in the control of appetite and feeding was postulated almost half a century ago (24), but several studies suggest that hepatic glycogenolysis and gluconeogenesis are actually responsible for catecholamine- and amphetamine-induced anorexia (25, 26) . Glucagon, epinephrine, and amphetamines are more effective in suppressing hunger when glycogen levels are high than when they are low (26). All of these facts are compatible with a concept of a hepatic fuel sensing system causing appetite suppression through its communication with the central nervous system outlined in Figure 8. Sympathetic activation of phosphorylase during

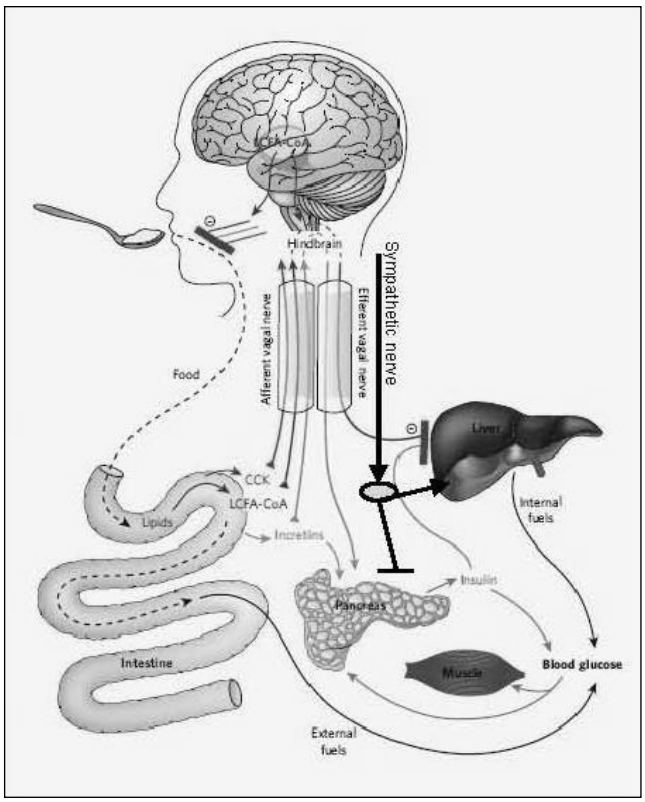

Figure 8 legend: Autonomic control of hepatic glucose production. Nutrient intake stimulates release of insulin which blocks hepatic glucose production through the parasympathetic nerve vagus. Sympathetic nerves are activated during exercise. They stimulate hepatic glucose production through a synapse within the celiac ganglion (oval in center of figure). Figure from Thaler and Cummings (27).

exercise is responsible for increasing hepatic glucose output. Vagal afferents may send the information about the rate of hepatic glucose production to the brainstem and hypothalamic nuclei (22, 23) and from there to higher cortical regions responsible for hunger sensations (11).

Several lines of evidence suggest that increased hepatic glucose output, particularly when glycogen levels are high (26), in response to catecholamine or amphetamine stimulation, is associated with decreased food intake in animals (23,26). This would suggest that increased hepatic glucose output during exercise-induced glycogenolysis is a probable cause of exercise-associated appetite suppression. It would also explain why intravenous nutrients have no impact on hunger sensation during exercise since they do not affect the rate of hepatic glucose production. Metabolic hormone responses may similarly be affected by this putative hepatic metering of carbohydrate energy depletion during exercise. However, bolth ghrelin and leptin responses appear also to sense circulating energy availability as their concentrations rapidly track changes in the energy balance caused by energy cost of exercise as well as intravenous nutrient infusion. The failure of ghrelin/letin ratio to respond accurately to energy expenditure at high exercise intensity could be a consequence of sympathetic inhibition of sensory vagal function at high levels of sympathetic activation.

This analysis of the possible hormonal and autonomic factors in exercise-associated appetite suppression, and hypothesis about the etiology of exercise-induced appetite suppression, are amenable to further experimental testing. If our speculative hypothesis is confirmed, new therapeutic agents aimed at hepatic glucose output could be developed to curb hunger sensation and aid in weight loss. The encouraging information for the lay person is that our body tracks exercise energy expenditure and, instead of increasing hunger and food consumption, suppresses appetite and blocks compensatory eating. These facts can be useful in weight control even in the absence of complete understanding of the underlying mechanism.

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PROMOTING ENDURANCE TRAINING ADAPTATIONS THROUGH NUTRITIONAL INTERVENTIONS: LOW-CARBOHYDRATE TRAINING?

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Abstract

Skeletal muscle responds to endurance exercise via increased transcription of metabolic and stress related genes to ultimately yield increased steady state levels of specific proteins. These changes in transcriptional activity are highly dependent on the mode, duration, intensity and frequency of the contractile stimulus. One of the major challenges for exercise physiologists is to identify the exercise 'signal' that is responsible for initiating the adaptive response. In this regard, it is now becoming apparent that carbohydrate availability may have an important role to play in this process. For example, many stress and metabolic related genes are enhanced when the exercise is commenced under reduced pre-exercise muscle glycogen levels and attenuated when glucose is ingested during exercise. Taken together, such findings suggest that training under conditions of reduced carbohydrate availability from both endogenous and exogenous sources may provide an enhanced stimulus for inducing beneficial adaptations of skeletal muscle. This hypothesis is in stark contrast to the widely held belief that intense training periods should be supported by a high carbohydrate diet in order to maintain training intensity and replenish energy stores for future training sessions. This presentation will outline current thinking regarding the potential for carbohydrate availability to modulate the adaptations typically observed following periods of endurance training. Relevant data from both our own laboratory and the literature will be presented with a view to providing some practical recommendations for both athletes and coaches and which highlights the potential advantages and disadvantages of training with reduced carbohydrate availability. This information will have specific relevance for sports that utilise high-intensity intermittent activity patterns such as soccer.

Key words: *endurance exercise, nutrition, carbohydrates*

HIERARCHIES OF SYNERGIES IN HUMAN MOVEMENTS

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Abstract

This brief review addresses the problem of motor redundancy, which exists at many levels of the neuromotor hierarchies involved in the production of voluntary movements. An approach to this problem is described based on the principle of abundance. This approach offers an operational definition for motor synergies using the framework of the uncontrolled manifold hypothesis. It is shown that hierarchical systems have inherent trade-offs between synergies at different control levels. These trade-offs have been demonstrated in experimental studies of human multi-finger pressing and prehension. They are likely to be present in other hierarchical systems, for example those involved in the control of large groups of muscles. The framework of the equilibrium-point hypothesis offers a physiologically based mechanism, which may form the basis for hierarchies of synergies.

Key words: *synergy, motor redundancy, principle of abundance, hierarchical control, prehension*

The problem of motor redundancy

All the neuromotor processes within the human body associated with performing natural voluntary movements involve several few-to-many mappings that are commonly addressed as problems of redundancy. In other words, constraints defined by an input (for example by a task) do not define unambiguously patterns of an output (for example patterns of joint rotations, muscle forces, activation of motoneurons, etc.) such that many (commonly, an infinite number of) solutions exist. This problem has been appreciated by Bernstein (1935, 1967) who viewed it as the central problem of motor control: How does the central nervous system (CNS) select unique solutions from the numerous seemingly equivalent alternatives?

The problem of motor redundancy can be illustrated by examples at different levels of the neuromotor hierarchy. For example: How is a joint configuration selected for a desired endpoint limb position n the three-dimensional space given the larger than three number of individual joint rotations? How are muscle forces (or activation levels) defined for a desired joint torque given that all major joints are spanned by more than two muscles? How is a motor unit firing pattern defined for a desired muscle activation levels given the large number of motor units and a possibility to vary their frequency of firing?

A traditional method of dealing with the problems of motor redundancy has been to assume that the CNS uses a set of criteria to find unique solutions to such problems. In particular, a variety of optimization techniques have been used to address such problems including optimization of cost functions based on mechanical, psychological, and neurophysiological variables (reviewed in Prilutsky 2000; Rosenbaum et al. 1993, Latash 1993). There is an alternative view, however, on such problems. This view originated from the seminal works by Gelfand and Tsetlin (1966) and has been developed recently (Gelfand and Latash 1998, 2002; Latash et al. 2007).

The principle of abundance

Gelfand and Tsetlin (1966) compared the many elements involved at any step of the generation of movement to a class of lazy students who want to do minimal work compatible with the task at hand. They introduced the principle of minimal interaction to describe such behaviors of large ensembles of elements. According to this principle, each element tries to minimize its interaction with other elements, the controller, and the environment. In other words, each element tries to minimize input is receives from all the mentioned sources.

Recently, this principle has been developed into a principle of abundance (Gelfand and Latash 1998). According to the principle of abundance, the problems of motor redundancy are wrongly formulated. The few-to-many mappings typical of such problems should not be viewed as a computational problem for the controller but rather as a luxury that allows combining stable performance of a task with performing other tasks and responding to possible perturbing influences from the environment. Solving problems of motor redundancy involves not selecting a unique, optimal solution but rather facilitating families of solutions that are equally successful in solving the task. Note that this family of solutions is much smaller than the total number of possible solutions. So, a certain selection/optimization is likely to take place. For example, we do not use military parade gaits and do not walk sideway although these ambulation patterns solve the task

of moving from point A to point B. The shift from searching for unique solutions to defining rules that organize families of solutions have resulted in a novel view on motor synergies, a paradigm shift that has led to an operational definition of synergies and the creation of a new computational approach to identify and quantify synergies.

Synergy – an operational definition

The word "synergy" has been used in studies of movements and to describe motor disorders for over 100 years. Commonly, it has not been defined beyond the direct translation from Greek meaning "work together". Recently, however, this word has acquired a more specific meaning rooted in the principle of abundance (for a detailed review see Latash 2008). The easiest way to introduce this new meaning of the old word is with an illustration (Figure 1).

Imagine a person pressing with three fingers of a hand on three force sensors. The task is to produce a certain level of the total force, for example 20 N. This is a typical problem of motor redundancy since the equation $F_1+F_2+F_3=20$ has an infinite number of solutions. These solutions form a two-dimensional sub-space, a plane in the three-dimensional space of finger forces (Figure 1A, UCM_F, this abbreviation will become clear later). The original formulation of the problem of motor redundancy implies that a neural controller finds a unique solution, a point on that plane, that satisfies an optimality criterion (for example, point A). The principle of abundance, however, implies that a whole family of solutions are allowed by the controller; these solution should all belong to an area within the plane shown in Figure 1 with dashed lines. Now consider that each element (each finger) has an inherent variability that cannot be reduced to zero. This means that actual observations in such a task over repetitive attempts are expected to generate a cloud of points. What could be the shape of such a cloud?

If a unique solution is selected, and there is inherent variability that is approximately equal for each of the fingers, the cloud will look like a sphere centered about point A. This corresponds to a stereotypical solution that does not make use of the design of the hand and does not deserve to be called a synergy. If a whole family of solutions is selected, one may also expect some variability that goes beyond the plane shown in Figure 1, but it may be expected to be smaller than variability within the plane. In other words, different solutions may be observed across trials, but these solutions will show co-variation of finger forces such that most of the variability is confined to the plane corresponding to perfect execution of the task (illustrated with the ellipsoid in Figure 1A).

Imagine now that the force sensors are mounted on a plate that is placed on a narrow support under the middle finger (the insert in Figure 1) such that the whole system is in an unstable equilibrium. Now the subject has to balance the moments of force produced by the two lateral fingers. This task corresponds to another equation $F_1=F_3$, which also allows an infinite number of solutions corresponding to a plane in the space of finger forces (thick dashed lines in Figure 1B). Following the same logic, two strategies of dealing with this problem are possible. First, the neural controller may select a unique solution. Second, a whole family of solutions may be facilitated. In the first case, one may expect a close to spherical distribution of data points recorded in several trials centered about a point. In the second case, an ellipsoid of data points may be expected oriented parallel to the plane of perfect solutions.

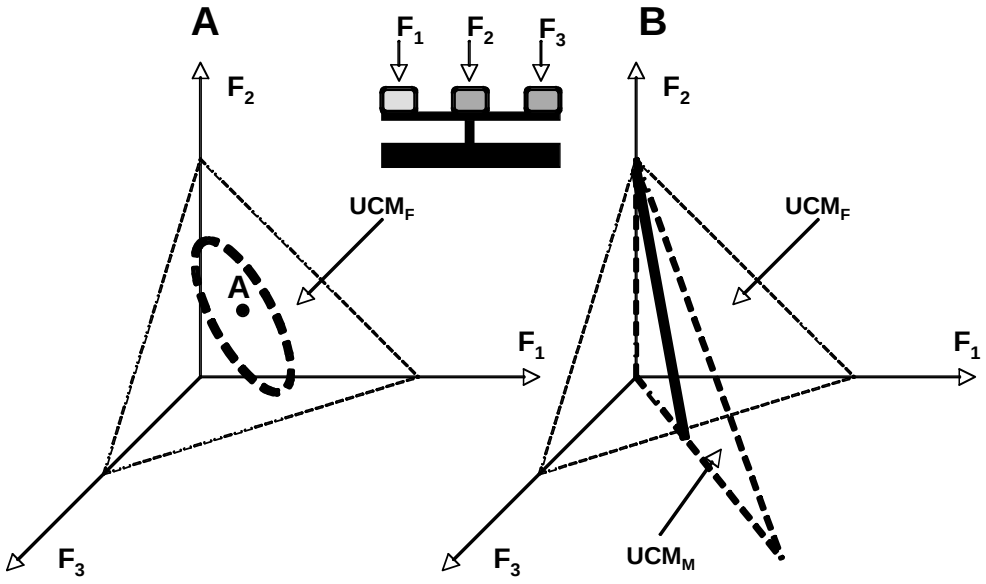

Figure 1. The task of constant total force production with three fingers acting in parallel. A: The sub-space corresponding to constant total force (UCM_F), an average sharing of force among the fingers (point A), and a possible data distribution across a series of trials (the ellipsoid); B: The sub-space corresponding to constant total moment of force, UCM_M (with respect to a pivot shown in the insert). The thick solid lines belongs to both sub-spaces shown by dashed lines

Note that both tasks can be performed at the same time, that is producing a total force of 20 N and simultaneously balancing the plate. Then, both equation are satisfied, and the space of solutions becomes one-dimensional, a line formed by the intersection of the two planes shown as the thick solid line in Figure 1B.

This example allows to introduce three characteristics of synergies. First, when an apparently redundant set of elements is involved in a task, an average *sharing pattern* is selected that will characterize the average contribution of each element. Second, when several attempts at a task are analyzed, elements may show co-variation of their outputs that is beneficial for the task, i.e., that reduced variability of the important performance variable as compared to what one could expect in the absence of the co-variation. This feature is sometimes referred to as *error compensation* or *stability.* Third, the same set of elements may be used to form different synergies, i.e. different co-variation patterns that are beneficial for different performance variables produced by the whole system. This feature may be called *flexibility*. Only systems that can demonstrate all three features will be called synergies.

Synergies always do something; there are no abstract synergies. Within the current framework, we assume that they ensure low variability (high stability) of a performance variable. So, every time the word synergy is used, one has to mention what elemental variables form the synergy and what the synergy is doing. For example, an expression "a hand synergy" carries little meaning, but it is possible to say "a synergy among individual finger forces stabilizing the total force" or "a synergy among moments of force produced by individual digits stabilizing the total moment of force applied to the hand-held object." A number of recent studies have suggested that sometimes co-variation among elemental variables contributes to a quick change in a performance variable (Olafsdottir et al. 2005; Kim et al. 2006); in such cases, one may say that a synergy acts to destabilize the performance variable.

This framework allows to offer the following definition of a synergy: *Synergy is a neural organization of a set of elemental variables with the purpose to ensure certain stability properties (stabilize or destabilize) of a performance variable produced by the whole set.*

The uncontrolled manifold hypothesis

The introduced definition of synergy requires a quantitative method that would be able to distinguish a synergy from a non-synergy and to quantify synergies. Such a method has been developed within the framework of the uncontrolled manifold hypothesis (UCM hypothesis, Scholz and Schöner 1999; reviewed in Latash et al. 2002, 2007). The UCM hypothesis assumes that a neural controller acts in a space of elemental variables and selectes in that space a sub-space (a UCM) corresponding to a desired value of a performance variable. Further, the controller organizes interactions among the elements in such a way that the variance in the space of elemental variables is mostly confined to the UCM. There have been several attempts to offer a mechanism that could organize such type of control. In particular, feedback using peripheral sensors (Todorov and Jordan 2002), feedback using central back-coupling neural loops (Latash et al. 2005), and a feed-forward control scheme (Goodman and Latash 2006) have all been shown to lead to data point distributions compatible with the UCM hypothesis.

Consider the simplest case of a mechanically redundant system, two effectors that have to produce a certain magnitude of their summed output (Figure 2). The space of elemental variables is two-dimensional (a plane), while any magnitude of the summed output may be represented as a one-dimensional sub-space (a line). This line is the UCM corresponding to a desired value of the performance variable (E_1+E_2). Now it is clear why in Figure 1, the two planes corresponding to stabilization of the total force and total moment of force are labeled as UCM_F and UCM_M, respectively. As long as the system's state belongs to that line, the task is performed perfectly, and the controller does not need to interfere. According to the UCM hypothesis, the controller is expected to organize co-variation of E_1 and E_2 over a set of trials in such a way that the cloud of points recorded in those trials is oriented parallel to the UCM. Formally, this may be expressed as an inequality $V_{UCM}>V_{ORT}$, where V_{UCM} stands for variance along the UCM and V_{ORT} stands for variance along the orthogonal sub-space (shown with the dashed slanted line in Figure 2). Another, more intuitive pair of terms have been used to describe the two variance components, "good" and "bad" variance (V_{GOOD} and V_{BAD}). V_{BAD} hurts accuracy of performance while V_{GOOD} does not while it allows the system to be flexible and deal with external perturbations and/or secondary tasks. For example, having large V_{GOOD} may help a person to open a door with the elbow while carrying a cup of hot coffee in the hand.

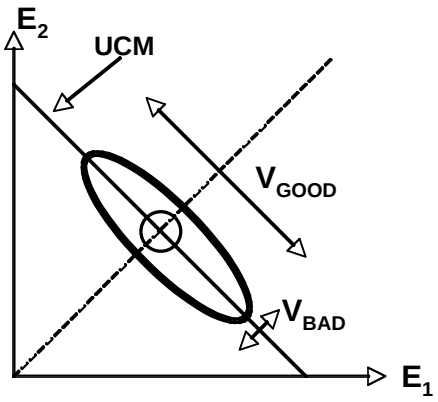

Figure 2. The task of constant output production by two effectors, E1 and E2. The circle and the ellipse show data distribution across repetitive trials. The slanted solid line is the UCM for the task. The ellipse show more variance parallel to the DCM (V_{GOOD}) as compared to variance orthogonal to it (V_{BAD}), while the circle has equal amount ofvariance in the two directions. The ellipse illustrates a not very accurate synergy, while the circle illustrates a very accurate non-synergy.

Analysis within the framework of the UCM hypothesis involves several important steps:

1). First, one has to select a set of elemental variables or, in other words, to commit to a certain level of analysis.

2). Then, one has to formulate a hypothesis on a possible performance variable that may or may not be stabilized by co-variation of the elemental variables. The performance variable may be complex, that is multi-dimensional. This is a very important step. It follow the basic idea that synergies always do something. We assume that they ensure certain stability properties of important features of performance.

3). One has to compute relations between small changes in the elemental variables and changes in the selected performance variable, the Jacobian of this system. This step leads to linear analysis of the system, which may not be appropriate for systems with strongly non-linear properties.

4). In general, the UCM is non-linear, for example for joint configurations corresponding to a desired endpoint position of a limb. If one accepts a linear approximation of the UCM, the null-space of the Jacobian may be computed and used instead.

5). One has to perform an experiment with repetitive measurements of the elemental variables assuming that the subject tries "to do the same thing". Then, data (values of the elemental variables) may be analyzed across trials at comparable phases of the actions or across time samples.

6). Finally, variance in the space of elemental variables has to be projected onto the null-space of the Jacobian and onto its orthogonal complement and compared per dimension in each of these sub-spaces. If $V_{GOOD}>V_{BAD}$, the hypothesis may be accepted, and one may conclude that a synergy in the space of those elemental variables stabilizes the performance variable hypothesized at step #2.

Note that the inequality $V_{GOOD}>V_{BAD}$ is not required for accurate performance. For example, the tiny circle in Figure 2 illustrates very accurate performance (small variability of the sum E_1+E_2) without any co-variation between the two elemental variables such that $V_{GOOD}=V_{BAD}$. So, there may be very accurate non-synergies as well as very sloppy synergies.

Hierarchical control

The idea of hierarchical control of human movements is very old. In particular, Bernstein (1947, 1967) introduced and developed a scheme involving five to six hierarchical levels. As mentioned earlier, few-to-many mappings exist at different levels of the neuromotor system. Hence, one may expect the existence of hierarchies of synergies such that outputs of a synergy serve as inputs into a hierarchically lower synergy. The input into the higher level is provided by the task, while the lowest level acts on the environment (Figure 3).

Most studies have considered at most two hierarchical levels in analysis of synergies. In particular, studies of multi-muscle postural synergies have suggested that the CNS manipulates fewer variables than the number of involved muscles; these muscle groups have been addressed as muscle synergies (d'Avella et al. 2003; Ivanenko et al. 2004; Ting and Macpherson 2005; Tresch et al. 2006) or as muscle modes (Krishnamoorthy et al. 2003a,b). In turn, muscle modes have been viewed as elemental variables that are organized into synergies with the purpose to stabilize such physical variables as coordinates of the center of pressure and shear forces acting from the supporting surface onto the body (Danna-Dos-Santos et al. 2007; Robert et al. 2008).

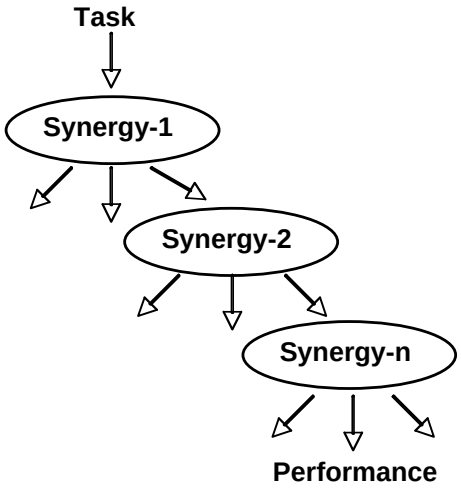

Figure 3. An illustration of a hierarchy of synergies. At each level, the number of output variables is larger than the number of input variables. The output of each synergy serves as an input into a hierarchically lower synergy. Task serves as an input into the hierarchically highest synergy, while the hierarchically lowest one acts on the environment.

The idea of a two-level hierarchical control has been developed for prehensile tasks such as holding an object with the digits of a hand. Within this scheme, at the higher level, the task is assumed to be shared between the thumb and the virtual finger (VF, an imagined finger with the action equivalent to the summed action of the four actual fingers, Arbib et al. 1985). Al the lower level, the action of the VF is shared among the actual fingers. Patterns of co-variation of elemental variables stabilizing aspects of the combined action have been demonstrated at each of the two levels (reviewed in Zatsiorsky and Latash 2004). In particular, the combined action of the thumb and VF has been shown to stabilize the grasping action and the rotational action of the hand in accordance with the principle of superposition introduced in robotics (Arimoto et al. 2001). The combined action of the fingers has been reported to stabilize the grasping force applied to the hand-held object (Shim et al. 2004).

Trade-offs inherent to hierarchical control schemes

Consider a very simple task: To press with two hands, two fingers per hand, such that the total force is constant (Gorniak et al. 2007a). Panel A of Figure 4 illustrates a distribution of data points across a number of trials with an ellipse elongated along the line $F_{LEFT}+F_{RIGHT}$=const. This line represent the UCM in the space of two elemental variables (F_{LEFT} and F_{RIGHT}) corresponding to the required constant value of the total force. The illustrated data show a much larger variance along the UCM (V_{GOOD}) than orthogonal to the UCM (V_{BAD}). So, we may conclude that a two-hand synergy stabilizes the magnitude of the total force. Note that the variance of each of the hands (for example V_{RIGHT}) may be rather large because it reflects both V_{GOOD} and V_{BAD}. Hence, a strong synergy with a large V_{GOOD} is expected to show large variance of each of the two forces.

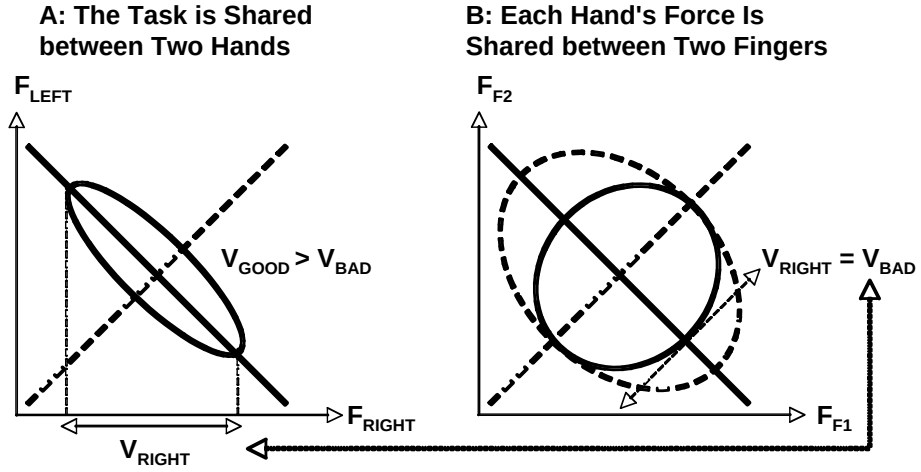

Figure 4. An illustration of data distributions for a task of producing a constant force level by four fingers, two per each hand. A force stabilizing synergy at the two-hand level (panel A) implies an inequality $V_{GOOD}>V_{BAD}$, which may result in large variance of each hand's output (e.g., V_{RIGHT}). This results in large V_{BAD} at the two-finger within-a-hand level, which may prevent a force stabilizing synergy at that level

Consider now the lower level of the hierarchy where each hand's force is shared between the two fingers (Figure 4B). By definition, at this level, variance of that hand's force is V_{BAD}. It is large due to the large V_{GOOD} at the upper level of the hierarchy (panel A). So, to show a synergy at the lower level, V_{GOOD} at the lower level should be very large to satisfy the inequality $V_{GOOD}>V_{BAD}$ (the large, dashed ellipse). It is more likely, therefore, that V_{GOOD} will not be large enough such that there will be no synergy (the smaller ellipse). So, there seems to be an inherent trade-off between synergies at two hierarchical levels: V_{GOOD} at the higher level contributes to a synergy at that level but potentially hurts chances of the lower level to show a synergy stabilizing its output. Two studies (Gorniak et al. 2007a,b) provided experimental support for this conclusion by showing that during one-hand tasks, there are strong synergies among the fingers stabilizing the total force, while during two-hand tasks there are such synergies between the two hands but not between the fingers within each of the hands. Moreover, when a one-hand task turned into a two-hand tasks (by instruction), within-a-hand force stabilizing synergies disappeared; when a two-hand task turned into a one-hand task, such synergies emerged.

Does the mentioned trade-off present an insurmountable obstacle for the central nervous system? In general, it is possible to have synergies at both hierarchical levels if the inequality $V_{GOOD}>V_{BAD}$ is satisfied at both levels, as illustrated with the very large ellipse in panel B of Figure 4. However, is this feasible during natural behaviors?

A recent study (Gorniak, Zatsiorsky, Latash, unpublished) explored multi-digit synergies stabilizing components of the hand action during a variety of tasks that involved holding an object steadily. As mentioned earlier, the hand has commonly been viewed as being controlled by a two-level hierarchy in prehensile tasks (Arbib et al 1985; MacKenzie and Iberall 1994). The total force and moment of force produced on an object are distributed at the higher level of the hierarchy between the thumb and the virtual finger (VF). At the lower level of the hierarchy, the VF action is distributed among the fingers that form the VF. Let us assume for simplicity that all the points of digit contacts belong to one plane (the grasp plane), and the external moment of force acts in the same plane. Then, the problem becomes two-dimensional. Holding an object steadily is associated with equilibrium constraints at the upper hierarchical level:

1. The sum of normal (superscript N) forces of the individual fingers on the object should be equal and opposite to the normal force of the thumb.

$$0 = F_{VF}^{N} + F_{TH}^{N}$$

$$F_{VF}^{N} = F_{i}^{N} + F_{m}^{N} + F_{r}^{N} + F_{l}^{N}$$

2. The sum of tangential (load resisting, superscript L) forces of the individual fingers and of the thumb (along the Y-axis) should be equal to the weight of the object (W).

$$W = F_{TH}^{L} + F_{VF}^{L}$$

$$F_{VF}^{L} = F_{i}^{L} + F_{m}^{L} + F_{r}^{L} + F_{l}^{L}$$

3. The total moment in the grasp plane (M^{TOT}) should be equal to the external moment of force (M^{EXT}).

$$M^{TOT} = M^{N} + M^{L} = M^{EXT}, \text{ where } M^{N} = M_{VF}^{N} + M_{TH}^{N} \text{ and } M^{L} = M_{VF}^{L} + M_{TH}^{L}$$

$$M_{VF}^{N} = F_{VF}^{N} d_{VF} = F_{i}^{N} d_{i} + F_{m}^{N} d_{m} + F_{r}^{N} d_{r} + F_{l}^{N} d_{l}$$

$$M_{VF}^{L} = F_{VF}^{L} r_{VF} = F_{i}^{L} r_{i} + F_{m}^{L} r_{m} + F_{r}^{L} r_{r} + F_{l}^{L} r_{l}$$

In these equations, superscripts relate to forces that produce mechanical effects (*N* – normal and *L* – load resisting), subscripts refer to digits (*TH* – thumb, *i* – index, *m* – middle, *r* – ring, and *l* – little fingers), *d* and *r* stand for lever arms for the normal and load forces respectively.

Note that the same elemental variables enter different equilibrium constraints. This fact, in combination with the mentioned inherent trade-off between synergies at different hierarchical levels. leads to rather complex interactions between V_{GOOD} and V_{BAD} for different variables and different levels of analysis. Note that these interactions are not dictated by the task mechanics but rather constrained by them. To make the long story short, experiments have shown that some of the variables (for example, the load force) can show synergies stabilizing their values at both levels of the hierarchy. Some variables (for example, the grip force) show synergies only at the upper level (similar to the mentioned study of pressing tasks), while other variables (for example, the total moment of force) show synergies only at the lower level. These interactions can be analyzed similarly to the chain effects described in earlier studies of relations among the magnitudes of elemental variables (reviewed in Zatsiorsky and Latash 2004), while here we are interested in relations among their variance components.

Ideas of multi-level hierarchical control have also been applied to analysis of multi-muscle synergies. Most experimental studies have addressed multi-muscle synergies at only one level. In particular, some studies applied matrix factorization techniques to muscle activation indices to discover muscle groups that may be viewed as controlled with only one central variable (Ting and Macpherson 2005; Tresch et al. 2006). Such groups have been addressed as multi-muscle synergies. Other studies viewed those groups not as synergies but as elemental variables and explored co-variations among the magnitudes of those variables that could be related to stabilization of such mechanical variables relevant to postural control during standing as coordinate of the center of pressure, horizontal force, and moment of force about the longitudinal axis of the body (Danna-Dos-Santos et al. 2007; Robert et al. 2008). A few recent studies have shown, however, that the composition of muscle modes can change under challenging conditions (Krishnamoorthy et al. 2004) and as a result of practice (Asaka et al. 2008) supporting the view that the modes are flexible muscle groupings that may be viewed as synergies in the space of muscle activations.

Synergies and the equilibrium-point hypothesis

The equilibrium-point hypothesis of single-muscle control (reviewed in Feldman 1986; Feldman and Levin 1995) may be viewed as an example of how a large set of elements (motor units) can be united by a physiological mechanism (the tonic stretch reflex) to stabilize an important feature of performance – the equilibrium point characterized by values of muscle force and length. According to this hypothesis, the central nervous system specifies a value of the threshold of the tonic stretch reflex, while muscle activation level as well as its mechanical output are defined by both the central command and the reflex feedback from peripheral receptors.

The main idea of threshold control has been generalized to the control of multi-effector systems using the notion of *reference configuration* as a control variable at a higher level of a control hierarchy involved in the production of natural multi-muscle movements (Feldman et al. 2007; Pilon et al. 2007). Reference configuration defines, in the external space, a configuration, at which all the muscles would attain a minimal level of activity – a set of threshold values for muscle activation. If external conditions and/or anatomical constraints prevent a system from reaching its current reference configuration (as it commonly happens), muscles generate non-zero forces. In particular, fingertip forces on an external object emerge when a reference hand configuration corresponds to shorter flexor muscles as compared to the actual configuration. The general idea of control using reference configurations may be described as following a *principle of minimal end-state action*: The body tries to achieve an end-state, compatible with the external force field, where its muscles show minimal activation levels. This principle is a natural extension of the principle of minimal interaction (Gelfand and Tsetlin 1966).

The notion of *reference configuration* offers an attractive framework to analyze motor synergies. This framework assumes a hierarchical control system where, at each level of the hierarchy, the system is redundant, that is, it produces more output variables than the number of constraints specified by input variables (as in Figure 3). Other characteristics of action may be allowed to vary based on secondary considerations, possibly reflecting optimization of certain features of performance. Because the system is redundant, a reference configuration at a higher hierarchical level does not specify unambiguously all the reference configurations at a lower level. Emergence of particular lower-level reference trajectories may be based on a feedback mechanism or on a feed-forward mechanism. Hence, a hierarchy of control levels, where each level functions based on the equilibrium-point control principle, seems like a plausible control structure leading to motor synergies.

Concluding comments

This review offers a new look at the century-old concept of synergy. It suggests an operational definition that makes synergies quantifiable using the framework of the UCM hypothesis. It shows how synergies may compete or co-exist at different levels of the neuromotor hierarchy involved in the production of any voluntary action. It also links the idea of an hierarchy of synergies to a physiologically-based hypothesis of motor control, namely the equilibrium-point hypothesis. This approach seems to be applicable to apparently suboptimal movements performed by persons with movement disorders (Reisman et al. 2006), following atypical development (e.g., Latash et al. 2002a), and resulting from healthy aging (Shim et al. 2004; Olafsdottir et al. 2007).

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SCIENTIFIC BASES OF TAPERING FOR COMPETITION

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Abstract

The taper is a progressive non-linear reduction of the training load during a variable period of time, in an attempt to reduce the physiological and psychological stress of daily training and optimise sports performance. The main aim of the taper should be to minimise accumulated fatigue without compromising adaptations, but further fitness gains can also be attained. This is best achieved by maintaining training intensity, reducing the training volume (up to 60-90%) and slightly reducing training frequency (no more than 20%). Pre-taper training affects little optimal training load reduction, but it does affect ideal taper duration. The optimal duration of the taper ranges between 4 and more than 28 days, and this duration should be individual. Progressive non-linear tapers are more beneficial to performance than step-tapers. Performance usually improves by 3% (usual range 0.5-6.0%).

Key words: *taper, reduced training, performance, detraining*

Introduction

The tapering period that precedes the most important competitions is without a doubt one of the most important phases of the training season. Unfortunately, this is also the period during which coaches feel more insecure: when should the taper start? How much should the training load be reduced? Which is the most efficient tapering method? Will the swimmers detrain instead of peaking performance? There are no simple answers to these questions, and the method most usually followed by many coaches has been purely empirical. The taper has thus been planned and designed following the trial and error strategy.

It is the aim of this article to review the scientific knowledge on planning tapering strategies, with the aim of helping coaches to face this important period of the season with increased security and confidence.

Definition of taper

Various definitions of the taper have been provided by different authors over the past two decades. However, according to the data and results of the international scientific literature, the taper could be defined as a progressive non-linear reduction of the training load during a variable period of time, in an attempt to reduce the physiological and psychological stress of daily training and optimise sports performance (Mujika and Padilla, 2000).

Aim of the taper

Mathematical modelling studies on the effects of training have shown that the main aim of the taper should be elimination of fatigue accumulated by the swimmers during periods of intense training rather than attaining higher fitness levels. Indeed, the positive influence of training increases markedly during periods of intense training, but only develops slightly during periods of taper. However, intensive training is also characterised by a great increase of a swimmer's fatigue level (the negative influence of training), which "hides" his adaptations and prevents him from performing satisfactorily. A great reduction of the fatigue level during taper, along with slightly increased capacities, leads to the "appearance" of the swimmer's true fitness level, and to achieving great performances in competition (Mujika et al., 1996a). However, recent mathematical modelling studies suggest that training-induced adaptations can be further enhanced through the training undertaken during the taper period (Thomas et al., 2008).

This seems to be confirmed by physiological results, since it has been shown that there is a relationship between the percentage performance improvement during taper and an increased testosterone-to-cortisol ratio (Mujika et al., 1996b), which has often been considered as an index of an athlete's fatigue level. Other biological markers of increased recovery and reduced physiological stress include, among others, a positive balance between erythropoiesis and hemolysis, and reduced blood creatine kinase concentrations (Mujika and Padilla, 2003).

Psychological benefits of tapering periods have also been reported in the literature. These include a reduced perception of effort, reduced global mood disturbance, reduced feeling of fatigue, increased vigour and improved quality of sleep (Mujika and Padilla, 2003).

Reduction of the training load

The training load has three well-known components: intensity, volume and frequency of the training sessions. A reduction of the total training load can be performed by individually reducing each of these three variables, or by any simultaneous reduction of these variables. The question that arises is thus: can the training load be reduced by reducing intensity, volume, and/or frequency without falling into detraining during periods of taper? As we are going to see, scientific research can help to answer.

Reduction of training intensity

It has been shown that, in highly trained athletes, maintaining training intensity seems to be the key factor in order to retain the training-induced adaptations and performance during periods of taper. As a matter of fact, a high-intensity taper, compared to a reduced intensity taper, increased oxygen transport capacity, muscle glycogen content, mitochondrial enzymatic activities, force production, hormonal status and performance (Shepley et al., 1992). This has also been confirmed by a recent meta-analysis by Bosquet et al. (2007).

Reduction of training volume

As long as training intensity is maintained, coaches should not be afraid of reducing the training load by reducing the training volume, even with highly trained swimmers. A correlation has been observed between the percentage reduction in the training volume and the performance improvement during taper in national and international level swimmers (Mujika et al., 1995). Moreover, several physiological and performance improvements have been reported as a result of tapers during which the training volume was progressively reduced by 60-90% (Mujika, 1998). A meta-analysis study suggests that training volume reductions of 41-60% would be optimal for performance enhancement, although alternative volume reductions can also have positive effects (Bosquet et al., 2007)

Reduction of training frequency

Results of the literature show that training frequency should be maintained relatively elevated to avoid the loss of adaptations during periods of taper (Mujika et al. 2002a). Highly trained subjects, for whom technique is extremely important, should try to maintain training frequency during taper. This suggestion is also supported by a meta-analysis of the literature. (Bosquet et al. 2007).

Previous training

Computer simulations show that the characteristics of an optimal training reduction in elite athletes depend on the training performed in the weeks prior to a taper. The highest performance gain with the taper should be greater when an overload training is performed by the athletes, i.e. the athletes are overreached. On the other hand, this strategy requires a longer taper duration than when no overload training occurs before the taper (Thomas et al., 2008).

Duration of the taper

Several studies performed on competitive swimmers show that physiological variables such as maximal oxygen uptake or muscular power can be retained, even increased, during tapers lasting between 10 and 28 days. Improved performances have also been reported following tapers lasting 10, 14, 21 and 28 days (Mujika, 1998). However, there is a great interindividual variability in the optimal duration of taper, which depends on the velocities of disappearance of training-induced adaptations on the one hand, and accumulated fatigue on the other hand. In this respect, the above reported mathematical modelling study showed that one week of tapering was optimal for certain swimmers whose fatigue level disappeared rather quickly, but their fitness level faded away quickly too. On the other hand, other swimmers could reduce their training load during 28 days, because having a long-lasting fitness, they could maximise the elimination of fatigue without the risk of detraining (Mujika et al., 1996a). More than ever, it is thus absolutely necessary to individualise training during periods of taper. According to the meta-analysis study by Bosquet et al. (2007), a two-week taper would maximally benefit a majority of athletes, but significant gains can also be achieved with much shorter and also longer tapers.

Type of taper

Researchers have used two methods of reducing the training load in scientific studies investigating the effects of taper: a sudden standard reduction, referred to as step taper, or a progressive reduction, ads implied by the term “taper” (Houmard 1991). The only available study comparing these two methods was performed on highly trained triathletes, and the results indicated higher performance improvements following a progressive taper. The same study also reported

that a fast exponential reduction of the training load was more efficient at improving performance than a slower, more lineal reduction (Banister et al., 1999).

Performance improvements

Performance usually improves by about 3% (usual range 0.5-6.0%) during a successful taper. A recent investigation on the magnitude of performance changes during the final three weeks of training leading to the Sydney 2000 Olympic Games indicated that improvements of this order of magnitude can be expected regardless of gender, event, nationality and calibre (Mujika et al., 2002b).

Conclusions and practical implications

An updated version of the recommendations for optimal tapering strategies provided by Mujika and Padilla (2003) would be:

1. The primary aim of the taper should be the elimination of accumulated fatigue, and to attain additional physiological adaptations or fitness gains. This should be achieved without compromising previously acquired adaptations and fitness level.
2. The maintenance of training intensity is necessary to avoid detraining, provided that reductions in the other training variables allow for sufficient recovery to optimise performance.
3. Reductions in training volume as high as 60-90% have been shown to induce positive physiological and performance responses in highly trained athletes.
4. Even though training-induced adaptations can be readily maintained with very low training frequencies in moderately trained individuals (30-50%), higher training frequencies seem to be necessary to avoid detraining and/or "loss of feel" in the highly trained (>80%).
5. Even though the negative effects of complete inactivity are readily apparent in athletes, positive physiological and performance adaptations can be expected as a result of tapers lasting 4 to 28 days.
6. Progressive, non-linear tapering techniques seem to have a more pronounced positive impact on performance than step-taper strategies.
7. A realistic performance goal based on individual performance levels previous to the beginning of the taper should be an improvement of about 3% (usual range 0.5-6.0%).

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BIOMECHANICS IN SPORT: A CHALLENGE ON PERFORMANCE AND SAFETY

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Abstract

Biomechanics plays an important role in optimising the training quality in elite sport. The areas of applying biomechanics in the training process of elite athletes are very diverse. In the first area those parameters which essentially influence performance have to be analysed. These investigations have to be done during field studies using highly developed kinematic, kinetic and electromyographical measurement systems. The scientific challenges lie in the precision of the parameters determined (accuracy of the measurement system) and in the fact that the athlete should not be interfered severely by the measurement system during performance. The results of such investigations lead to a better understanding of movements used and provide coaches and athletes valuable support in directing training goals.

The efficiency of the training process also depends on the quality of performance tests available. Standardised tests should be built into the trainings process for all performance-relevant features. These tests must satisfy the criteria of objectivity, reliability and validity. In recent years specific test batteries using various high tech measurement devices has successfully been developed at our department.

Especially in seasonal sports like alpine ski racing the quality of training relies to a great extent on the availability of specific training exercises. Specific exercises must be in harmony with those parameters of movement which characterise the structure of competition technique. Most of these exercises can only be performed on specially developed training devices. Both, training exercises as well as training devices have to be evaluated using kinematic, kinetic and electromyographical methods.

Numerous investigations in the area of motor learning and technical training have indicated that suitable feedback systems can significantly contribute to shortening acquisition time. These systems, on the one hand, should measure as exactly as possible the characteristics which are to be improved in training and, on the other, make the measurement results available to the athlete in an easily understandable form and within the most effective ‚PR-KR Interval'.

And, last but not least, biomechanical investigations should also assist the athlete's efforts of optimising the equipment. For example, Alpine skis and the corresponding equipment as bindings and risers are not optimised yet for individuals in ski racing regarding length, shape, stiffness etc. The bases for this optimisation are measurements of the mechanical characteristics of the material in typical and natural skiing conditions. This knowledge is used to optimise the skiing equipment to finally enhance the performance.

Challenges on safety in Alpine Ski racing

In recent years many dramatic changes have taken place in Alpine skiing. In ski racing as well as in recreational skiing skis have become much shorter, their side cut has increased to a great extent and binding plates (risers) have been fixed between the ski and the binding. In addition the stiffness of the ski has changed, too. This evolution has, of course, also changed the movement patterns of performing ski turns but might also have changed the risk of sustaining injuries. The aim of skiing with carving skis on a competition level is to perform turns with a small turning radius without any skidding. The turning radius depends on the side cut radius of the ski, the edging angle and the stiffness of the ski and the piste. The smaller the turning radius and the higher the speed the bigger becomes the skier's load. Skiing turns with small radii on high speed might exceed the skier's physiological capacity soon. The more strongly waisted the ski and the greater the on-edge angle the more strongly the ski must flex in order to maintain contact with the slope along the total length of the edge. The curve cut into the snow under full contact with the slope is designated the turn radius (Fig. 1).

The use of carving skis with binding plates also increases the probability of catching an edge. The higher the risers between the ski and the binding the smaller edging angle is needed to initiate the catching of an edge and due to the smaller side cut radius of the ski the distance of the lateral deviation from the intended skiing direction becomes too big within a short period of time and therefore makes a successful correction movement impossible. The binding plates are also considered to increase the acting moments in the knee due to the lengthening of the lever arms of the lower leg. As a consequence of these findings the F.I.S limited the maximum standing position for ski racing.

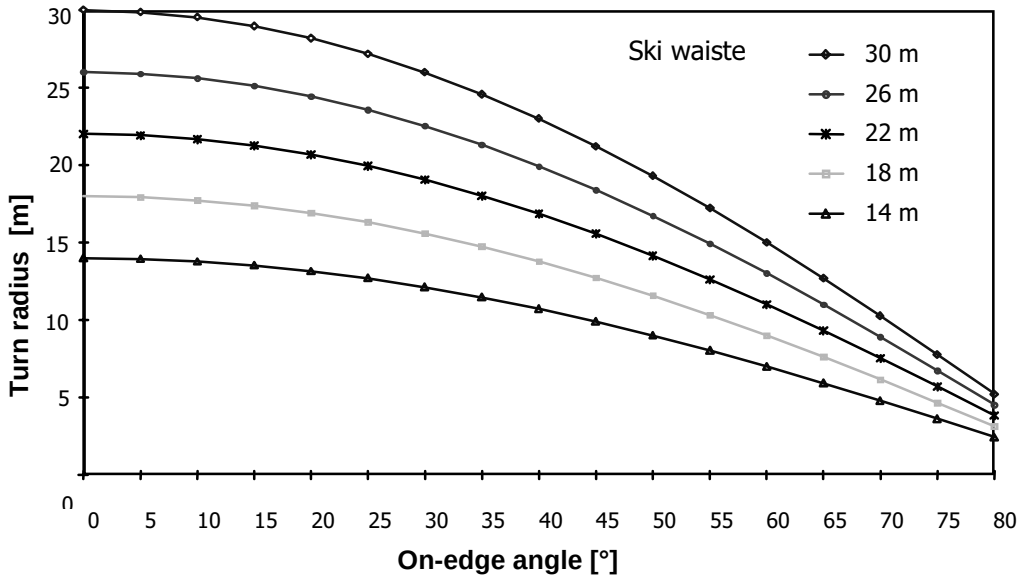

Fig. 1. Turn radius as a function of on-edge angle for variously waisted skis

Key words: *biomechanics, challenge, performance, safety*

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FROM KINESIOLOGY TO KINESIOLOGY 1854-2008: LOOKING BACKWARDS TO LOOK FORWARDS

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Abstract

The Swedish gymnasiarch C.A. Georgii used the term kinesiology in 1854, three years before N. Dally published his magnum opus *Cinésiology* in 1857. Georgii and Dally had been rivals in 1847 in Paris when they were both in competition, trying to introduce their gymnastics method in the French School system. Neither one of them succeeded to do so because of the February Revolt of 1848. The term and concept of kinesiology was introduced in the United States by the Swedish gymnasiarch N. Posse in 1886 but from 1909 onwards it would be narrowed to 'movement analysis'. Kinesiology was used in the U.S. in this narrowed sense untill the term biomechanics made its breakthrough in the 1970ies to indicate the domain of the mechanics and analysis of movement. At the same time proposals were made to use kinesiology to replace the well established term of physical education as the umbrella term for the science of human movement. In 1993 the prestigious American Academy of Physical Education (AAPE) changed its name into American Academy of Kinesiology and Physical Education (AAKPE). In the same period, a plethora of new terms appeared in Europe to replace physical education at the academic level: sport science(s), movement science(s), motor science(s), physical activity science(s), kinanthropology and kinesiology. The University of Zagreb was the first one to rebaptize its Physical Education Faculty into Faculty of Kinesiology. The K.U.Leuven did so in 2004 when the Faculty of Physical Education and Physical Therapy changed into Faculty of Kinesiology and Rehabilitation Sciences. It is noteworthy that Georgii, who first used the term of kinesiology in 1854 had already used the term kinesitherapy in 1847. Why did it take more than one and a half century before Georgii's neologism kinesiology was rediscovered as an appropriate and international common denominator for the science of human movement and humans in movement?

Key words: *kinesiology 1854-2008, looking backwards, look forwards*

ADVANCING SWIMMING SCIENCE WITH CARE

Ross H. Sanders, Stelios G. Psycharakis, Roozbeh Naemi and Carla B. McCabe

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Abstract

This paper provides an overview of how the research team at The Centre for Aquatics Research and Education is adding to knowledge in swimming science to assist swimmers and swimming coaches. Topics covered include improving the glide in starts and turns, body roll in front crawl, technique differences between sprint and distance front crawl swimmers at sprint and distance pace, and rhythm in front crawl swimming.

Key words: *body roll, front crawl, passive drag, rhythms, swimming*

Introduction

The Centre for Aquatics Research and Education (CARE) was established in 2001 with a mandate to conduct applied research in aquatic activities including swimming and hydrotherapy. This presentation focuses on recent findings in swimming and includes work from three recent graduates from the doctoral programme. Roozbeh Naemi has developed a new method of quantifying the passive drag of swimmers and, as a postdoctoral fellow during the past year has developed 'coach-friendly' software to assist coaches and swimmers to improve their glide performance in starts and turns. Using three-dimensional analysis techniques Stelios Psycharakis has shed new light on the characteristics of body roll in front crawl swimming. While there is some knowledge about how swimming technique differs between swimmers swimming at sprint and distance pace not much is known about whether specialists in sprint swimming differ in technique from distance swimmers when both groups are swimming at race pace over the same distances. In addressing this issue Carla McCabe has uncovered some very interesting as well as some surprising findings. The presentation concludes with a discussion of recent findings with respect to the rhythms and 'body waves' that underpin coordination in skilled front crawl swimming.

Improving glide performance in starts and turns

Performance in starts and turns is a major contributor to success in swimming and is influenced greatly by the glide performance. It has been established that the glide time after starts and turns corresponds to 10 to 25 percent of total swim time (Chatard et al., 1990). Glide performance depends on the initial velocity of a glide as well as on the glide efficiency, defined as the ability of a body to maintain its velocity and to avoid deceleration (Naemi and Sanders, 2008b).

The initial velocity of a glide is related to the preceding action, and is affected by propulsive force development during pre-glide actions such as pushing off the wall in turns. Increasing the initial velocity of a glide by increasing propulsive force during the pre-glide phase can improve the glide performance. However, it does so with a metabolic cost and is limited by the athlete's strength. In contrast, maximising glide efficiency (minimising resistance and/or maximising inertia) improves performance without increase in the metabolic cost. A 20% increase in glide efficiency during passive glides achieved by adopting a 'streamlined' posture leads to a 7% increase in the average speed. Depending on the race distance, in which the number of turns varies, this can yield a 0.5 - 3% improvement in the race performance. Such an improvement can change a swimmer's result from being eliminated prior to the finals to being a medallist. Improving glide efficiency enables the swimmer to increase time in the passive glide phase after starts and turns, thereby increasing the period of recovery and reducing the period of active swimming. Thus the knowledge of the factors contributing to glide efficiency and the ways to quantify it are of utmost importance.

The methods used in previous studies (Sharp and Costill, 1989; Starling et al., 1995) do not allow quantification of the glide efficiency at different velocities and do not relate the glide efficiency to the hydrodynamic characteristics of a body. The Hydro-Kinematic Method (HKM) (Naemi and Sanders, 2008b) accounts for the inertial and resistive characteristics of the gliding body. A mathematical function, based on the equation of motion of the gliding body, is fitted to the kinematic position-time data of a swimmer performing a rectilinear glide. From the fitted function a glide factor that represents the ratio of inertia to the resistive factor is deduced that is a measure of the glide efficiency.

The HKM requires only a single underwater camera positioned perpendicular to the swimmer's glide plane and two-dimensional digitising software. This method has advanced the capability of measuring glide efficiency and has been

shown to be accurate and reliable enough to detect small differences in glide efficiency. Figure 1 provides samples of the output of the model together with indications of the goodness of fit and its ability to detect differences in gliding ability between subjects and between trials within subjects.

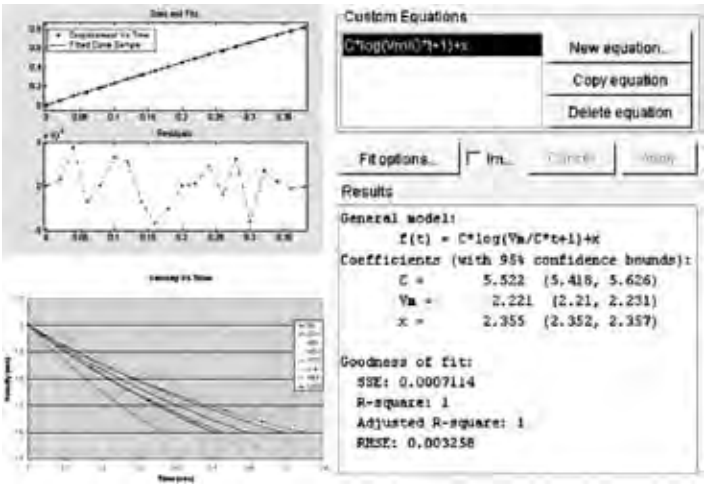

Figure 1. Sample output of the of the HKM. From top left clockwise, raw displacement data and the corresponding fit together with the plot of the residuals; the mathematical model and the quantified parameters obtained for each trial; and the reconstructed velocity Vs time for the subjects.

The development of the HKM provides an opportunity, for the first time, to 'fine tune' swimmers' glide efficiency by adopting the most streamlined position. Many swimmers adopt inappropriate postures during glides. Flow separation, resulting from an excessive angle of attack, increases the 'pressure drag', the main source of drag during an underwater glide. Adopting a body alignment with a minimum angle of attack and maintaining an appropriate posture with suitable joint angles minimises the pressure drag by reducing the area exposed to the flow as well as the flow separation associated with water moving over 'non-streamlined' body contours. Special attention needs to be paid to the neck, hip and knee angles which were found to be significantly correlated to the passive drag and hence the glide efficiency (Naemi, 2007).

It has been established that maintaining a passive streamlined posture at higher velocities than a critical value is more beneficial than an active propulsive movement (Sanders and Byatt-Smith, 2001). This is due to the fact that in these conditions the net decelerating force (the difference between the active drag and the propulsive force) is greater than the passive drag for a gliding position (Lyttle, et al., 2000). This has important implications as a swimmer can lose speed unnecessarily if the passive glide is finished prior to or continued beyond an optimum speed. In these cases, additional energy and time is required to regain the optimal velocity. Thus, it is beneficial to predict the speed at which a swimmer with a particular glide efficiency and post-glide velocity characteristics should commence the propulsive actions (Sanders and Byatt-Smith, 2001). This not only improves performance in the starts and turns but also avoids losing energy unnecessarily, improving performance in the mid-pool phases. Thus it is highly desirable to predict how performance may be optimised by initiating the post-glide phase at the best time. This means that an accurate record of instantaneous velocity during the glide is required in actual un-tethered glides. It is possible to determine the instantaneous velocity of a body during the whole period of a glide by video analyses. However, due to variations in the velocity as a result of instabilities in flow (Howe et al., 2001; Wang et al., 2003) that cannot be distinguished from noise, the determined instantaneous velocity data may not be valid for comparison (Klauck and Daniel, 1976; Naemi and Sanders, 2004). The HKM overcomes that problem by fitting a mathematical function to the raw displacement data enabling precise reconstruction of the velocity variations of the body during a glide (Fig.1). By knowing how the glide efficiency of a swimmer changes across velocities, it is now possible to determine how fast they decelerate during a glide. This information is particularly important in predicting the exact timing for initiating the post-glide action for a particular swimmer with a distinct glide efficiency and post-glide performance. For example for each swimmer the glide should end when the velocity reaches the velocity which can be sustained by the post-glide actions.

Based on the applications of the Hydro-kinematic method (Naemi and Sanders, 2008b) 'user friendly' software named "GlideCoach" has been developed (Naemi et al., 2008) for coaches to provide immediate feedback to swimmers to optimise glide efficiency and time of initiating post-glide actions in starts and turns. The output includes a video replay, graphs, and tabulated results in an aesthetic and effective display. The 'GlideCoach' software enables coaches to 'fine tune' swimmers' streamlining posture as well as to optimise timing of initiating post-glide actions.

Recent findings from three-dimensional analysis of body roll

It has been suggested that body roll, the rolling action of the trunk around its longitudinal axis, has important functions in front crawl swimming. Such functions include: making the recovery of the arm easier and permitting a shorter radius of rotation of the recovery arm; placing the strongest part of the arm pull more directly under the midline of the body; facilitating the breathing action and; reducing the risk of developing shoulder injuries (Counsilman, 1968; Richardson et al., 1980; Ciullo and Stevens, 1989).

Computer simulation studies have indicated that body roll assists in the development of propulsive forces and, therefore, the improvement of swimming performance (e.g. Hay et al., 1993; Payton et al., 1997). In most empirical studies body roll was measured for the whole trunk by mounting a balsa wood fin on a curved aluminium base and strapping it on the back of each swimmer. Body roll was then defined as the angle between the rear end of the fin and the vertical, and was measured with the use of two-dimensional analysis. Some interesting findings were reported in these studies. For example, it was shown that swimmers roll more during breathing than non-breathing cycles (Payton et al., 1999; Castro et al., 2003), and that they roll less to the non-breathing than the breathing side. Also, body roll was found to decrease with increasing swimming speed (Castro et al., 2003; Yanai, 2003). Nevertheless, there has been evidence that the assumption that the whole trunk rolls as a rigid segment might not be tenable, because the shoulders and hips might roll to different extents and in some cases with different phase (Cappaert et al., 1995; Yanai, 2003).

In an attempt to improve our knowledge of body roll and its possible links to swimming performance, Psycharakis et al. (2007) used a 6-camera system and three-dimensional analysis methods to calculate separately the rolling actions of the shoulders and hips in freestyle swimming. It was indicated that swimmers were rolling their shoulders significantly more than the hips. Moreover, faster swimmers were found to have less shoulder roll than slower swimmers, while no similar trend was identified for hip roll. Figure 2 shows the roll-time profiles of the shoulders and the hips for one of the swimmers tested. The profiles were clearly very different in terms of the magnitude of SR and HR.

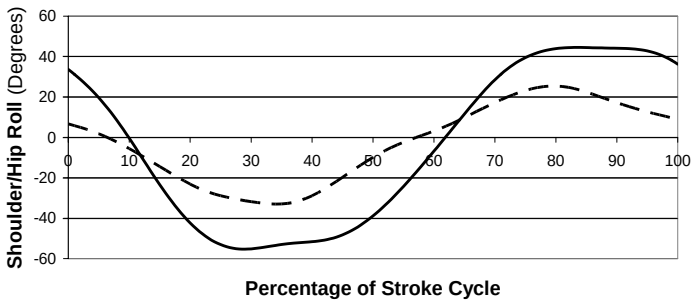

Figure 2. Patterns of shoulder (continuous line) and hip roll (dashed line) for a freestyle swimmer. Positive and negative roll values represent roll to the right and left side, respectively. (Adapted from Psycharakis et al., 2007).

Further to the above, Psycharakis (2006) examined the bilateral asymmetries in shoulder/hip roll, as well as the timing differences for the peak shoulder/hip roll at each side. Eleven national and international level swimmers performed a maximum 200m freestyle swim and four stroke cycles were analysed (one for each 50m). Left side dominance was identified in shoulder roll, while no similar pattern was found for hip roll. Given that all the swimmers tested were right-handed, Psycharakis suggested that factors related to handedness might affect the roll symmetry in freestyle swimming. Finally, despite the inter-individual differences in the timings between shoulder and hip roll peaks in each side, there was no consistent pattern to suggest that the swimmers' shoulders lead the hips or vice-versa. The results of the three-dimensional analyses indicated that shoulder and hip roll should be calculated separately in freestyle swimming.

Do sprint and distance front crawl swimmers differ when swimming at the same pace?

Many authors have proposed that sprint and distance front crawl swimmers differ in their stroke characteristics. However, there has been a paucity of three-dimensional quantitative data to support these assumptions.

Some research has indicated that sprint and distance swimmers differ in terms of the magnitude of stroke depth (Cappaert, 1998), stroke width (Colwin, 2002), elbow angle (Wilke, 1992; Cappaert, 1998; Voronstov and Rumyantsev, 2000) and the foot range of motion (Cappaert, 1998). However, in the recent study by McCabe (2007) sprint and distance swimmers did not differ with respect to the aforementioned variables when both swim at race pace over the same distance. Thus, these findings challenge current views with regard to front crawl sprint and distance swimmers.

McCabe did find some differences with respect to other variables. Sprint and distance swimmers are different with respect to the duration of the pull (Figure 3) and push phases ($p<0.05$) (Figure 4). The shorter duration of these phases

by the sprint swimmers was linked to a faster horizontal velocity and vertical acceleration of the hand by the latter group within the pull and push phases.

Sprint and distance swimmers had a different sequencing pattern of the shoulder and hip segments - a characteristic not previously investigated. When sprinting, both sprint and distance swimmers rotated the hips prior to the shoulders. The sprint group showed this sequencing pattern distinctively throughout the stroke cycle, whereas was less pronounced with respect to the distance group.

This altered sequencing of the shoulders and hips between groups when sprinting may also explain the differences found between groups in terms of maximum shoulder roll (both sides) with the sprint swimmers obtaining maximum shoulder roll later in the stroke cycle than the distance swimmers when sprinting (Figure 5), perhaps due to a greater time delay between the shoulder and hip segments rotating.

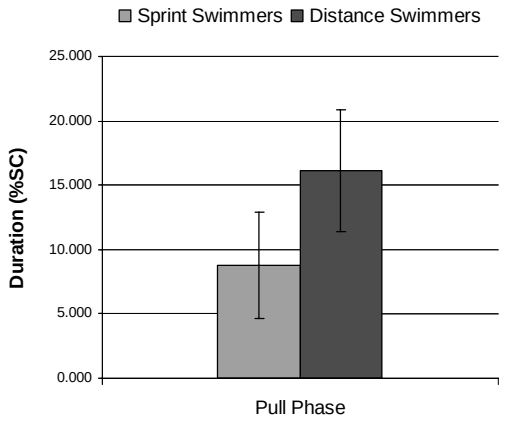

Figure 3. Shorter duration of the pull phase by the sprinters than the distance swimmers when sprinting.

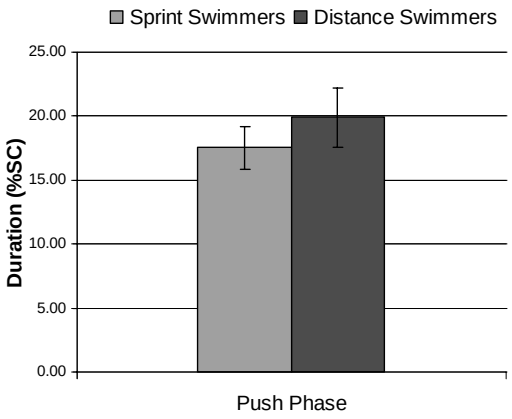

Figure 4. Shorter duration of the push phase by the sprinters than the distance swimmers when sprinting.

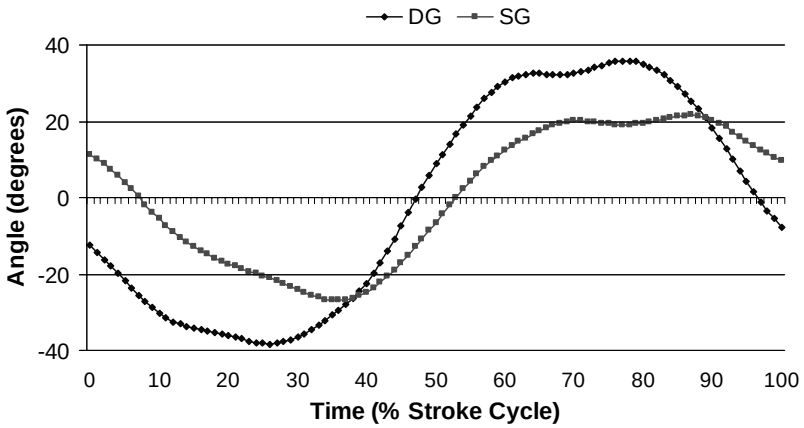

Figure 5. Mean shoulder roll angle for distance and sprint groups. The difference in time of attainment of maximum roll to each side is evident.

When distance swimming, the distance group rolled the shoulders in advance of the hips, whereas the sprint group rolled the shoulders and hips simultaneously. There was some evidence that the different sequencing order of the shoulders and hips between the groups was related to the range of motion of the kick.

Irrespective of the distance specialisation, all swimmers changed a broad range of kinematic and kinetic variables between sprint and distance pace. The magnitude of average vertical and lateral range of the finger's displacement changed between paces (Figure 6), with evidence of a link to the adjustment of shoulder and hip roll magnitude between paces.

The elbow angle at the conclusion of the backward push was the only elbow angle variable to change between paces (Figure 7) and it is unlikely that the elbow angle contributed to the altered trajectory of the finger.

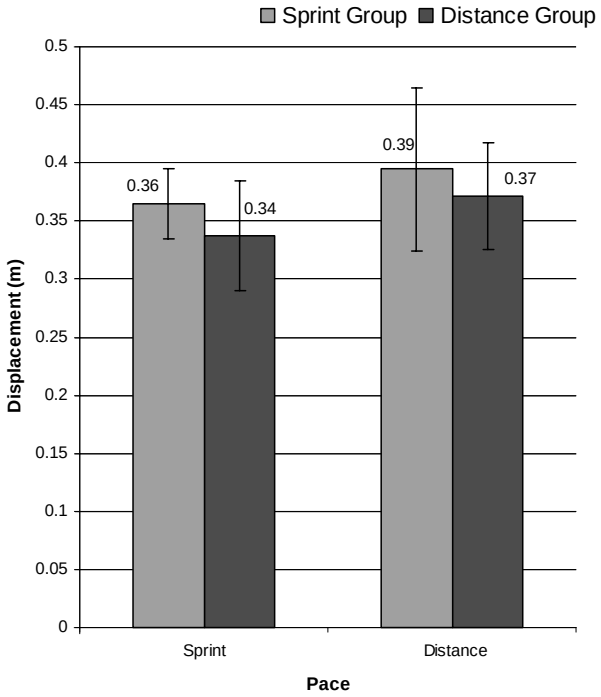

Figure 6. Average vertical displacement of the finger throughout the underwater stroke phase: Sprint group vs. distance group.

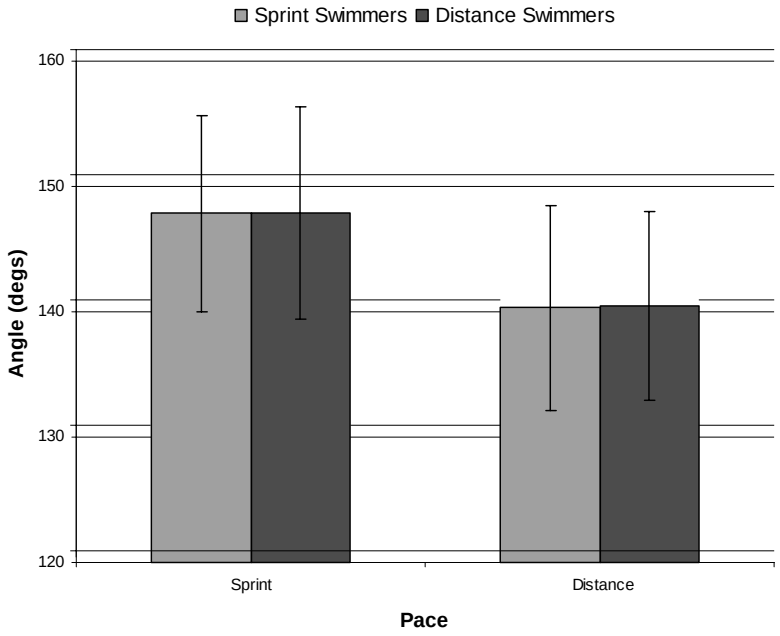

Figure 7. Comparison of elbow angle at the end of the push at sprint and distance paces. Both groups had a greater angle when sprinting.

The temporal aspects of the stroke trajectory also changed between the paces, primarily due to the varied duration of the entry phase. Specifically, the duration of the entry phase was approximately 10% longer when swimming at distance pace relative to sprinting. Maximum stroke depth and the execution of the catch position were both attained 10% later in the SC when distance swimming (Figure 8). Contrary to the extant literature, the catch position did not differ between swim groups, but did change between swim paces. This finding challenges the existing knowledge of the catch position and requires further examination.

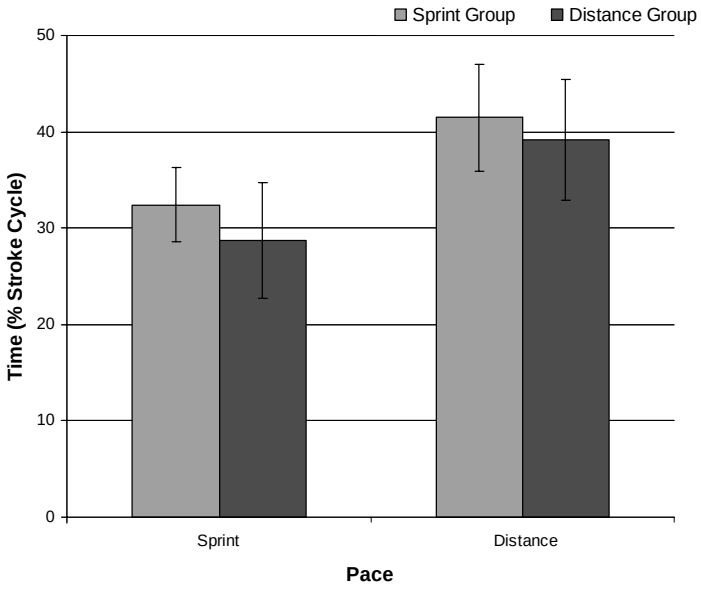

Figure 8. Time (% SC) corresponding to the catch for both swim groups, swimming at sprint and distance pace.

Finally, foot ROM changed between sprint and distance paces. Adrian et al. (1966) suggested that this occurs due to the energy requirements of the race distance. The magnitude of hip and shoulder roll appeared to be strongly influenced by the contribution of the leg kick between paces (Figure 9 and 10).

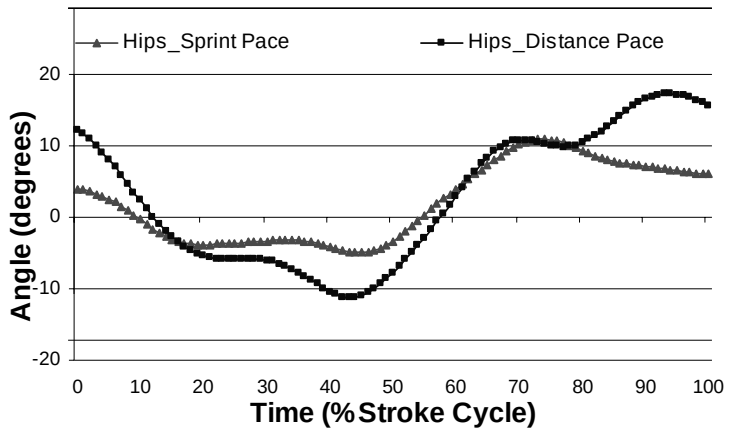

Figure 9. Time (%SC) to maximum left (negative) and right (positive) hip roll for the SG.

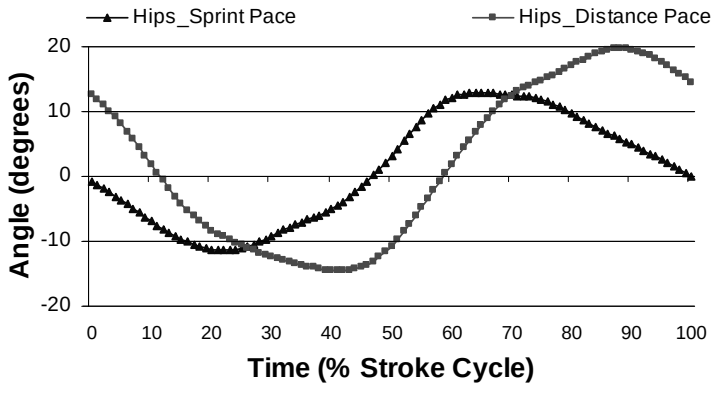

Figure 10. Time (%SC) to maximum left (negative) and right (positive) hip roll for the DG.

Rhythm in front crawl swimming

Athletes and coaches frequently use the term 'rhythm'. If rhythms are regarded as being represented by sinusoidal waveforms, an assumption that fits well with dynamical systems theories of movement control incorporating limit cycle oscillators (e.g. Kelso, 1995), then Fourier analysis is a powerful tool to quantify rhythms. Fourier analysis represents any time series data, for example a displacement/time signal, as a series of waveforms. Each waveform (harmonic) is an integer multiple of the fundamental frequency. For example, if the fundamental frequency is 1hz, then harmonics occur at 2hz, 3hz…nhz. Fourier analysis determines the amplitude of each of those contributing waveforms and the 'phase', that is, the timing of when the peaks of the wave are attained.

To investigate the complex situation of the whole stroke that incorporates a roll about the long axis three-dimensional data were obtained from seven adult squad level swimmers simulating a 200m race (Sanders and Psycharakis, in press). The upper body roll consists of a roll to either side, that is, a two beat pattern with one maximum and one minimum. Each arm action is likely to produce a maximum and

minimum torque about the longitudinal axis. Given that there are two arm actions this may produce a four beat pattern with two maxima and two minima. As its name implies, the six beat kick consist of three upbeats and three downbeats of each leg that are out of phase thereby producing three maxima and three minima. In the full front crawl stroke, rather than being confined to a vertical plane as in flutter kicking without upper body roll and arm action, the lower limbs scribe an arc and their motion can be regarded more appropriately as a rolling action about the longitudinal axis. Thus, it is possible that the resultant waveforms associated with the rolling actions of the whole body comprise two beat, four beat, and six beat influences and, if very rhythmical in nature, may be reflected in three sinusoids represented as Fourier harmonics, these being the fundamental frequency (H1) with one maximum and one minimum, the second harmonic (H2) with two maxima and two minima, and the third harmonic (H3) with three maxima and three minima.

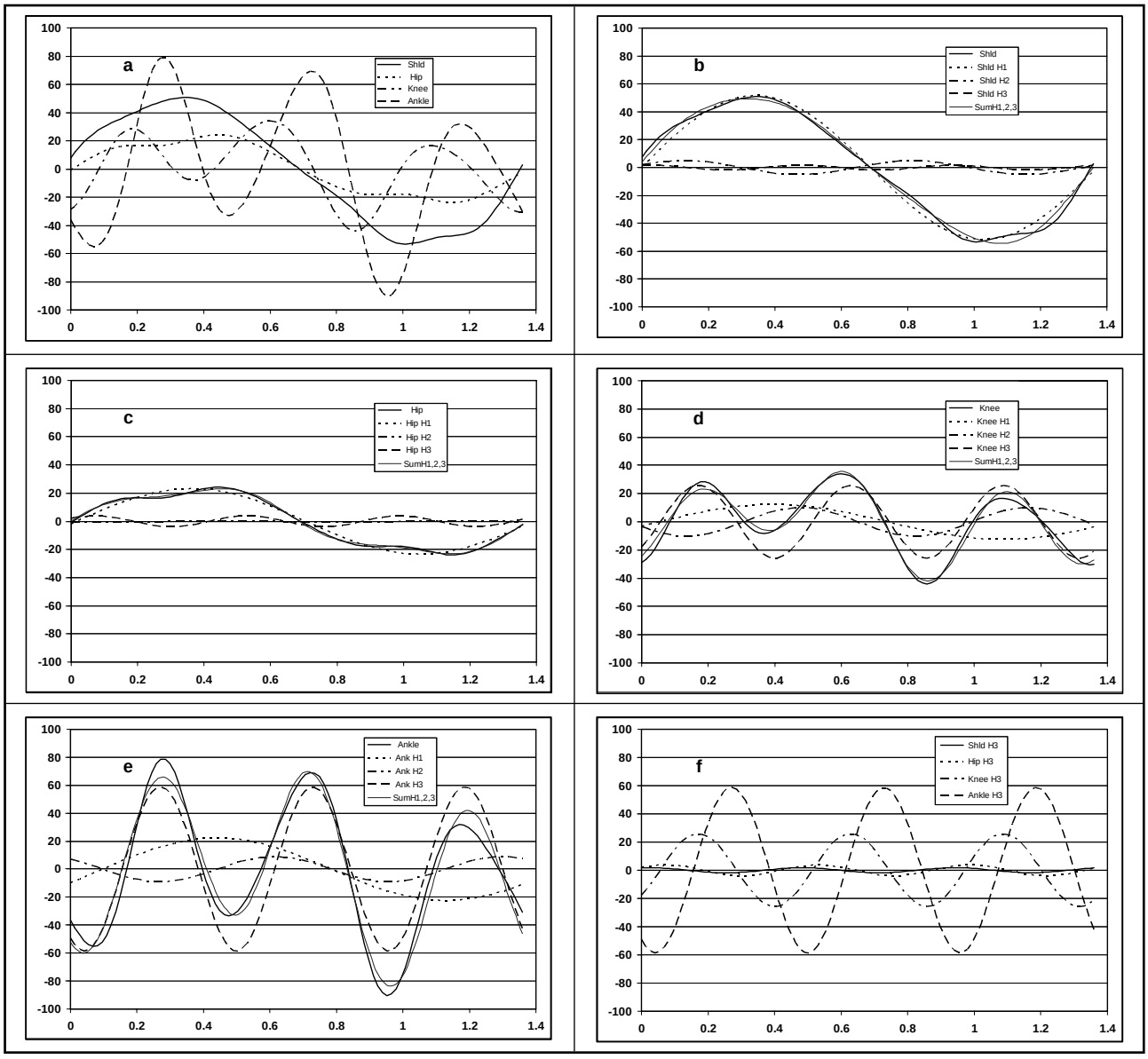

Figure 11. Rotation about the longitudinal axis (degrees) plotted against time (s) for one cycle of the best swimmer (S1) of a) shoulder, hip, knee, and ankle; b) shoulder and its H1, H2, and H3 contributions and sum of H1, H2, and H3; c) hip and its H1, H2, and H3 contributions and sum of H1, H2, and H3; d) knee and its H1, H2, and H3 contributions and sum of H1, H2, and H3; e) ankle and its H1, H2, and H3 contributions and sum of H1, H2, and H3; f) H3 of shoulder, hip, knee, and ankle.

Figure 11 shows the rotations about the longitudinal axis of the shoulders, hips, knees, and ankles, and the contributions of the H1, H2, and H3 harmonics for the best swimmer. Figure 11a shows that the shoulders rolled approximately 50 degrees to each side while the hips rolled only 22 degrees to each side. The amplitude of roll increased at the knees and reached about 80 degrees to each side in the ankles. Figures 11b to 11e show the contribution of the harmonics to the rolling action of each body part. The shoulder roll was very rhythmical with approx 98% of the power contained in a

single sinusoid corresponding to the frequency of the stroke cycle. It is largely unaffected by the kicking action. The hip roll is also dominated by H1 but there is some of H3 in reaction to the kicking pattern. The roll of the lines joining the knees is predominantly H3 due to the six beat kicking action but also contains considerable power in H1 indicating the influence of the upper body roll. The same applies, but to a lesser extent to the ankles. While the roll is dominated by H1 and H3, the power contained in H2 in the knee and ankle roll is not insignificant. It is due to the effect of the arm action occurring twice, that is two arm pulls, per cycle.

Only the H3 wave is transmitted in a consistent manner. The very high wave velocity for the H1 wave from shoulder to hip indicated that the shoulder and hip roll were almost exactly in phase. In contrast, the much slower wave velocity for H3 from hip to knee and from knee to ankle indicates a sequencing of the lower limb actions such that the H3 wave is transmitted in a cephalo-caudal direction. The sequencing is indicated by the differences in the times at which the H3 waves reach their peak for the hips, knees and ankles (11f). Small within and between subject variability in wave velocity indicated that this rhythmic pattern is characteristic of skilled front crawl swimmers using a six beat kicking pattern. The moderate H3 wave velocity, accelerating as it moves caudally, is consistent with the effective production of propulsion observed in marine animals (Sfakiotakis et al., 1999).

Figure 12 shows the velocity of the H3 wave from hip to knee (a) and from knee to ankle (b) for each of the four laps for each of the seven swimmers analysed. The four best swimmers had slower wave velocities than the other three swimmers. This in interesting in view of research with marine animals in which wave velocities of the caudal fins of the animals is only slightly faster than the swimming speed reflecting great efficiency (Sfakiotakis et al., 1999). The slight increase in wave velocity from knee to ankle relative to hip to knee among the best swimmers is in keeping with the goal of generating propulsion in an efficient manner.

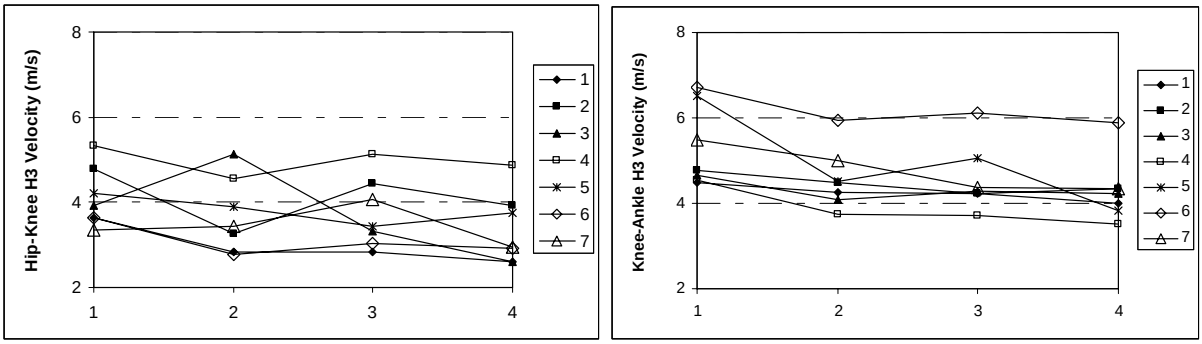

Figure 12. Line graphs of a) hip-knee H3 wave velocity and b) knee-ankle H3 wave velocity for each swimmer. Swimmers are ranked from fastest (S1) to slowest (S7).

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SPORTS MANAGEMENT - A MODEL OF PROFESSIONAL DIVERSIFICATION IN SPORTS SCIENCES STUDIES

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Abstract

Based on a historical analysis of the construction of sports sciences in France, the creation of degrees in Sports Management, about twenty years ago, appears as a successful example of professional diversification. This subject, numerically the most important, is built upon three skill domains, science, management and sport. The case study of the Sports Sciences Faculty of Lille will make it possible to highlight the objectives and the training programmes that we are to analyse today. The consideration of the possibility of a European model will allow us to identify the strengths and the weaknesses of the current training programmes.

Key words: *sports management, sports studies*

Introduction

The sports management courses are historically quite recent into the French academic system, as well as anything connected to sports economy, or should I say anything related to the image that French sports have developed throughout the 20th century: sports are pure whereas money is wicked; sports would be merely based on three pillars: amateurism, voluntary work, and associanism. The associations must only work thanks to money coming from the memberships and public funding, subsidies given by public authorities is the name of public services. Professionalism is no more than a historical incident which shouldn't be the subject of too many conversations, and the relationships between sports and politics are nothing but vague opinions or disparagement. However, when dealing with sports in France, one should keep some basics in mind: it's under Charles De Gaulle's presidency that the Ministry of Sports was born in 1965. France is not only one of the rare countries to have such a ministry but it's also the country that is employing the more civil servants for that ministry in the world. It's still De Gaulle that did what had to be done for France to obtain the Olympic Games in 1968. When in the late 80's, a French businessman called Bernard Tapie took the lead of the Olympic Club of Marseille, he increased the salaries in an incredible way and improved the structure of the club to bring it to the best European level. He was criticized and disparaged, and the case was brought before the courts. Indeed, even if he had done a good job, he had forgotten than in sports as in business ethics matter and corruption is illegal, at least when it comes into light...

Thus, French sports have entered an era of professionalization, of show business and merchandizing, and therefore of management, but this new direction was to be taken lately and reluctantly. When I wanted to start a thesis dealing with sports economy in 1979, there were absolutely no supervisors interested in this subject and I've been the second one in France to produce such a thesis in 1982. This particularity even brought about some difficulties for me to find a job at the university. And from the study of sports economy to the one of sports management, a huge step was still to be done as it meant a shifting from theoretical aspects to studies leading to concrete activities. Ten years have been necessary to walk this step. When in 1999 the sports sciences faculty of Lille offered me a job aiming at stimulating the management course that was ending with the management Master of the time -which corresponds to nowadays Licence, or 3 years of studies-, I found out that for the teachers of this faculty management courses only consisted in asking the students to organise a few local or regional events. The courses were given by physical education teachers who tried to turn into management but who had no real training in this domain.

That's why I'm going to use my personal experience to talk about sports management in France, with several parenthesis to analyse what is or has been done in other countries.

Brief history

An analysis of sports management cannot be understood without a brief reminder of the birth of sports sciences in France. This can be summarized in three periods:

The foundations of physical education: After the setting up of the first training centres for executives in gymnastics in schools ((Ecole de Joinville) during the 19th century and the Teacher Training Colleges (Ecole Normale) in Physical Education, the first regional institutions of P.E. were created as part of faculties of medicine in 1927. In the awakening of the events of May 1968, the following year a reform law concerning higher education transformed the centres known as Instituts Règionaux d'Education physique et sportive -the sport education local institutes- (IREPS) into ones known as Unités de Formation et de Recherche en EPS -physical education research and training units. The first real university faculties started in 1975, with the creation of what is known in France as DEUG STAPS, a two year university diploma in sports sciences. A three year degree came into being in 1987 and it became possible to do a PhD in sports sciences in 1993. So in a century the situation shifted from a solid professional training in P.E. to a system of university studies in the Sports Sciences. But those training places were only meant to produce physical education teachers who, under certain circumstances, could become federations' executives and could be sent by the ministry to the different federations to become national coaches, for instance. People coming from these trainings who had passed the CAPEPS -the diploma needed to become a physical education teacher- or who were holders of the agrégation constituted the elite of the profession as the exams permitting to obtain these diplomas were particularly selective.

The physical education faculties have only been created with such teachers, who had been trained to work in high schools, not in universities. Some of them resumed their studies to pass a thesis, still with the goal of coaching or becoming a physical education teacher.

The strong growth and the diversification of the first university training programmes:

The second period was marked by the impressive increasing of the number of students following the suppression of the competitive entrance exam which acted as a barrier during the mid nineties (3 times more students; 45,000). Catering for the new numbers made it necessary to diversify the offer of training programmes. The latter were based on 4 different axes; teaching, coaching, management and supervising physical activities for the disabled and the elderly. A 5th axis which had trouble asserting itself was sports ergonomics. Each of the aforementioned axes targeted a particular employment sector, and corresponded to a training program as well as a specific research.

When I arrived in Lille sports faculty there were about 70 teachers but only 10 of them or so were real university teachers, the others being mere high school teachers working for the university.

It is easy to understand that these teachers weren't very open to changes and reforms. The research was also highly limited for those teachers' status didn't take into account this aspect of their job in a faculty. Things began to change about ten years ago when the university hired several teachers and researchers that were external to the STAPS, such as economists, sociologists and the like.

The management course has been created in the early 80's. It first interested students who didn't want to become or failed to become sports teachers. From the 1990's onwards job openings developed and sports management studies became efficiently structured. It wasn't until year 2000 that Sports Sciences Faculties employed teachers / researchers to meet the increasing demand in this sector. The creation of research teams in Management strengthened this line of studies.

The why of the management department was -and still is- quite difficult to understand for some people. One of my colleagues told me recently that for her, a department in which there were no sports activities was totally unconceivable in a STAPS faculty. People like physical education teachers as well as people issued from the association sphere, such as heads of clubs, leagues or federations, who are very often former sportsmen, were considering this department very badly as it corresponded to everything they hated -a harsh management, professionalization and changes in the administration's requirements. Actually they were convinced that it would bring a loss of sports values, mainly amateurism. They hung on several values corresponding more or less to the way sports were practised in the sixties whereas the number of people practising a sport, whether they were club members or not, was unceasingly increasing, as well as the number of sports that could be practised, with the arrival of new disciplines that could be practised outside the stadiums, sliding or gliding sports, etc..., each one constituting a new market. The federal world first rejected these new kinds of sports without taking into account the expectations of the ones who were practising them, who were far from the competition spirit but on the contrary wanted to return to pleasure and conviviality. It was necessary to get out from the logic of earning money through sport practising and to enter the one of making money with sport; that is, in other words, to transform sports events and clubs into companies, to link together the different players which are the sports events' organizers, the sponsors, the advertisers and the medias, to use the sportsmen's image and popularity and to bring sports amateurs to spend more money for their hobby and the consumers to consume more and more, sports becoming a perfect conveyor of communication.

Whereas the defenders of a rigid kind of sport, far from the realities of our contemporary society, were leading a battle that we could qualify of "old-fashioned", in the meantime the reference organism for world sports, the IOC, was becoming the organiser of several interesting events economically speaking, especially with the arrival of Juan Antonio Samaranch. It was using sponsoring and marketing methods directly inspired from the companies' universe. In the same time, in the sphere of professional sports, vast amounts of money generated by TV broadcasting rights were circulating

and very high salaries were paid within the legal framework of the associations, whose status weren't corresponding anymore to the extent they were taking. I'd like to catch your attention on the crucial role filled by money provided by the media, for I will talk about this close link between sports and media later. Sports advertisings were multiplying, as well as the turnover of sports equipments producers and sports articles distribution companies who diversified their products, adapting to those new markets or stimulating the old ones. The same phenomenon happened for many structures such as private fitness companies, wellness centres, etc...

One can easily understand that nobody had been trained to fulfil the needs generated by those developments.

The current situation, between return and consolidation; professionalization

Following the diffusion of alarmist information concerning the absence of job openings in the sector concerned, the number of enrolling students has been falling since 2004. Sports sciences faculties in France have also had to face up several reforms changing the duration of studies to the pan European system of three, five and eight years (Licence, Master, Doctorat). And today there is a new reform of university renovation. The universities are now preoccupied with the professional insertion of their students (see the CEREQ studying 2005 which indicates that 85% of students who obtain a three-year sport sciences degree have a permanent job six months after the end of their studies).

In the meantime, there has been an evolution in sport's legal standards. When the organizations in charge of sports events reach a precise turnover or come to distribute a certain amount of salaries, they are obliged to create a structure which is very close to the one of a company. Furthermore, more and more rules and controls concerning these associations are appearing whereas their subsidings are stagnating or decreasing. On the national as well as on the international level, everything is progressively setting for the development of professionalism in sports, even for the executives of amateur clubs welcoming mainly people practising sports as a simple leisure. These new rules and structures correspond to the evolution of elite sport (rugby's professionalization, the recognition of professional athletics, etc...), to an increasing taste for sports in every industrialised country, the multiplication of elite and mass events, the proliferation of sports broadcasts on TV and of new TV channels entirely dedicated to sports, the proliferation of private funds in the organisation of these different types of events, the proliferation of events created by private corporations having barely any link with the actual federations, and the possibility for a number of organisms to bring pressure to bear on the federations. Let's take some examples: in formula 1, the different teams had threatened the international motorsports federation to build their own racing circuit. In cycling, the organisers of recognised competitions had refused to adopt the new system put up by the international cycling federation and its project to build up a closed league.

Sports management studies have really been introduced very lately in the physical education and sports sciences faculties.

Sports Management Studies

In the beginning, all the students issued from the sports management courses and having done three years of studies were all coming from the STAPS training. They could find a job in the framework of some sports events, but more often in every kind of companies who believed that their management training was perhaps not totally achieved but sufficient enough for the kind of missions they were given. Moreover, they reckoned that these students had a very interesting way of thinking due to their sports-like mind which brought them more easiness to work in teams and to produce many efforts when necessary.

We can say that two sorts of markets were accessible to the sportsmen-managers: the sports universe, and the business sphere -whether it was based on sports or not. In a world where sports are a crucial element socially and economically speaking, the faculties couldn't stay away from this phenomenon.

There has been simultaneity between the reinforcement of the faculties' courses, with improved diplomas requiring five years of studies, and the creation of courses about sports management in business schools. A sort of rivalry grew up between those two types of training, the former being a public one with very low fees -300 Euros or so maximum- and the latter being private and very expensive, about several thousand Euros a year.

Private schools provide their students a management training with a small touch of sports knowledge, whereas in the sports sciences faculties the students' profiles have changed: indeed, many of them aren't coming from the STAPS anymore, but from diverse sorts of trainings, each one trying to specialize in a precise field. A double competition is born between, on one side, private and public schools, but also between the different faculties teaching sports management. This second type of competition is due to the specialization of the different masters.

In France there are three "Grandes Ecoles" which are very well known and guarantee their students with a good salary: EuroMed Marseille, Audencia Nantes and E.S. Gestion Paris. The contents of the lessons are similar to those in the Sports Sciences Faculties, the difference is the enrolment fees: more or less 10,000 Euros and in the partnership with companies which are large groups (Nike) or sports clubs like the Marseille football team.

In Europe there are some training programmes in sports management which are internationally recognized and are private: Glion Leisure Management School (Switzerland) Fifamaster in Italy, Solvey Business School in Belgium. The difference with the French schools is in the "entrance fee": more or less 15,000 Euros and the fact that the lessons are exclusively in English.

At present there are 38 Sports Sciences Faculties which teach management to 45,000 students involving 304 permanent lecturers; there are also 18,000 teaching hours for teachers who don't actually belong to the universities. That is to say an average of 191 students (if one includes all study levels) per faculty in Sports Management departments in 2006.

A question which needs to be answered is why have sports management studies been created in sports sciences faculties and not in management schools? Part of the answer is that this sector of activity is part of an original political, economic, judicial and financial logic of the modes of organization and the development of sport in France. A French model of sports management is necessarily based on a double logic; public and private which is organized on the basis of a delegation of powers from the state attributing to the federations prerogatives of public power. Thus these organizations constitute a real "public sport service" which is based on an administrative and financial solidarity between sport for the masses, top level sport and professional sport.

This situation justifies forms of management and development which are specific.

They are all the more particular since French sport has been confronted with a quick evolution of its environment; shifting in less than a quarter of a century from a supply-type economy based on a strong commitment from the state to a demand-type economy The historic producer ("the sporting movement") has had to come to grips with a supply-side which is both competitive and complementary: the one made up by the regional authorities (facilities and instructors working for the local council) and the one of the companies of the private sector which have turned sport into a business (facilities one has to pay for such as squash courts and gyms etc.). These are for the majority companies which didn't exist before the mid-seventies and now offer new sports service and sporting products.

The rapid progression of this new economy of the demand for sport has had an important effect on the forms of management and marketing of the organizations in charge of the development of sport in France. Today, in order to adapt, the latter must take into account both the constraints of the public and the private sector. This rather particular configuration has been analysed by the management laboratories of Sports Sciences Faculties (see the creation in 1993 of the first reference work in sports management, entitled "Sport and management, from ethics to practice", a study containing more than 600 pages, by 35 authors, all from Sports Sciences Faculties). Thus there is a very strong specificity; if we just take the example of the marketing of sports services, we can see that they are permanently evolving at the edge of profit-making and non profit-making activities; in this way creating the conditions of a unique marketing system. In the same way if one takes the conception, the production and the marketing of "sports events", the unpredictable quality of the sporting result or outcome ("the glorious uncertainty of sport") makes the marketing (and also the management) of professional sporting clubs very particular (see the introduction of clubs to the stock market). Therefore, we can clearly see that this type of profit-making and non profit-making activities is different from the economic and financial logic of strictly commercial activities, the classic study subject of management sciences.

Case study: Sports Management at the Sports Sciences Faculty of Lille 2 University

This section was created in 1984 and concerned students (mainly male) who were not interested in teaching or being a sports instructor.

As in the case of the other Sports Sciences Faculties, the problem of the professional insertion of students enrolled in this section led our faculty to become more diversified as shown by the creation of training programmes with a strong practical side and placements.

At present we are offering a Superior Technical Academic Studies Diploma (DEUST, several professional licences, a Master, year 1 and 2, and the possibility to prepare a Master's thesis. One can also notice that by proposing a complete curriculum from the first year of university up to Master level, the courses offered firstly attract a public made up of students from the traditional sports sciences, looking for a professional alternative to Physical Education teacher, then progressively attract students coming from other areas of higher education (economy, sociology…) and from other European countries and even from China, North Africa...

The Master curriculum covers two years and is divided into four semesters. 300 credits (ECTS) being necessary to obtain the master. Although the entry to the first year of the Master is open to all students who have completed a three years university course in management, the admission to the second year is subject to particular conditions.

The first year of the master is divided into two parts: the first semester runs from September to December and is essentially composed of academic lessons and a few interventions made by professionals. The second semester itself is divided into two parts: the lessons end in February, and the rest of the year is dedicated to a work placement. The mission given to the student must allow him to take some responsibilities, but he's still not completely responsible for a particular case or mission. More often, the student is not asked to present a report of his placement, but it's not a national rule.

The master's thesis is still very academic in a way to give the student the opportunity to propose a problematic and to develop his ideas and have a correct sense of writing. He then has to present his thesis in front of two academic teachers or researchers, one of them being his supervisor.

To be concise, if one takes the example of students enrolled in the second year of the master's degree, the teaching is done by the setting up of an alternative training programme including fundamental university teaching. The academic aspect is carried out in the first semester. During this semester the lessons are a mix between what we could call the theoretical aspects (socio-economic analysis of sport, judicial and financial analysis, strategic analysis, computing, etc.) and the interventions made by professionals. The professionals coming from private companies or administrations provide 35% of the lessons. They can be required to dispense a complete course, which corresponds more or less to 18 hours, or they can talk about their own experiences during seminaries.

The second semester is dedicated to the work placement. It has to be at least two-months long, but it generally lasts for six months. During this period the students are observed by their placement supervisor, who is a member of the company they work for. At the end of their placement they have to present a thesis, which they would have written with their thesis' supervisor, a member of a university. This thesis is not a mere placement report: it must give the student the possibility to show his capacity to take some distance from a particular problem, to analyse it and to produce a well-built argumentation based on academic works.

We can notice a deep change between the missions that were given during the students' placements some three or four years ago and the ones they have to manage nowadays. This change is due to several criterions:

- First, More attention is paid to the title of the placement and the description of the mission. The student's thesis supervisor, his employer and the faculty's responsible for the work placements examine carefully the placement convention to avoid any possible mistake.
- Then, In the universities it's usually the students themselves who have to find a placement, contrary to the business schools who have a special service to contact the companies. This is due to the fact that first of all, it wasn't possible financially speaking, but above all we were not used to hire a person who could at the same time put the faculty in touch with the companies and establish a network of former students, which would have been an excellent way to find out jobs and work placements. In Lille, this gap has been fulfilled two years ago, a teacher having been discharged of a part of his lessons to do this kind of tasks. A junior company is even being created.
- Finally, the companies are more involved when selecting the candidate nowadays. For a long time, the universities have been extremely reluctant to let the companies step into what they were considering as their private property. In France the relationships between the world of the universities and the one of the companies have long been exceedingly strained, and still are for many persons who see these links as "unnatural" for they consider that the university should be free from any constraint or any idea of profitability. it was the same phenomenon for teachers: the lessons taught by people coming from companies to talk about their own experience have long been limited to some seminars. We thought it would be sufficient enough to convince them to welcome a number of students for work placements in their companies. This state of things has been deeply modified, but ten years have been necessary to evolve.

The diploma entitled "Sport, Organization, Leisure, Events and Sports Careers" contains two options: "Sport, Events and Communication" and "Management of Sports Organizations and Leisure". We understood that we were functioning with the obsolete supply system, that is to say that we were offering diplomas following our estimations of the companies' demand, without any previous market analysis. To give you an example of how we were proceeding, we've decided to create a Master in sports management the same way a gambler would have rolled the dice: at the end of one of the three annual parties organised by the faculty. Then, with the help of one of my colleagues who later took the head of the DESS -which was the previous name for the Master- we have established a program and a specialization according to our own idea of the market and our means in the faculty or the persons who could have helped us, but without any preliminary analysis nor any forecast about a recruiting program. Such a forecast would have been extremely difficult to do as we've had to obtain, year after year and post by post, the transformation of physical education teacher posts into ones of managers, sociologists, jurists and so on and so forth. We've also had to obtain the creation of new posts for those courses, against all expectations.

Nowadays, thanks to the more realistic links that we've tied with many companies we understood that it wasn't necessary to have a master to organise a sport event. Moreover, the market is rapidly saturating and it's more and more difficult for many of our students specialized in "organization of sport events" to find a job; that is why we have decided to work with more precise fields of studies and from 2010 onwards, this specialization will be removed from the master. In return, we will open two professionalizing licences, the first being turned to horse riding and the other one to leisure. Today, the master has become more accessible to the demands of the companies: for example, we're linked to the Decathlon registered office in Lille, which is to hire several thousands persons in the next few years. This master's courses have not only been created to meet this particular market requirements, but also the ones of sports journalism, of sports articles' outputs, etc... In Lille, for instance, we have one of the companies producing all the equipments for well-know sports events such as the Tour de France, the Olympic Games, the Football World Cup and the like. It also produces the flags, the

barriers, all the signs and boards, and so on and so forth. To keep competitive, this company has to renew and diversify it's activities perpetually. For example, the barriers and the signs that lay in the last hundred metres of each stage of the Tour de France have had to be conceived in a way to avoid the possible accidents with the other barriers, which are by the way too heavy and bulky to be put up and taken down rapidly. It's the same thing with the podiums and the cabins reserved for the journalists, which also have to be put up and taken down as quickly as possible. People are needed to conceive and manage these products, people with various skills who are aware of the difficulties they could encounter in the sports universe and are able to solve a problem as fast as possible, wherever it takes place. The public relations manager of the Team Areva, whose building regattas on every continent to prepare the America's Cup has to be skilled in public relations, but also have a good knowledge of the competitive sailing universe. You also have to keep in mind that for such a job, speaking English correctly is absolutely necessary, which is a major handicap for French students.

We also have some contacts with Amaury Sport Organisation, the French tennis federation, etc. One can give examples of jobs occupied by holders of a Master's degree in management; project leader with a sporting specificity, marketing director, head of communication or relations with the press of federations or sporting groups, shop manager (sports retailing), director of a sporting complex (water sports, fitness, specialized..) manager of a professional sports club, administrative executive in the federations..

To sum up, a student with a master's degree has three different skill domains; scientific, managerial and sporting.

In a way to adapt our courses to the companies' expectations and to meet the demand of those who are already working but who'd like to increase their knowledge and have an access to a better diploma, we're going to bring an alternate formation in our master, that is to say that our students are going to alternate between working three weeks in a company, and then one week in the faculty to follow intensive courses, eight hours a day from Monday to Saturday.

The research in sports management

I still have to explain the situation of research in sports management. It is very important for the Ministry of Superior Education that the masters lean on research teams which are recognized on the national as well as the international levels. As a result, small laboratories have had to group into bigger ones, specify precise research axes, develop scientific activities, etc... For instance, the laboratory I am in charge of was employing about fifteen researchers in 2006, and more than fifty nowadays after the grouping of all the small laboratories in the north of Paris. The fact that researchers coming from different scientific cultures are collaborating on several axis and themes that have been decided in common has allowed us to find a quick national and international recognition.

The students willing to work into sports management researching have specific courses from their first Master year and they carry out their placement in a laboratory instead of a company. Their thesis plays a very important role as it is the principal element used by the selection committee to decided if they can continue their studies. Very few students chose this option, mainly because of the very low number of jobs that have been created by the ministry in the past few years. An intellectual revolution still has to be done, to admit and understand that a thesis can lead to direct applications in a company, and not only to an academic career. This is an extremely sensitive question for it is not only the way of thinking of the academic circle that has to be changed, but also the one of French employers who are most of the time frightened by high-level diplomas, as they fear an unfair competition with an employee who would have a better diploma than themselves, and to have to pay high salaries.

Conclusion

The development of a professional branch in the sports sector at a European level, structured in a way that takes into account a strong associative sports element, is an essential process for the future development of sport in our countries. This progressive process of "controlled Europeanization" is currently leading to the creation of EOSE (European Observatory of Sports Employment) and of a European network of the Institutes of Sports Sciences.

The European cooperation in professional training in the sports domain, including management, necessitates a coordination of the educational institutes, leading to European Master's degrees, facilitated by the setting up of the semester system and that of the ECTS (European Credit transfer System), which supposes a harmonization concerning the whole or part of the curriculum. I am personally trying to create a new master turned to sports tourism, with the help of six partner countries which are Portugal, Greece, Romania, Italia, Algeria and of course Croatia. This European diploma will probably lean on the Erasmus Mundus system, which would allow us to finance the movements of students and teachers.

Our participation in this conference contributes towards this regulation effort which targets five indisputable professional sectors in the field of management:

1st sector: creation, marketing and distribution of sporting goods and services

2nd sector: professional sport and sporting events communication

3rd sector: sport and public action

4th sector: sport, leisure and tourism development

5th sector: the management of sports organizations

Even if French universities have been extremely late to get into sports management instruction and research, it has now evolved in such a way that it has now a privileged place in Europe concerning this particular field of studies, especially due to the fact that sports sciences faculties are involved in these studies. Several faculties coming from different European countries have contacted Lille's sports sciences faculty to find some help to make up sports management courses. These appeals even extend beyond the mere European borders since, besides the partnerships with Greece and Romania, we are also working to the creation of a Master with the Algerian universities of Tlemcen and Ouargla, and the Chinese university of Sheng Yang. These courses will combine some lessons given by local teachers and speeches that are grouped together on short periods, usually one week, made by teachers coming from Lille and having their own speciality which doesn't exist in the given university. This leads to the birth of a new category of teachers that we could call the "jet-teachers". But it is said that travel broadens the mind, and above all it allows meeting many people and making lots of new experiences which are always rewarding personally as well as professionally speaking. When hearing the word "university", I like to recognize the words "universe" and "city", in the way the Greek people understood them.

A European association for sports management (EASM) created in 1993 makes it possible to know and to develop scientific exchanges in practice and experience in the field of sports management.

ADAPTED PHYSICAL ACTIVITIES AND SPORTS FOR THE DISABLED

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Abstract

Sport for the Disabled is included in this concept, but actually very little co-operations are reported. It is more likely felt that the elite and international sports movement for athletes with disabilities ignore the APA approach. This is not the fault of IFAPA representatives who always try to contact and to invite the international organisations to their Symposia and Congresses. Best examples are the Paralympic Congresses which are rarely frequented by athletes, coaches and administrators of the international sports federations. A neutral observer may find that athletes and coaches have to fully concentrate on their competitions and the necessary mental adjustments and may have no free capacities available to visit seminars, workshops and scientific presentations. Even we can state that APA and Sports for the Disabled possess a common denominator in characteristics like disability and movement the defined intentions are not fully compatible. One reason can be found in the history of both movements which developed independent from each other for a long time.

Sports for the Disabled and Adapted Physical Activities can identify in the field of rehabilitation and recruiting their most effective opportunity of cooperation. The existing deficiencies in the national sports programmes for people with disabilities could benefit if APA experts as scientists and as practitioners would help to develop programmes and qualify athletes and lay people to teach and assist to organize community programmes.

Key words: *adapted physical activities, sports for the disabled*

The content of 'Adapted Physical Activities' is quite comprehensive described in the Textbook of SHERILL C. (2003) "Adapted Physical Activity, Recreation, and Sport". It aims towards a healthy life style for all as an important base for allowing self actualization of any individual. The author and her co-authors belief that all individuals with disabilities have the right to demand adequate training and education of adapted physical activities to reach any level of competitions from grass roots to elite. This concept seems to be well implanted in the US in schools as a service delivery system and as training of APA specialists at University level. In the history of the APA movement a growing number of sciences are included according to the found complexity of health parameters and the significance of attitudinal factors in health education.

Sport for the Disabled is included in this concept, but actually very little co-operations are reported. It is more likely felt that the elite and international sports movement for athletes with disabilities ignore the APA approach. This is not the fault of IFAPA representatives who always try to contact and to invite the international organisations to their Symposia and Congresses. Best examples are the Paralympic Congresses which are rarely frequented by athletes, coaches and administrators of the international sports federations. A neutral observer may find that athletes and coaches have to fully concentrate on their competitions and the necessary mental adjustments and may have no free capacities available to visit seminars, workshops and scientific presentations. Even we can state that APA and Sports for the Disabled possess a common denominator in characteristics like disability and movement the defined intentions are not fully compatible. One reason can be found in the history of both movements which developed independent from each other for a long time.

In this article I will present in a first approach reasons for this discrepancy and in a second one areas of common interests and useful cooperation.

Historical implications on development of Sports for the Disabled and the Paralympic Movement

➢ The Beginning at Stoke Mandeville

The paralympic movement started with an outstanding medical achievement in the year 1944. A devoted neurologist, who marginally escaped the Nazi-terror in Germany, Sir Ludwig Guttmann, succeeded in finding a method to keep people with spinal cord injuries alive. For thousands of years a spinal cord injury was resistant to any treatment and subject of suffering and early dying. The feeling of success and having transcended human limitation inspired the whole team around Guttmann. By chance he realized the positive physical and emotional effects of sporting activities in the rehabilitation of his patients. The world wide known 'Stoke Mandeville Spirit' inspired Guttmann to make another

important step. Long before the ICF code was published by the WHO, he aimed for public acceptance and participation of people with spinal cord injuries in all aspects of life. The first Stoke Mandeville Games started on the same day as the opening ceremony of the Olympic Games in London 1948 to herald the beginning of the realisation of his vision to the public(GUTTMANN 1976).[1]

Connecting the wheelchair sports movement to the ideals of the Olympic Charta opened the vision for social integration of individuals into our societies who had been regarded so far as symbols of pity and grieve. Wheelchair sports proved to become the best means to overcome the deeply felt negative image of being confined to a wheelchair. Contrary: wheelchair sports participants demonstrated the ability to achieve, to enjoy life and to demand respect instead of pity. Public acceptance improved proportional with the betterment of sports competitions and athletes' performances.

➢ Focus on public recognition and elite sports

In the beginning sports as a mean of rehabilitation and therapy of patients with spinal cord injuries was quite congruent with the aims of APA. To focus primarily on public recognition by meeting the criteria of journalistic interests caused by time the major difference to the APA objectives. The strive for excellence in sports performance is not only an inherent goal of sports but was accelerated by the necessity of individuals in wheelchairs to pull down emotional and attitudinal barriers in our societies. Guttmann may not have known sports better in all its variations and specifications. Certainly he and his devoted supporters under estimated necessary provisions to develop sports participation on community level. The desperate need of public recognition focused on organising an international event with athletes coming from the entire world and to be represented every year in Stoke Mandeville.[2] His best collaborators became medical doctors who went on pilgrimage to Stoke Mandeville to learn the new treatment method and to realize the benefits of participation in wheelchair sports.

➢ Athletes' strive for excellence the motor for the evolution of sports for the disabled

All positive achievements which are connected with wheelchair sports and later also with sports of other disability groups[3] were positive results of athletes' striving for sports excellence at international events, provided by the international sports federations. Many doctors regretted the beginning of specialisation on single sports and disciplines by the athletes or the acceptance of ambulatory people in wheelchairs and of others than those with neurological impairments. Obviously athletes did not focus on positive health effects but on competition and to challenge prejudices and imposed limitations.

The Olympic ideals faster, higher and wider provided new sports, new equipments and orthopaedic devices, effective compensation skills and ingenious training opportunities. All these improved athletes' health level, independent living, social acceptance and emancipation towards self-determination. These results fascinated the APA representatives and their scientific personal. Obviously important goals of APA had been realized by elite athletes. Could they not become ideal role models for many others to participate in sports? (SHERILL 2003, 633).

➢ Tim Nugent's philosophy on education and rehabilitation

The principles of this process which guided this athletic movement was described at an early stage by Tim NUGENT (1964), the founder of the NWBA in 1949 and of the training programmes for students with disabilities at the State University of Illinois in Champaign/Urbana/USA. He became the advocate for the policy of self-determination for individuals with disabilities. Scientists and specialists in rehabilitation should primarily assist athletes to develop their own identity. Sports and specially the international events provided in fact the stage for athletes with disabilities to develop their own identity by trial and error. The consequences of this process provided reasons to regard disability as a challenge of life that allows opportunities to grow, to strengthen an individual's personality and to support social integration in all aspects of life. As one of the positive results we can notice public admiration of the Paralympic Games. The relationship between people with and without disabilities improved tremendously.

These are the most positive results in the paralympic movement. Regrettably there are significant deficiencies to report, if, following the Olympic principle that participation is more important than wining, we look on numbers of active athletes and the actual situation on recruiting at the national programmes of the IPC member countries.

[1] *The Games started on 27th July 1948*
[2] *Already 1952 the first International Stoke Mandeville Games took place.*
[3] *Until 1972 the Games allowed only athletes with neurological impairments (spinal cord injury and post polio).*

Deficiencies in sports participation in Sports for the Disabled

The IPC is quite proud to report at the Beijing Games a new record of participating countries. Another figure showing the number of medal events gives reasons not to compare simply with the Olympic Games but look at the differences and specifications more seriously.

➢ Diversity of impairments, functional levels and number of classes

The diversity of people with disabilities is quite extreme. 4 international organisations: IBSA, IWAS (formerly ISMWSF & ISOD), CP-ISRA and INAS-FID, whose population is extremely inter and intra different with regard to interests and competing opportunities, want their athletes to be well represented at paralympic events. The Paralympics offer a much bigger number of events for fewer participants than the regular Olympics. At the Paralympics 4000 athletes compete in more than 600 events, whereas for 15000 athletes only 300 events take place at the Olympic Games.

At the Paralympics events are reserved for athletes with sensory impairments, neurological impairments, orthopaedic impairments, coordination impairments and even mental limitations. Quite complex classification systems in each of these basically medically defined categories try to allow fair competitions. Each sport and each disability group is mandated by the IPC to reduce the number of classes with well adapted equipment (wheelchairs; bicycles, prosthesis etc.) and by applying a functional approach in classification that combines and transcends the original medical categories. Many sports still did not succeed in developing from a medical system to a functional and sport specific one.[4] Nevertheless, even with optimal classification systems the still existing functional differences between all athletes demand to maintain a reasonable number of classes. As an example the following table shows the number of classes in athletics, valid as well as for female and male competitors:

IBSA (International Blind Sports organisation)	3
IWAS (International Wheelchair & Amputee Sports Organisation)	
➢ Standing for Amputees and Les Autres	7
➢ heelchair rack t W	3
➢ Wheelchair field	7
CP-ISRA (Cerebral Palsy – Int. Sports & Recreation Association	8

Classification is still an issue of controversy and discussion. Especially athletes with cerebral palsy feel disadvantaged when combined with athletes without brain impairments. Articles on this issue are frequently published in IFAPA's journal APAQ.

IPC gives this issue great significance. Therefore it organized in Godesberg/Bonn (Germany) 2006 an international conference solely on this special and difficult issue. The VISTA Conference 2006 used the slogan: Classification - Solutions for the Future[5]. More than 200 participants from all over the world showed great interest and attended this conference, including many scientists of IFAPA. Unfortunately athletes and administrators of the various sports were only marginally represented. Discussion between the sports practitioners and the scientist did not take place. It is no secret that because of missing communication between the sports and the scientists no effective solutions can be reported which may come into effect at the Paralympics 2008.

➢ Poorly developed structures and programmes on national level

A major deficiency for participation of athletes with disabilities is not found at the Paralympics but has to be reported from national programmes of the member countries of the IPC. The quality of development of the various sports with regard to level of organisation and opportunities to train and to compete in the member countries of the IPC are quite poor. No useful information on structure, or of number on athletes, nor of real data on sports participation can be obtained from the countries. The level of organisation and quality of programmes for the different disability groups are not known. The IWBF, as one of the advanced sports federations, tried to receive data from its membership. Only 60% of its members replied and the reported figures are quite small and often obtained by estimation and not by objective assessments (Anonymus 2002). Even the German Sports Federation, the biggest federation in number of members in the world, could not give real data on active athletes in paralympic sports.

➢ Dominant interest of countries and athletes to compete on international level

In fact, for the majority of sports do not exist well structured programmes which start from grass roots to elite level. One of the main reasons for the deficiency in sports participation was and is the wrong attitude in sports for the disabled to

[4] *Wheelchair rugby classification is governed and applied by medical people and not by athletes on equal level.*
[5] *DVD with Proceedings can be obtained from IPC Office in Bonn/Germany.*

put emphasize on the organisation of international competitions before sound structures were built in a reasonable number of countries and continents.[6] You can not develop a sports structure from the top. Today it is even worse to correct the faults from the past. Athletes and administrators who enjoy international travelling and selection for international events possess no free capacity to promote national programmes and may not be interested to share their privileges with others. New athletes are discouraged to participate not only because of missing recruiters but they face a too wide difference of their performance level in comparison with internationally experienced athletes. Missing organized opportunities to train and to compete on equal levels with peers lead to frustration and drop out of novices.

➢ Professionalism in Sports for the Disabled

The movement towards elite competition and the interests of countries and their representatives to gain medals at the Paralympics have aggravated the problem on participation. Since 1996 also sports for the disabled gradually left behind the conditions of amateur sport. More and more elite athletes, who want to have a chance to gain a medal, train under professional conditions. Sports for the disabled are at present the privilege for gifted and motivated individuals who are willing to commit their lives to sports excellence and who find the resources to execute the necessary training under the guidance of sophisticated and paid coaches and managers. Professional sport is not interested in many participants but only on talented ones, and if possible, in many paying spectators. Being related to success and spectator interest sports loses the ideal of fair play and self-determination of the athletes. Sports have to meet the interests of spectators and media, not to forget to mention the interests of sponsors. Sport leaves the realm of play which regards the activity free of any other purposes and is opposed to work. Ideals and rules become subordinated and are primarily influenced by spectator interests and show-business. Athletes with disabilities count like in able bodied sports as useful human material for sports functionaries, politics and business enterprises.

Major differences and difficulties in sports organisation for individuals with disabilities

➢ People with disabilities are most divers in form and capacity of movement

Nature and degrees of disabilities are utmost divers and different. Disability affects people more frequent as adults and at older age.

- Children with congenital impairments are a relatively small group.
- The numbers of casualties with acquired disabilities increase during the age period between 18 and 25 years and again beyond 55 years (Statistics and Report on Rehabilitation of the Federal Republic of Germany 2004).
- Fortunately athletes of younger age with acquired disabilities are less frequent. The major group with congenital impairments are individuals with cerebral palsy.
- The male gender is affected by disability through accidents more than three times.
- Among the population with disabilities two major groups can be distinguished: Those with congenital impairments and those with acquired impairments. These two groups are mostly different in their capacity of sports experience and learning capacity.

Conclusion: The distribution of people with disabilities on an age scale starts with a small base, becomes broader at adult level and finds the majority of members from 55 years and older. The distribution of the female gender is much smaller. Diversity of the motor potential is utmost complex and heterogeneous. Teaching physical activities and sports finds very great challenges and demands a variety of specialisations.

➢ Teaching of individuals with disabilities faces great challenges and limitations in most countries

- Disability is felt as a tragedy of life which challenges not only a person's future perspectives but very often also those of his/her family members and friends. The process to adjust and to over come a disability is a major challenge of life, especially for those with acquired disabilities.
- Teaching physical activities and sports in this situation is a difficult and demanding challenge for physical educators and APA specialists.
- Sports for the disabled were originally addressed to adult people with acquired disabilities.
- Programmes for children and young adults are very difficult to organize. In many countries children programmes are rarely to be found. Main streaming into regular schools improved but difficult to organize in physical education.

[6] *In sledge hockey sitting volley ball and wheelchair rugby the national team is in most countries the only team.*

➢ **Teaching sports in hospitals is an exception**

- Sports Therapy and teaching sports was part of special clinics for spinal cord injuries and not for all disability groups.
- Because of growing costs patients stay shorter time in hospitals. Application of sports therapy and learning of sports have less time, if any, available.
- The close relationship between the medical personal and sports for the disabled, between rehabilitation and sports organisations, terminated, when the needs for proper training demanded sports specialists.
- The athletes also wished to emancipate from a patronising attitude in medical rehabilitation and strived for self-determination.(STROHKENDL, 1996, 20f.)

Summery:

- **Recruiting individuals with disabilities for permanent participation in sports programmes has to become part of the complex rehabilitation process. This makes the major and extremely demanding difference to regular sports.**
- Means used for motivation and participation in sports, like media coverage, role models for children, can have only a marginal effect.
- The complete process of rehabilitation and education of people with disabilities has to become the point of reference to find ingenious concepts for the various disabilities.
- Separation from believes in able bodied concepts are necessary to some extend, especially believes that success in elite sports may increase numbers in sports participation.
- A total revision of the actual policy in sports for disabled of most countries is necessary, if more individuals with disabilities may enjoy participation in sports.

APA could play an essential role in building the national programmes at rehabilitation centres, at schools and at communities.

Revision of Sports for the Disabled policy and ways for solutions

Public recognition, media coverage of role models and information on the significance of adapted physical activities and sports in all kind of publications do not generate initiatives to establish programmes. Also graduates on APA studies rarely start initiatives on community level to allow people with disabilities to participate regularly in sports programmes.

The interests of the few Federations who represent IPC sports at national level are absorbed by promoting elite sports and by participation at international events. They do not feel responsible to build a good national structure from grass roots to elite level. A necessary closer contact to APA-experts maybe exceptions, even though a closer cooperation should be expected. The national federations for sports for the disabled represent mostly elite sport concepts and a population of athletes that are not the major group for APA – programmes. On the other hand qualifications in APA rarely provide highly specialised coaches that are demanded in elite sports. Sports for the disabled have reached a deadlock. Where could be found the necessary energies and pioneers who can initiate change and develop a new policy at least for the attractive IPC sports?

Nugent's philosophy on self-determination promotes as a logical consequence an increased involvement of athletes, preferably after their career. The majority of developments in sports for the disabled came through athletes' initiative and contributions. Could this creative energy, that over estimated for good reasons a long period of time the wining philosophy, not be directed and channelled into a solidarity movement that focuses on a 'Sport for all philosophy'? Peer counselling brings sporting activities back to the original rehabilitation process of people who have to over come disability as an extremely demanding challenge of life. Here the circle of the history on sports for the disabled closes. The former patients matured to become respected athletes and admired representatives of their sports. Their experiences and learned values can add to the most important psychological segment in rehabilitation as role models. SKLORZ (2005, 61) reports in her thesis: Athletes possess a most effective ability to recruit novice players to participate in wheelchair rugby.

➢ **Revision of the paralympic philosophy**

Actually the paralympic spirit, the successor of the Stoke Mandeville spirit, developed when hospitalized patients were integrated into community life. At this threshold is the real challenge for sport development and a working field for any organisation, which regards physical activities for all as the ultimate goal to achieve, to get involved.

Sports as a means of rehabilitation and recruiting makes the major difference to regular sports and has to be identified as the most challenging factor for participation in sports.

From this perspective the Paralympic Games are an additional opportunity for a small number of elite athletes who may qualify from widely applied community programmes.

APA expert should, according Nugent's principles, provide the stage: They can not expect that the actual people in office of national sports federations for the disabled are the right address to offer their support. Nevertheless, APA experts should try to identify those Sports Federations who are actually willing to promote sports development from the grass roots. New pioneers are demanded who focus first of all on sports participation on community level and who define themselves not only as recruiters for elite sports.

Here APA can find its real and important tasks. According to Nugent they can help to provide the stage for experienced athletes to work as peer counsellors in rehabilitation and at community level programmes.

➢ Relationship of volunteers and APA experts

The history of sports for the disabled is the history of devoted and capable people who succeeded in organising real programmes for regular and permanent sports participation. These people are often no sports specialists and may not have qualified through studies and examinations on physical education. The majority of those people are family members or friends who are in close contact with somebody affected by disability. They are guided by their intrinsic motivation to help individuals to over come the psychological and social limitations caused by disability. They realize that learning and participating in sporting activities improve the rehabilitation process towards self-actualisation and prevent social isolation by successful inclusion into self-aid groups. Such an approach is different from medically oriented sports therapy that focuses primarily on physical effects of sports participation and most of all from an elite sports concept that aims solely on personal best and record.

The psychological and educational adjustment to disability is the primary intention of devoted lay people. In deed, a great task to achieve, if self-actualisation becomes the ultimate goal to achieve in Rehabilitation. The conditions to organize such a programme during hospital stay are difficult to fulfil, because the period of stay in hospitals is too short. An important resource for organising workshops and camps are self-aid groups in cooperation with national organisations for each population of individuals with disabilities. The legacy for equal rights and none discrimination acts in many countries could support initiatives for the establishment of community programmes for sports and APA.

APA experts could assist in this process as well informed partners.

➢ Models for improved participation of people with disabilities

In Germany we can report very good results from workshops on mobility training for children and young adults of six to seven days duration. Invited are people in wheelchairs with one family member or partner. The instructors are combined teams of wheelchair users and none disabled both lay people who convene one to three workshops at the most per year. All instructors are trained on APA and sport elements that provide successful learning of skills, enjoyable games and. as a free choice, introductions into sports of major interest. The preference to use trained lay instructors is not only less costs, the intention is to facilitate positive personal relationships between all participants of the workshops.

Although the workshop is named as 'wheelchair mobility training', recreational activities like swimming, singing and relaxation are included. The priority is put on successful learning of interesting skills, of useful all day activities and of enjoyable co-operative games in an atmosphere of positive human relationships. Success and appreciation of each others personality leads to mobilize the immanent resources of an individual towards self-actualisation.

Professional Sports and APA experts in co-operation with experienced peer counsellors prepare the lay instructors not only how to teach novices but to perceive disability as a challenge of life that pertains the chance of mutual learning of human values and personal growth.[7]

➢ Rehabilitation and Recruiting in national Sports Federations for the Disabled

Striving for excellence is not eliminated from national programmes. It has to be organised independently and reserved to a small minority of gifted and highly motivated individuals. Elite sports needs highly experienced and qualified coaches for each single sport and a professional working management.

Also scientists have to specialize and to develop a closer relationship to one sport and to experienced athletes if their competence may come to fruition.

The mutuality for all athletes with disabilities is the challenge to over come disability. Sports as a means of rehabilitation and combined with active integration into community programmes provide the placenta for sport development from grass roots to elite level. Recruiters address individuals with disabilities at rehabilitation fairs. It seems that the willingness to develop interests for sports for the disabled demands a certain stage of acceptance by the new client. The known concepts

[7] *The German wheelchair sports programme for physically disabled children started in 1972 with a study on Spina bifida. The mobility training courses were implanted in 1981 and become the most effective means for more than 130 community programmes.*

on rehabilitation programmes that put emphasize on psychological and educational objectives need more research about individual patterns and solutions.

In wheelchair rugby of the German Wheelchair Sports Federation (DRS) I chair a committee on rehabilitation and recruiting since 2004. The following actions had been proven to provide good results:

- Potential players are contacted by players at rehabilitation fairs
- The Wheelchair Rugby Federation advertises for workshop programmes.
- The committee looks for devoted new players and one able bodied assistant who are willing to organise a local workshop.
- The committee sends 3 instructors (1 low-point, 1 high-point,[8] 1 official) and rugby wheelchairs with additional gloves and straps. Most important is the low-point as role model for the novices.
- Basic skills and first playing experiences as a team are supported by the high-point and the official. Assistants of novices are encouraged by the workshop personal to support the implantation of the new sport on community level.

Revision on APA's philosophy and its ethic of human services

➢ Review of APA's involvement in Sports for the Disabled

A part of using elite sport as a good resource for research and for achieving academic qualification the major deficiencies in sports development are not identified in APA research seriously enough. Actions that are learned from regular sports and advertising through media coverage are not efficient enough at this stage to promote participation in sports for the disabled. The effect of written material is over estimated. Pioneers are needed who are able to implant and organize sports programmes on community level nation wide. Devoted and qualified individuals are the limiting factor in sport development. This conviction applies also to APA-experts. What can the national members of IFAPA do to establish active programmes in communities? For permanent participation in physical activities and sports close cooperation has to take place between APA-experts, athletes and representatives of national sports federations.

An essential improvement could be expected if the practical element for students' studies are consequently extended and become an important part of their training and self-actualisation (SHERILL 2003, 31f.). Inspired students could bridge the gap to community based activities which are conducted by volunteers and may become experts for the future development of community programmes. As already mentioned above, devoted pioneers are often found among lay people, mostly family members and friends of individuals with disabilities, to organize community programmes.

Their involvement would be more effective if cooperating with and being advised by professional experts from APA and sports.

➢ The importance of emotional effects and positive individual and social relationships in APA programmes

The extension of the practical part of student studies would address a most important subject. Close contact with athletes and first successful interventions as assistant in motor learning programmes help to develop a close relationship to sports and rehabilitation. Positive effects on personality and identity of the students can be expected:

Respect for any human being, appreciation of learning potentials, willingness for mutual learning and first positive results on teaching effects.

Studying APA and sports for the disabled demands to develop an attitude, that is open for emotional and even spiritual components, as they are connected with exceptional situations of life and border line experiences.

Conclusion: Developing a positive personal relationship to individuals with disabilities, respecting the dignity of any human being are the key elements to bring studies on APA and Sports for the Disabled to fruition.

In this aspect the emotional effects of any means becomes more significance than their cognitive correlate and additional information. Back to the roots in rehabilitation and sports means to put emphasize on generating positive emotions when enjoying success by learning motivating and interesting skills and by participating in exciting games among ones' peers. The name APA may mislead our perception of the real values of physical activities. Actually people participating in APA and sports use their body as instrument and as tool to experience success, risks, competitions and

[8] *Low-points are represented by Tetraplegics with level of lesion T5/6 (no triceps m.), High-points represent level of lesion C7, C8 (with triceps m.)*

limitations. The resource for these activities is the vital power, the inherent energy, which is located in the emotional parts of the human being.

The positive emotional effects of learning sporting activities and mutual appreciation of personal relationships are the means to help to develop a new self-concept. Regular participation at community programmes empower individuals with disabilities for a more active life, even if they may participate no more than one time per week. Strengthening the inner resources of a person help to take more responsibility, realize new opportunities and improve quality of life. Physiological improvements of the body are more or less positive secondary effects of an increased activity level.

➢ Unimpaired individuality of a person and the challenge of disability

Any disability is in the beginning a tragedy of life that is beyond all imaginations. Nothing has changed about this traumatic situation until this date. The perspectives to over come the challenge of disability by application of useful means and methods has much improved. The results and experiences, especially in sports for the disabled, have changed the whole anthropology on disability. The spiritual and emotional parameters of a person may not be affected by disability, if the senso-motoric system of the body is impaired. This knowledge may be the result of a positive learning process in rehabilitation but is out of sight for the novice at the beginning.

At first an individual has to learn to accept the functional limitations and even more to surmont the trauma of a destroyed self-concept. These are the real challenges in the rehabilitation process. In sports many aids had been invented and improved which can be used successfully in rehabilitation. They may even extend movement opportunities and enhance excitement (cars, bicycles, boots, sledges, skies etc.) Nevertheless, any severe disability is regard as a serious crisis of life and a challenge that demands the activation of all human resources.

It is quite painful for an impaired individual to develop a new body self with orthotic devices. The best functioning equipments like well adapted wheelchairs or electric wheelchairs which can be moved without effort are not regarded as an alternative to function of the unimpaired body. There is hardly a more difficult and challenging task than to assist and teach an individual to accept a permanent disability and develop a new self-concept. Theories on health (ANTONOVSKI 1997) and recilience (LUTHAR et al. 2000), the psychology on disability and how to master limitations and deficiencies (SCHUCHARD 2005) have to enter APA philosophy and research to optimize the necessary adaptation and learning process.

During a positive rehabilitation programme the offered equipments are incorporated and more and more positively assessed. The negative perception changes with the experience of positive learning and unexpected improvements. To understand this phenomenon helps the following analogy. A perfect equipment handling during sporting activities can have similar positive emotional effects like for a musician playing an instrument for pleasure and for enjoyment.

➢ Recruiting athletes for Sports for the Disabled

Adjusting to disability, compensating limitations, learning a new self-concept and starting to participate in regular sporting activities is one of the most difficult challenges in the field of education and teaching. Taking into account the history of sports and rehabilitation of individuals with spinal cord injuries and most of all on their impressive results that had been achieved during the last 60 years give reasons to specialise on rehabilitation and recruiting by the means of sports. Studies in APA are encouraged to cooperate closely with athletes and if possible with existing programmes and sports organisations for the disabled. Experienced and retired athletes possess the best potential in assisting novices to learn a new identity and self-concept as role models.

To optimize this potential needs proper training that can be guided and provided by APA experts. Devoted athletes who are interested in rehabilitation and recruiting possess because of their practical experience an implicit knowledge (POLANYI 1966). Polanyi defines implicit knowledge as qualities and skills that can not be put into words but are a very useful resource. Apart of this given advantage a peer counsellor does not automatically possess the necessary teaching skills and the attitude to identify with the psychological and emotional situation of novices who had been just recently injured. APA experts could train and advice them with regard to three important principles:

- Learn to forget about your own learning career, in order to be
- Ready to learn and to identify with the feelings, capacity, experience, attitude and interests of your client.
- Develop a wide resource of well structured movements, skills and games that allow to initiate successful learning and practice according to given performance level of the client.(STROHKENDL, 2007, 280)

The quite complex issue of learning proper teaching skills is a subject that is mostly neglected in studies on University level (STROHKENDL 2007). On the highest level teaching can be described as an intensive communication between the student and the teacher with the ultimate goal that the student himself is involved in the adaptation and learning process as much as possible. Scientists question the fact whether didactic concepts are useful and effective in teacher training (GLÜCK 2005; KANSANEN & MARI 2003). The above mentioned importance of practical studies for students in the

field of sports for the disabled for the development of positive relationship with people with disabilities and for their own identity has to be extended with practical teaching courses (GLÜCK 2004).

Sports for the Disabled and Adapted Physical Activities can identify in the field of rehabilitation and recruiting their most effective opportunity of cooperation. The existing deficiencies in the national sports programmes for people with disabilities could benefit if APA experts as scientists and as practitioners would help to develop programmes and qualify athletes and lay people to teach and assist to organize community programmes.

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CURRENT CHALLENGE IN HEPA

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Abstract

During the last decades the knowledge about health enhancing effects of physical exercise and physical activity has increased rapidly. Today, the beneficial effects of physical exercise and activity are nearly organ specific. The positive effects of physical exercise and activity are recognized in both prevention and treatment of several Western diseases. Simultaneously, as our knowledge about HEPA (health enhancing physical activity) has increased, the sedentary life style, decreasing activity, has become more popular. As a sign of that, physical fitness has decreased and overweight has increased in many countries. It is also well known, that overweight increases the risk of many diseases, especially coronary heart disease (CHD) and type 2 diabetes. It has been estimated that in the 21st century obesity will probably surpass cigarette smoking as the primary killer in the USA (Grundy 1998). As for coronary and carotid atherosclerosis, obesity increases morbidity substantially. Obesity, either moderate or severe, tends to promote clusters of CHD risk factors. Fortunately, there are scientific data indicating that lifestyle interventions can reverse the further development of obesity and related co-morbidities (e.g. Diabetes Prevention Study, Tuomilehto et al. 2001).

In order to give an example of increase of overweight and the trends in physical activity and physical fitness, the results are presented from last three decades from Finland. While about 30% of young Finn men age 25-34 years were overweight at late 1970's, today nearly 60% of the same age group are overweight. In fact, the probability of to be overweight at that age today is nearly as high as that of the fathers of the young men, age 55-64 years. The increased obesity in Finland might not only be caused by decreased activity; dietary habits may also influence the increasing trend of obesity. However, the changes in diet are not all negative, since adults are consuming less saturated fat and more vegetables today than few decades ago. Therefore, physical inactivity might be even more important cause of obesity than has been calculated.

The physical fitness of Finnish army conscripts has declined from late 1970's gradually. While 30 year's ago the 19-y men ran about 2.750 m during 12 min running test, Cooper's test, today the mean result is less than 2.450 m (Santtila et al. 2006). Similarly in muscle fitness, in early 1990's about 2/3 of the men achieved good or excellent total muscle fitness, but today about 40% of men achieve the same results. The changes in body weight (+6.1 kg from 1992 to 2006) may explain a half of the decline of the results, but the other half is of lower physical fitness caused by less physical exercise and activity. The power of the results is underlined by the great sample size. The sample of the population-based army study represents practically all Finnish men aged 20 yr (nearly 30.000 men yearly), because Finland still have compulsory military service and about 90% of this age group every year do their military service.

The results from physical activity from Finnish adults are inconsistent. Leisure-time physical activity (LTPA) has increased during the last 30 years. The percent of adults exercising at least twice a week has increased from 40 to 65%. However, those exercising at least four times a week have not changed during the last 15 years. On the other hand, those walking or cycling daily at least 15 min to work has decreased in both women (from 45 to 35%) and men (30 to 20%). Further, the activity associated to work has also decreased. When early 1970's only 25% of employees were sitting during their working hours, today about half of the employees spend sitting their working hours (Barengo et al. 2002). When trying to conclude the total of physical activity, both positive and negative trends are seen. But by combining the results from body weight and physical fitness, the total activity is concluded to decrease at the population level. Despite the positive trends in LTPA, the total activity has not increased. Therefore, Finland like many Western countries has to be challenged how to increase HEPA at population level. The goal is to increase activity in every age group from children to elderly. Importantly, the success of the challenge needs to be measured in population level e.g. changes in physical fitness and total physical activity. The funds invested will paid back within few years if the total activity will be increased.

Key words: *challenge, HEPA*

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SPORT AS A SOCIAL PHENOMENON

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Abstract

Sport is shaped by and derives symbolic significance from its close links with society. With its classic, socioculturally valid and transparent norms, it forms a social subsystem in which different types of identity reinforcement or social recognition are possible. Identity reinforcement can be found through membership of a sports group, a particular sporting role, a sports performance; or it can be experienced vicariously as sport spectator – either live or via the media. In this contribution I would like to discuss those special features of sport – in particular top level sport – which can make it an excellent way of satisfying the human need for identity reinforcement. This sort of motivation is based on external satisfactions associated mainly with displaying special skills in sports and receiving approval, status, or material rewards for performing well. In modern societies there is no other social subsystem that gives so many people, regardless of their religion, gender, age or social or educational level, access to a system of social validation and acknowledgement by others.

Key words: *identity, social recognition, identity reinforcement in sport*

Introduction: Types of social recognition in sports

Sport has a vital social dimension since it ideally combines self-recognition with social recognition. This can occur because sport is a culturally specific and clearly visible activity. As sport takes place unequivocally within the context of society's significant symbols, it can have an impact on the actor's self-perception, self-esteem, and self-worth. Taking the theory proposed by Popitz (1987), who categorized people's demand for recognition into five types of "social subjectivity", the following examples show how the individual can find social acceptance and confirmation through others in sport.

Recognition as member of a group

The first type of social subjectivity refers to the need to be recognized as a member of a group, and most sport activities are practised in groups. Recognition here means being like the others, an equal among co-equals, an insider. The feeling of belonging is a basic social experience and the certainty that comes with belonging is a basic form of self-confirmation.

This type of *social subjectivity* with its low individuality is found typically in mass and club-based sports: membership of a football club in a municipality, for example. The high degree of social control is achieved through the all-pervading authority of the group: the group as a whole – each and every member – decides whether a particular member is to be accepted or not. The intimacy and security that membership gives is tested through permanent symbolic ritual. Communication between players on the field and in the bar afterwards has one main objective, namely to reinforce the feeling of belonging. The wisecracks, friendly horseplay and joint singing session all serve this purpose. Many other forms of sport today, particularly mass leisure sports, are based on these same social relationships.

Recognition in an assigned role

The second type of social subjectivity concentrates on the desire for recognition in an assigned role. The behaviour patterns in assigned roles include features that are determined at birth: age, sex, background and possibly social class. Self-esteem can be socialized accordingly towards these behaviour patterns from birth onwards.

The desire for recognition by this type is more specific. It is not a question of being the same as the others but of having a particular social function or role, and thus the activities through which a person can find affirmation are more precisely defined. In sport this involves special emphasis on a social component through sporting activity: the stressing of masculinity through sports involving strength such as wrestling; the expression of femininity through gymnastics; sports played predominantly by young people such as squash, or by older persons, such as hiking; or sports in which social class plays an important role: riding, golf and yachting for the upper classes, and football or boxing for the lower classes.

Recognition in an acquired role

In this type *social subjectivity* refers to recognition of an acquired role. The demand for recognition here includes two groups of activities. As with the assigned role there is the ability to perform a role (role affirmation). At the same

time, however, there is the success that comes with role acquisition, with having achieved or "become" something that one was not born with.

This type is thus based on a further specification since it is not only role affirmation, the ability to perform a role, but also the success in acquiring the role that is involved. It is at the basis of professional sport today. Success in the role of an athlete can be achieved only through top performance. No one is born with this role; it can be acquired by an individual only through developing special skills. This type is clearly meritocratic, giving athletes status or rewards for their achievements rather than their social position.

Recognition in a public role

The fourth type of social subjectivity is the need for recognition in a public role. The potential for this is provided wherever people are willing to gather to watch and listen. Court and religious festivals, meetings, crowds at a market place, court proceedings, theatre, sport and circus require performers offering something of general interest.

The special dimension of social subjectivity is to be found here in the emphasis on the public role. The public expects visible performance. Sport satisfies this requirement ideally, be it in the form of public events or of media sport. The public exposure of this type is particularly strong in the world of sport: athletes today are often more apparent in the media than politicians or captains of industry, just as Lowenthal shows they were some 50 years ago (Lowenthal, 1990).

Recognition of personal identity

The fifth type of *social subjectivity* articulates the desire for social recognition of a person's individuality. It is based on social confirmation of individual existence through being different or unique.

As far as sport is concerned this might be reflected in individual sports such as skiing, tennis, golf or riding. In these cases the practitioner is not only interested in an outstanding performance but also in experiencing unspoilt nature far away from the masses. Possibilities are also offered by alternative sport, where the desire is not to force the body to perform but to experience an emotion through the body, or by bodybuilding, where muscles are a form of status symbol (Klein, 1993).

The five types of *social subjectivity* indicate the role of sport with regard to the satisfaction of the human need for social recognition; their order represents their chronological development in a historical sense. With the growing complexity of society through the ages the five types evolved, always overlapping to some extent in the process.

The different challenges and dimensions offered by sport prove in general to be strongholds of roles with high recognition value. For more and more groups it is a primary way of experiencing confirmation, praise or recognition in society. Sport provides an ideal vehicle for identity reinforcement.

As social symbols (values, norms, principles etc.) can be seen and experienced in sport significantly and intensely sport is more than just a microcosm of society; it is an ideal form of communication, and functions on the basis of significant symbols such as scores, records, goals etc. This will be discussed below using an approach from the symbolic interactionist perspective.

Sport identity theory

Identity theory is built on the assumptions, definitions and propositions of symbolic interactionism and emphasizes the relationships between self, society (social structure) and role performance. This theory seeks to understand the reasons why people select a particular role performance, given the variety of available and reasonable possible alternative choices. It is from this perspective that the roles and the performance of sportsmen and women can be considered.

In Coleman´s (1961) classic study of adolescent society he observed that the high status of athletes may be due to the representative nature of athletics and the visibility of the awards given. There has indeed been considerable research on the importance of sport in validating and strengthening identity (see Brandl-Bredenbeck/Brettschneider, 1997; Curry, 1993; Curry and Weaner, 1987; Curry and Weiss, 1989; Donnelly and Young, 1988; Jackson, 1981; Weiss and Curry, 1997).

The nature of identity is that it is situational and changeable: it shifts and changes with time, context and interaction with others; therefore, it is constantly in the process of being (re)created (Hall, 1996; Kondo, 1990; Shogan, 1999). Thus Klapp (1969: 5) emphasizes that identity is "a fragile mechanism whose equilibrium needs constant maintenance and support from the proper environment, and it is quite easy for something to go wrong with it." An examination of the identities of one individual along a timeline reveals a mixture of identities of varying degrees of salience and prominence; some are rigid and long lasting, whereas others quickly fade away. Furthermore, identities from multiple spheres may complement or conflict with each other. For example, within sociology of sport one research tradition has considered the possible conflict or complement of student-athlete identities.

The identity associated with the athlete role is the primary focus of Snyder´s (1986) discussion, and of Tsang´s (2000) experience of identity within high-performance sport. Another argument is that sport contributes to a quest for identity

(Jarvie, 1993). Or in the case of Irish Olympians, sport questions rather than consolidates the quest for identity (Cronin, 1997).

Sociopsychological assumptions

As symbolic interactionist and interpretive theorists showed, humans are social (and cultural) beings who relate to those around them within a system of central relationships (Cooley, 1902; Gehlen, 1978; Mead, 1934; Weber, 1964; Zurcher, 1983). Mead (1934) was the first to point out that the process of anticipating the reactions of others ("significant others" first of all and "the generalized other" thereafter) fosters the development of the self and makes it possible for humans to see themselves as they are seen through the eyes of others. This self can also be understood as a set of different identities. Every human being possesses identities, be it as a pupil in school, as a member of a sports club, as the youngest child in a family or, later, as a parent, teacher, doctor or colleague. In every social relationship which humans find themselves in or enter into, they take on an identity.

From this perspective, human behaviour can be understood as a fundamental endeavour to confirm an identity, and self-esteem is rooted in identity reinforcement or social recognition. Self-awareness involves having confidence in this self-esteem, and this is influenced by the way an individual adopts the recognition of others in relationship to the self. In this respect, it must be assumed that active efforts are needed to gain social recognition, that is, identity reinforcement.

The postulate is not new. It appears repeatedly in many variations: Veblen (1899) defines it as a demand for prestige; according to Mead (1980) we all believe that we are basically better than others; Goffman (1959) argues that we all try to present ourselves in the best possible light; and Homans (1961) describes striving for social recognition as an elementary form of human behaviour; Goldschmidt (1972) made a further suggestion, localizing this element as a drive and calling it "the desire for a positive effect"; Plessner (1975) claims that human beings, unlike other creatures in the animal kingdom, live in an unstable, but artificial and unnatural, equilibrium between "being the body" and "having the body". Nor are human actions simply steered by the drives "action" and "reaction", as is the case with animals. Humans can observe themselves. We play tennis and see ourselves playing, speak and hear ourselves speaking, for instance. Human beings are in a position to watch and judge themselves. It is in reference to this that Plessner (1975) speaks of "eccentricity" (*Exzentrizität*). Humans can be aware of themselves from outside, because they relate to themselves, and this is self-awareness. But this self-awareness needs reinforcement at a social level. Thus any action undertaken should earn as much social recognition as possible in the form of respect, prestige, status and the like. Only via actions can the human being satisfy this need. The consequence is an "extension of man" (Hall, 1977), which manifests itself in artefacts, technique or forms of human behaviour and social organization such as sports.

In the social sphere the "extension of man" process is reflected in the role structure of behaviour. We enact complex repertoires of roles (Heiss, 1981; Merton, 1957). Turner (1978) observes that the network of roles we enact facilitates the development of what we are as individuals. Stone (1962) suggests that our role enactments provide us with a flexible identity specific to and situated in social settings. Sarbin and Allen (1968) note that the internalization of role expectations creates in us a functional self-concept, a versatile perception of ourselves.

Our role enactments are best understood not by linking them to specific physiological and psychological elements, but as products of our social interaction with other people. "Motives" and "needs" emerge in those interactions as terms by which we explain or justify our role performances (Burke, 1962; Foote, 1951; Mills, 1940).

Sporting activities are to a greater or lesser degree governed by these basic sociopsychological prerequisites or assumptions. Role adoption enables the participants to confirm their identities. The athlete experiences success through society's attention, through its approval or disapproval. Regardless of any physical evidence of success, self-evaluation is also always an evaluation in the eyes of others. Self-recognition is not possible without the internal belief that recognition is coming from others. People need other people not only to survive, but also to enable them to experience themselves. Human beings cannot have any self-awareness, nor indeed any self, when cut off from contact with other human beings.

All self-acknowledgement is the unification of the awareness of one's own person with the knowledge of how others have reacted to that 'own person'. In this respect, athletes are completely dependent on the reactions that come from their sociocultural surroundings. A striving for social recognition, a craving for a name, also influence the athlete's sporting activities. The relationship between athlete and social environment is, in other words, a balancing act between being a body and having a body: there must be a balance between the mentally and socially influenced desires and what can be and has been realized.

And, as in other areas, identity reinforcement has consequences in sport as regards the person's relationship with the surrounding environment. In sporting activities the participant absorbs the attitude of other people, their regard or lack of it for him, and in this way becomes an object to himself. Since the athlete plans, designs, anticipates and sees himself as a participant in an interaction with others and his sporting behaviour through the perspective of his audience, he will see himself and be aware of his body as an instrument. The relationship he has to himself (his body's "being"), is the movens for his sporting activities, and it has its roots in the community or social group to which he belongs, or from which he wants to obtain recognition.

This can be demonstrated in terms of class relations. The long-term impact of economic inequality on people´s lives has led to differing amounts of wealth and power, that is to say to differing classes (Bourdieu, 1978; Laberge and Sankoff, 1988). For example, people from lower income groups do not run, bicycle, or swim as often as their higher income counterparts.

The organized community or social group that makes the identity possible can be considered as the "generalized other", which, as described by Mead, is instilled in the minds of children in the transition from "playing" to "game" (organized competition). At first the child, at playing age (before it reaches the phase of competition), takes on a series of different roles that the child itself, through its own spontaneity, triggers by switching from reality to imagination, although the aim is simply to play. There are no rules apart from those the child has determined, and these the child can change when it so wishes. The child is one minute this, the next that, but has no definite personality. Only when it begins to absorb the attitudes of the people around it, so as, from their point of view, to be able to play its own role successfully, will it become an integrated member of the community. Competition is an excellent example of this situation, of this development into an integrated personality: "In competition it [*the child*] sees itself as through the eyes of its group or gang and calls for set rules. The social use of playlike competition, in fact the importance of it, is that this access of the child to itself is essential. The child has to see itself as the whole group sees it" (Mead, 1983: 296).

Those participating in sport can only be conscious of themselves as objects (e.g. members of a group, representatives of a country, favourites) or as individuals and can only develop (possess) an identity when they assume the attitude of the generalized other, and the attitude the generalized other has towards them. Mead's baseball player plays the way his team-mates expect him to play. As a participant he takes on the attitude his fellow players expect of his role (batter, pitcher); he anticipates the reactions of each of the individuals in the team and they all become a type of unit – and this affects the unit (Mead, 1973: 196).

It is here that the double-sided aspects of the self, the "I" and "me" interact. The "me" makes the single player into a member of a team. The "I" allows him to recognise that he has his own, unique identity that he should try to maintain (e.g. by scoring a goal in football). The "me", the expectations of the others, on the one hand imposes limitations on the "I" (to play for the team), but on the other hand means that there is no other way for the "I", other than via the "me", to make himself and his exceptional quality clear. Mead does concede that the response of this "I" includes adapting. But because the "I" always brings something new into the game – the creative response by the player to suggested expectations – it changes the whole process all the time, as his contribution via "role-taking" into "me" is noticed by the others. Through this empathy, this reciprocal shift of the self into the roles of the others, and the recognition of the reactions of the others in the experience of each of the participants, the organized activities in playful competition will become axioms and control each of the reactions of the individual, which gives him his unity and builds up his identity (Mead, 1973: 202). This process occurs not only in competitions but whenever one human being has contact with others, and it is this that makes the individual a conscious member of a community. It is also responsible for the development of the personality and the social genesis of that person's self. The community/society surrounding the "I" has a fundamental significance for a person's self-image and thus his self-recognition: here it seems to be imperative to take "the role of the generalized other", that is, the "me". The whole question of interaction is extremely complex as the "me" is not only a product of team reaction but also the sum of all communications/reactions between the individual and the outside world (for instance, spectators, media, past background).

In sport this generalized other does not necessarily have to be the team. In many cases it has to do with the attitudes of a varying number of third persons (friends, acquaintances, the audience, trainer, sponsor) or of society as a whole. Doing a particular sport is one social role in one social subsystem; the athlete has one status given to him or her by society. The other roles are present in the thoughts and behaviour of the athlete as the generalized other; he knows what is expected of him because he generalizes the behaviour that a group or society expects. In this respect the athlete reaches that point of achieving awareness of himself that reflects how far he complies with the real or supposed expectations the others have of his performance, and earns their recognition/praise by this compliance.

Identity reinforcement in sport

Social recognition and/or the reinforcement of identity can only be maintained on the basis of the controlling value and norm system of the surrounding society or social group. This value and norm system is reflected in the subsystem of sport, so sport offers the chance of social recognition and identity reinforcement in many respects. Which sports are most likely to reinforce the identities of the athletes depends on the complexity of a society (quality of socialization, political situation, economic conditions, ecological awareness) Numerous studies have been carried out in which sports and athletes are analysed from a point of view similar to this – for example, bull-fighting and baseball in Mexico and the United States (Zurcher and Meadow, 1967), football in Brazil (Lever, 1969), baseball and football in the United States (Ross, 1973), American college athletes and Austrian student sport club members (Curry and Weiss, 1989), or top Austrian, Czech and American volleyball players (Weiss and Curry, 1997). These studies demonstrate that specific sports mirror the specific values, norms, structures and processes of societies or social groups.

In sport the actors' patterns of self-realization are also based on this premise. Behaviour patterns connected with social acceptance are formed within a framework of social and cultural principles. In other words, because of the culture of society, which provides sport with a ready-made value system, social actors in sport find a point of identification in the "me" that they share with others. The participant can employ abilities in sport and show off qualities, such as dexterity, strength, knowledge, intelligence, courage or self-control, that are appreciated in his or her social environment. By means of a generally understood and accepted complex role system in which even deviations from the norm and violations of the rules can be accommodated within role expectations, sport permits development and confirmation of identity and hence social fulfilment.

The constitutive components of sports determined by culture and society reveal aspects of society very clearly and visibly as hardly any other system of symbols can. This can be illustrated using "achievement" as an example. In the light of the interactionist assumption, achievement is subject to a framework of requirements involving action and representation. In other words achievement exists only when someone acts in a certain way and an observer judges this type of action to be an "achievement". Very often the participant must draw attention to the criteria for his or her actions so that the observer notices or recognizes these actions as achievement (for instance managers, economists, politicians). Then a second action/performance comes into play: the representation of the achievement that establishes the action as an achievement (Gebauer, 1972). The individual must be able to put the action into an appropriate scenario: only successful representation will lead to social acceptance of the action.

If we consider the possibilities for social reinforcement, standing and consolidation of self-awareness, it becomes evident that negative factors abound in our society. Boredom, lack of excitement and routine in many areas, at work in the industrialized world and in the family, for instance, lead to an absence of social recognition, a dividing of action and representation. Workers at a conveyor belt or shorthand typists in an open plan office, although paid wages, have no recognized social standing. Compare them with politicians, whose success may indeed result from unscrupulousness, demagogy or wily propaganda, researchers and scientists, whose achievements admittedly require publicly accepted yardsticks such as the Nobel Prize in order to gain credibility. For school pupils, students, actors, writers and artists certain actions bring achievement, but whether these are recognized or not depends on, for example, the – very subjective – evaluations of the teacher, the goodwill of the critic, the astuteness of the publisher. Industrial society is not an achievement society, but a success society (Krockow, 1972; Marcuse, 1987). Differentiation and division of labour have ensured that it is not possible for achievement to be seen; only success is really acknowledged. Success is provided through social acceptance, that is, recognition of the successfully represented achievement.

What makes sports stand out is the unity of action and representation, a unity that is seldom seen anywhere else. Performance in sport can be reduced to a quantifiable dimension: only goals, seconds, and centimetres count and so outstanding achievements or records can be understood by everybody. Reducing complexity to clear symbols unites action and representation and reinforces the identity of the actor. Whereas achievement in other areas remains invisible for many people and can often be appreciated only by experts, in sports success is immediately recognizable and can be understood by one and all. The standards of achievement are known to both participants and audience, and the reputation of the participants rises and falls, depending on how near to these standards they come. This is true in particular for top level sports.

Action and representation merge and society's values and norms can be seen and experienced most definitely in sport. Through a system of commonly understood and accepted values sport permits that recognition of achievement which is significant in the prevailing culture, society or social group and with this recognition the development and reinforcement of identity.

In contrast to modern society, a complex structure that demands increasing virtuosity in role-playing and in which there is in many areas little scope for creating an identity, the significant symbols of sport label and classify social values and norms very clearly and visibly – as the above example of achievement shows, where sport is a social subsystem that offers the potential of establishing and reinforcing identity.

Media sports

From about the age of two we are all continually exposed to the mass media. It instructs us on personal happiness and how to obtain it, success and how to achieve it, honesty and its rewards, greed and its punishment. Through advertising, dramatisation, entertainment and news, we are all instructed, directly and indirectly, about important values.

This is especially true for media sports which are communicative activities that reflect, convey, and reinforce values. As was pointed out above values and behaviour patterns striven for in sport not only cover the cultural principles in a society, but are, on top of that, fulfilled perfectly in sport. Thus, it is speculated that through the mass media individuals may vicariously identify with the professed moral traits of the heroic and claim them part of their own self-identities. "The hero can be best understood as an aspect of culture, a part of society's collection of symbols or totems. The hero is a human figure that serves as an object of admiration, aspiration, and, at times, worship. The story of the hero's life is a codification of a culture's values and prescribed behaviors. All cultures have heroes, but the heroes themselves vary from culture to culture" (Strate, 1985).

An example of this is found in Austria's skiing champions, personifications of all the characteristics considered of worth in this country. These athletes usually come from simple backgrounds, train rigorously, never give up, accomplish great things and are unassuming – but are, above all, successful. The media's portrayal of their careers presents a multitude of social maxims: the legend of their success will make clear that social advancement is open to anyone, if he or she wants it and is willing to try hard enough. The result is a direct confirmation of social worth and significance, and it is demonstrated that this application in sport does, as a rule, lead to success.

The validity of these social values and norms is also held up in front of the eyes of everyone whose day to day reality and whose own way of life is often quite the opposite. In sport, on the other hand, success is achieved simply by performing. Sport symbolizes the exact requirements that let it appear as a social ideal and offers the observer an excellent chance for a pseudosocial or para-social relationship: "The more the performer seems to adjust his performance to the supposed response of the audience, the more the audience tends to make the response anticipated. This simulacrum of conversational give and take may be called *para-social interaction*" (Horton and Wohl, 1956: 215).

As Peter L. Berger and Thomas Luckmann observe, the theatre also illustrates this participation in "multiple realities" outside ordinary social life. In a theatre, a person is psychologically drawn out of his or her objective social world into the realm of the play. One moment a person is talking to a companion in the next seat, the next moment both are absorbed in the fictional doings in an eighteenth-century drama. "The transition between realities is marked by the rising and falling of the curtain. As the curtain rises, the spectator is 'transported to another world', with its own meanings and an order that may not have much to do with the order of everyday life. As the curtain falls the spectator 'returns to reality', that is, to the paramount reality of everyday life by comparison with which the reality presented on the stage now appears tenous and ephemeral ..."(Berger and Luckmann 1966: 25).

Such vivid "transporting" experiences characterize all forms of media consumption. One can slip mentally out of the real social world and enter an artificial world of vicarious social experience. And we all spend much of our lives in the "other worlds" of the media. An important form of artificial role playing involves the complex process of "identification". People temporarily abandon their own identities and social roles and, by imaginatively projecting their consciousness onto the media image, take on alternative personal and social identities. Through identification they may feel the hero's or heroine's emotions, endure the character's personal tragedies, and achieve his or her social triumphs.

In a similar way, people may also vicariously live out experiences of fictional characters. When the TV is turned off, the book closed, or the newspaper thrown away, people continue to engage in artificial social relationships with the figures they have "met" in the media. Fans are attached to unmet media figures in ways that are analogous to, and in many ways directly parallel to, actual social relationships. This engagement in pseudosocial interactions often fills gaps in the individuals' actual social world.

By using interviews to analyse the interest in media heroes and heroines, it can be shown that the recipient's psychological response is closely analogous to that in an actual social relationship. The recipients characterize unmet media figures as if they were intimately involved with them, and in a sense they are: they see many media heroes and heroines as father figures, or models, or friends. In this way media sports serve as social substitution.

These relationships often fill gaps in the individual's actual social world. As Elihu Katz and Paul Lazarsfeld (1955) observe, escapist media often serves as a direct substitute for socializing activity. If the social situation is dissatisfying, an individual may compensate with artificial companions. Because they invade the individual's fantasies, media figures also affect economic and political behaviour and structure all kinds of decision making. I noted earlier that media figures as pseudo mutual acquaintances, often provide the basis for socializing. The ultimate example here is fan clubs, organizations of real people who come together and interact out of their mutual attraction to a celebrity none of whom they may have actually met face to face. Thus attachments to media figures have complex positive and negative consequences. They influence values, goals and attitudes, and through this they exert a pervasive influence on social conduct.

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Adapted Physical Activity and Sport for the Disabled

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PROCESS OF INTEGRATION, INCLUSIVE PE AND UNIVERSITY APA STUDY

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Abstract

The process of integration started in 70ies that the European Community has begun to assert its concern about people with disabilities and their integration into society. The recommendation was called "non-discrimination policy" and the attention was paid to social, economy and employment acceptance. The Charter for Children Rights in Europe (1975) was accompanied with Education for all Handicapped Children Act in the USA (1975). Even non-discrimination policy was officially presented any big changes were not perceptible.

The general lack of education seems to be main barrier of more rapid development of inclusive PE education. PE teachers needs support in different areas:

- basic education in APA/inclusion for all PE students,
- special offer to further, continuous education,
- advising system of APA/inclusion in special education centers: no PE or APA staff is working in this type of centers,
- direct assistance – as the teachers in integrative setting are usually special education teachers (minimal experience with PE), or PE teachers (minimal experience in special education), both of them with minimal experience in inclusion,
- less number of students in class – depends on legislation on school conditions,
- specials equipment - depends on knowledge of the teachers, on economy situation.

Process of integration has to be understood as the life concept of independent living of all individuals. PE is considered as the fixed part of school education. In spite of the quite relevant European legislation inclusive PE lag behind other areas of education. One of the important markers of weak development there is lack of teachers education on secondary schools level as well as on university level. Effort toward inclusion of students with special needs – sportsmen (with adequate support) can serve as positive features for understanding of phenomenon "the others" of all PE inclusive process participants. Research in this area should be oriented on the topics relevant to practice in PE/sports inclusive forms.

Key words: *process of integration, inclusive PE, university APA study*

Introduction

The process of integration started in 70ies that the European Community has begun to assert its concern about people with disabilities and their integration into society. The recommendation was called "non-discrimination policy" and the attention was paid to social, economy and employment acceptance. The Charter for Children Rights in Europe (1975) was accompanied with Education for all Handicapped Children Act in the USA (1975). Even non-discrimination policy was officially presented any big changes were not perceptible.

The Council of European Community presented the promotion to the activities in the framework of the HELIOS Community action (HELIOS I – 1989-1992, HELIOS II – 1993-1996). Those activities covered strongly, beside others, the areas of significant importance such as functional rehabilitation, integrative education and leisure activities of persons with disability (Aldomainte, R. (2004). The HELIOS II was designed for improving exchange of information activities including principles of education.

Only when The Charter of 80ies was proclaimed vocational, social and cultural integration were aimed domains for life of persons with disability. The goal of the Charter stressed two purposes: to proclaim the document and to provide ten years continuous process. Complete framework of the Charter developed during 80ies decade and follow up with next legislation activities covered up basic life-span domains: health care, social care, advising-consulting, services and accessibility, employment/job, education, leisure time. But medical aspect and economy impact were stressed again.

The policy of integration in education in Europe was endorsed in 1990 with main idea – integration of children and youth with disabilities to general, regular system of education in determined country (Resolution of the council and the Ministers of Education meeting). Next long term discussions related to "better educational system", higher quality of

education either "ordinary, integrative" or "special, separated" are stabilized in actual existence of two different systems (mainstreamed, integrative and special) in the most European countries. The regulation or guidance followed the non-discrimination policy and support too integrative education stressed special attention to specific minorities with disability: 1992 The Charter of Autistic Children, 1993 Resolution of Rehabilitation (separated traditional individual medical model and progressive social-educational model), 1996 New Community Disability Strategy (stressed education of persons with sensory-perceptual forms of disability).

It is fair to mention the Charter of Gifted Children was proclaimed in 1983. Both children with disabilities and gifted children are touched with phenomenon "the other". They are different they have right for early diagnoses, early intervention and adapted education approaches.

The European Commission (2000) followed European Parliament (2001) welcomed the Commission communication entitled "Towards the barrier free Europe for people with disabilities". The composed resolution aimed to take account of people with disabilities in the fields of employment, education and vocation training, transport, information society. In reality – principle of non-discrimination became long-life concept of integration in any field of daily life of individuals with or without disability. The acceptance of phenomenon "the other, different" seems to be crucial point of policy non-discrimination education related to positive attitudes towards social integration. It means the attitudes toward phenomenon "the different" (and changing attitudes) are considered as important part of non-discrimination policy, policy of independent living. Step by step, phenomenon of "the other", "the different" was introduced in movies, drama, in fashion style and beauty, in humor. The physical activity and sports have been next important domain of integration, social inclusion.

Inclusion and physical activity (PA), physical education (PE) and sports in Europe

The models of integration in education system in countries of EU are linked with historical routes in education and legislation in different countries. The Charter of sports for all: handicapped people (1986/87) is considered as great influence of future development of PA of people with disabilities. The Charter underlined three aspects of human rights:

- Right for active leisure (with physical activities, sports, games, outdoor activities).
- Right to be educated and guided with professional staff.
- Right to be educated for future profession in PE/sports domain (Válková 1998).

According European legislation the most educational laws were innovated in 90ies (1994 Salamanca declaration, 1995 World Conference on Social development in Kopenhagen 1995,

1999 World Summit of PE in Berlin). Categorical approach was common in system of education as so as in system of institutions and special schools. Categorical approach influenced the system of inclusion. Different number of categories were found: beside classical 4-5 (mental, visual, hearing, physical disability) there were 13 in Poland, 10 in Germany, 8 in Spain), environmental model is used in the UK and in Ireland. (Dinold and Valkova 2004). The school education legislation supporting inclusion is done in all EU countries. In reality, attention is paid to education in general. This situation helps to stress special education. PE is considered as the firm part of general curricula but in real situation students with special education needs (SEN) have not duty participate in PE lessons, but only the chance. The majority of them is excluded by physicians (or physicians with parents or/and special education center). There is a problem not only of SEN but all other children.

Besides regular PE lessons the system of out-class sports exists, like swimming courses for beginners, outdoor activities or summer-winter camps, exercises during break, etc. All of 23 European countries participated in THENAPA project (Dinold and Valkova 2004) presented a chance for SEN to choose and participate but very rarely in reality (15 countries). The reasons specified by representatives of THENAPA countries were as follows: lack of information about inclusion of parents and physicians, lack of information about available PA in general, access to sports venue, appropriate time, no interest of SEN, teachers non-preparation. One important reason which hinder successful integration was underlined with all project participants: physical education is considered less important than other subjects in school curriculum. There are named mostly similar reasons (Dinold and Valkova 2004):

- movement is less important than cognitive skills,
- no big attention among all other subjects,
- less value of the body in the educational system,
- not important for the "future" of children with special needs,
- low recognition for cultural and ancestral preconceived ideas about body and movement,
- sometimes traditional physiotherapy – regarded to be and alternative for PE lessons,
- lack of experience of positive values that PE can provide for all,
- lack of support.

In many countries the problems of integration are recognized in the area of special education as more important than the PA/PE integration.

PE teachers education related to APA and integration (Dinold and Valkova 2004)

Process of integration should start on the level of kindergarten and primary school. Pre-school inclusion is considered as no problematic, probably due to accent on social education aims. Similar situation is shown on primary school level. Primary level teachers are educated for teaching of all subjects, including PE. They are usually educated in the domain like "special education". Children on primary school level are easily included in PE and participate in PE due to teachers general education, their attitudes toward children with disability. Primary level teacher go through complete integrative process in all teaching subjects.

PE teachers – it means all graduates competent to teach PE at secondary level – are not specially educated in "PE integration competencies". The topic "inclusive PE" is the part of complete APA study. Only 6 EU countries presented between 3-5 Crp of APA obligatory for all PE graduates. Other countries (12) presented optional APA, 3-5 Crp, too. Obligatory special education in mentioned in 6 countries and optional subjects of APA. Completed specialization of APA is presented by 12 countries. The education there is very different: certificate /license in APA courses – additional to PE or physiotherapy, full specialization on the level of Bc., participation in international studies (EMDAPA, DEUAPA, CEEPUS, Erasmus-Mundus). Further education depends on system of Ministry of Education which is responsible authority and delegates competencies into independent university. Universities are more/less active to prepare curricula, courses, they have more/less capacity (finance, personal, etc.) Complete APA study program is developed in Palacky University, Olomouc on Bc. and MA level. The four main modules providing professional competencies consisted from: pedagogy-psychology, special education, PE, APA "didactics". Teaching competencies are proclaimed as the differences between Bc. and MA level. The topic "integration" is oriented on recreation and leisure activity on Bc. level, teaching of PE in various forms of integrative setting is the main aim of the "inclusion issue" on the MA level.

The general lack of education seems to be main barrier of more rapid development of inclusive PE education. PE teachers needs support in different areas:

- basic education in APA/inclusion for all PE students,
- special offer to further, continuous education,
- advising system of APA/inclusion in special education centers: no PE or APA staff is working in this type of centers,
- direct assistance – as the teachers in integrative setting are usually special education teachers (minimal experience with PE), or PE teachers (minimal experience in special education), both of them with minimal experience in inclusion,
- less number of students in class – depends on legislation on school conditions,
- specials equipment - depends on knowledge of the teachers, on economy situation.

Universities are responsible for the quality of PE graduates in general, in the knowledge, skills, experience in guiding integrative PE education. Universities should offer further education for field PE teachers, as well as for research.

Role of the university lecturers related to education of PE graduates

Recent very extend concept of integration in the domain of PA, PE, sports includes, besides traditional, various areas (Doll-Tepper, 2007):

- all agents, all limits or abilities (age, diagnosis, the content of activity, recreation, top competitive sport, school PE lessons, etc.),
- adventures sports, risk activities,
- improvement of technologies,
- PA related to cultural diversity,
- theoretical background of APA, fitness, health and safety,
- physical literacy.

APA and teaching in inclusive setting cannot be based on "cooking guide" due to various areas (see above). Even university lecturers in Europe are not educated enough from the aspect of APA or "PE inclusion". They need to study, to keep practical experience and programs which is not easy. One of the basic problems of university teacher´s fear toward inclusion seems to be lack of positive attitudes due to lack of knowledge and surviving "sports performance" concept in PE as well as concept: disability is equal to illness, illness is equal to exclusion from PA, PE. Participation in inclusive teaching (universities, secondary schools) has to be related to personal decision. Inclusion has to be considered as human right. Dignity of both partners in inclusive process means quality of services. Life projects in PA, PE, sports participation means the possibility of option (Rodrigues, 2007).

The professional boundaries in APA are constantly challenged, there are opportunities for new jobs, new vocations in "old jobs", it needs more knowledge skills, experience. There is necessary to use the different, innovated teaching styles

as the education is more and more heuristic process than training, more and more process of changing competencies. Teaching in integrative setting is process of applying multi-dimensional (knowledge), multi-contextual (environment, conditions), multi-experiential (attitude)approaches. Multi-approach education means congruency between traditional academic approach and practical professional approach. Professional isomorphism means study in real environment related to teaching needs. Traditional academic education, knowledge, is not enough. Personal experience, joy, empathy, passion – is not knowledge. Related to contact theory there is not possible to educate without personal meetings, communication with person with disability, with meeting integrative situation.

Inclusion of students with disability into university PA and sports study programs

Integration on the level of university study is supported with University Law (1998).

§ 21 acts university to be responsible (beside others):

d) for advisory services related to study orientation, study process as well as job orientation in practice,

e) for arrangement all services for leveling chances of study enrollment, process and graduation – for all students.

Developmental granted projects oriented on better conditions of university study of students with disability started in 1994. Among several of them projects oriented on leveling chances for APA, sports/sciences study, etc. were included. This year (1994) Palacky University of Olomouc coordinated mentioned project. The most successful results seemed to be Bc. study program of motor activities, drama and pantomime of students with hearing disability (Brno), APA structured program (Bc.-MA in APA) in Olomouc (Vaverka and Válková 1994; Válková 2002).

Developmental projects of CZ Ministry of education, youth and sports go through the competition every year, up to these days, financial support can be used for development related to characteristics of university: study rooms, students dormitory, special advices, personal assistant, sign language interpreter, etc., as well as for APA study improvement, university conditions for sports and recreation of students with disability.

Inclusion of students with special needs is quite common recently in the majority of universities study programs. Situation in PE/sports studies (in Czech - Kinanthropology) is not relevant existing legislation. Even we consider multi-contextual participation in real integrative environment, personal contacts and communication with students with disability on the university level very important the real inclusion of those students is very weak. First principles of inclusion were formulated in the 1994, in the project mentioned above with advising Marion Vosahlo, the director of the Centre for assistance of students with special needs, University in Alberta (Dokoupilová, 1994 . Basic clause for access of the students is "sports mobility". It means students are usually very good sportsmen on the international, European or world level of Paralympics, Deaflympics competitions. Students have the same rights and the same duty, only some of motors skills or performance achievements are modified related to individual diagnoses (hearing problems, motor problems, wheelchair user, etc.). Department of APA (Faculty of Physical Culture) has to provide special support for study process (sign language interpreters, special advices or tools, assistance, etc.). The issue of modifications is, unfortunately, discussed long time (14 years) with only specific teachers they have recent power to exclude the students from inclusive lessons to parallel education. But they have any knowledge in job diversification of APA graduates, attitudes related to miss-understanding the phenomenon of "the different". Discussions are oriented

a) on safety in PE teaching process (but APA is not only about teaching, but on diverse job and competencies),

b) on mobility modification and the "equal diploma" (all students can select optional B and C subjects),

c) on motor competencies related to profession (nobody knows if eg. hurdle run or parallel bar results can provide better professional competencies than wheelchair paralympic slalom, or handbike run, if passing standing shot-put is more competent than sitting shot-put).

Inclusion of the students is the great contribution for mutual education: they have very good experience with "different" sports environment and they are able to present high level specific skills, they can motivate of other students, all students can get experience with inclusion-exclusion, with study modifications related to motor limits of included students. They live together on the same students level: accommodation, meal, party, exams, loves… In spite of special support study is not easy for students, inclusive provcess is not easy for both sides.

There were about 15 students together in every study year (2-3 students per study course in full-time and part-time study programs). Seven students finished their study on MA level (1 on Ph.D level), several students felt and did not finished study.

Other good examples are reported from some European universities (information from 2004):

- 9 students at universities in France (2003), studying usually sports management, sports administration (results of comparative study in DEUAPA program),
- 1 student of Sports Academy in Poznan, Poland, recently the teacher of Academy,
- 2 students of Sports University in Kaunas, Lithuania, 1 of them the teacher of Academy,

- 2 students of National Sports Academy in Sophia,
- several examples from Austria and Norway.

Research

Attention to research is influenced by real situation in education. As there is the lack of APA specific studies in Europe, research is random. The small research projects (unpublished) were completed by doctoral, masters theses, mainly in general topic of APA. Only five, officially granted projects of 23 countries were presented (Dinold and Válková, 2004), even those projects were out of great publicity. Projects on national level, concentrated on school PE inclusion, were documented (Austria, Czech Republic, Finland, Germany and UK). Research of Czech Republic, mostly doctoral and masters theses, was cumulated around the project of Czech Grant Agency No 406/00/1606 (2000-1002) "The best place for all (integration of youth with disability through physical education and sports)". The main aim of all research theses was discovering the ways of successful inclusion of students with different diagnoses, on the different school level and different content of inclusive PE lessons (Čejka 2006; Halamičková and Válková 2003; Kudláček 1997; Obrusníková 1998; Mačáková 2004; Marshallová 2003;). Theses underlined one important findings: when the teacher keeps positive attitudes with phenomenon "the different" and when the teacher is informed, educated in inclusive teaching, the inclusive PE lessons can be successful for all participants.

Research results related to PE integration are documented in Adapted Physical Activity Quarterly (Block and Obrusníková, 2007). There is analyses of 30 articles, most of them are oriented on teachers or students attitudes toward integration. But – teachers need information useful for practice, for leading PE lectures or other inclusive forms. More research relevant to problems in practice has to be developed. The topic "integration of university students in PE sports program" should be one of them.

Conclusion

Process of integration has to be understood as the life concept of independent living of all individuals. PE is considered as the fixed part of school education. In spite of the quite relevant European legislation inclusive PE lag behind other areas of education. One of the important markers of weak development there is lack of teachers education on secondary schools level as well as on university level. Effort toward inclusion of students with special needs – sportsmen (with adequate support) can serve as positive features for understanding of phenomenon "the others" of all PE inclusive process participants. Research in this area should be oriented on the topics relevant to practice in PE/sports inclusive forms.

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THE EVALUATION OF THE MOTIVE POTENTIAL AT PRE-SCHOOL CHILDREN – PREVENTIVE PHYSICAL THERAPEUTIC INTERVENTION

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Abstract

The assimilation of motive skills during time was investigated by psychologists, physiologists, teachers and specialists from all the fields in which the motivity is manifested, in this way being determined a point of view regarding the stages that one must go through in order to acquire a skill.

Key words: *evaluation, motivity, pre-school children*

Introduction

Following the study of different sources of information, it can be observed a lack of interest for the motive potential of this age category, from different categories of scientists.

Today in the syllabus of the pre-school instructional-educational activities, the time allocated to these activities of (correctly) learning the motive skills is reduced or they are limited to the "*warm-up moves*", not respecting the proper execution of the movements. No importance has been given to this basic component of the child's harmonious growth and development, in this period in which the law of the great alternances is more and more visibly manifested.

We consider the evaluation and the capitalization of the motive potential very important for the harmonious development of small children.

The hypothesis of the research

- we presume that the motive potential evaluation process can be considered a physical therapy intervention;
- we presume that the correct evaluation of the motive potential can constitute a guiding mark in the case of an ulteriour preventive physical therapeutic intervention.

Material and method

The subjects in the research are pre-school children with the age between 5 and 6 years old, from the Kindergarten no. 29 of Bacau. The experiment is a part of the research project for the doctorate and started in april 15 2007, time in which the initial and the intermediary testing took place. For the experiment there were selected fourteen children from a total of twenty children. The selection criterion was based on age (homogeneity) and the frequency inside the directed motive activities.

The tests used for evaluating the motive potential were:

The test used for evaluating the motive skills is called "*synthetic, estimating the accomplishment degree of the physical education specific objectives – SDF 3/6*" evaluation chart, proposed by the authors: Sabău, E., Drăgoi, C. and Sabău, L., (1989).

This chart allows:

- a more rigorous evaluation of all the skills acquired during the pre-school period;
- the estimation, as precisely as possible, of the efficiency of the methods and procedures used for improving or raising the acquired motive skills level.

The *SDF 3/6* chart is composed of:

- the list of the chart items (the list of the motive skills in question);
- the description of each skill: the concise presentation of the right way of execution, the enumeration of the most frequent execution errors at the pre-school child;

- the motive skills are structured in 5 groups, which are also divided in different sections; each section starts with a target item, that is always followed by the description of the manner in which the child must execute it;
- it follows the intermediary items of learning process, the steps that forerun the correct learning of a skill.

The evaluated motive skills were: *walking* – ordinary walking, rhythmic walking, walking toward a certain indicated direction, walking on tiptoes, walking on heels, walking and going round some obstacles, walking and stepping over obstacles, walking in balance, walking on an inclined level; *running* – ordinary running, running in variated rhythm, running toward a certain indicated direction, running and going round some obstacles, running over obstacles; *jumping* – jumping with both legs at the same time, jumping with one leg, then the other, jumping deep (from an elevated surface, landing in crouching position), jumping in length, jumping and touching a suspended object; *throwing* – throwing with both hands down, throwing with one hand at the shoulder level, throwing with both hands at the chest level; *catching* – catching with both hands down, catching the ball with both hands at the chest level; *crawling* – crawling from lying down on the abdomen, with alternative movement of arms and legs, crawling on the abdomen, with support on the forearms and pushing with the tiptoes.

The Oseretsky – Guillmann test, quoted by Lozincă, I. and Marcu, V., 2005, gives a general examination of the motivity for this age category.

The test studies behaviors essential for the motive life under its 4 aspects: speed – force – coordination – resistance, on the coordinates: dynamic hand coordination, general dynamic coordination, balance, rapidity, spatial orientation.

We specify that this test shows the relation between the chronological age and the motive age. In the evaluation, the chronological age was expressed in years and months for an objective emphasizing of the motive age recorded in this manner.

Results

The selective global presentation of the SDF 3/6 chart results (motive skill – catching)

Table no. 1 The statistical descriptive analysis of ***catching - initial testing***

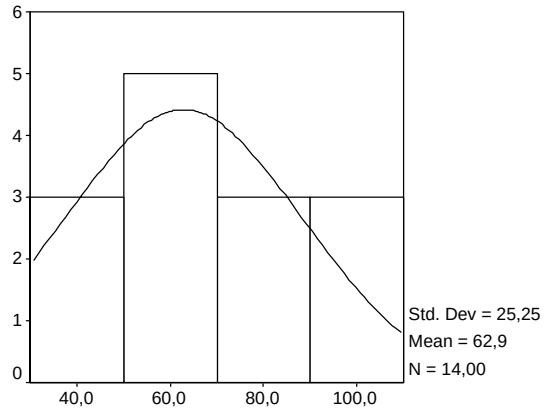
	N	Minimum	Maximum	Mean	Standard deviation
SDF - catching the ball with both hands down, initial testing (percentage)	14	30	100	62,86	25,246
SDF - catching the ball with both hands at the chest level, initial testing (percentage)	14	30	100	67,86	19,287
Valid N (listwise)	14				

Table no. 2 The statistical descriptive analysis of ***catching - intermediary testing***

	N	Minimum	Maximum	Mean	Standard deviation
SDF - catching the ball with both hands down, intermediary testing (percentage)	14	50	100	72,86	20,542
SDF - catching the ball with both hands at the chest level, intermediary testing (percentage)	14	50	100	76,43	17,368
Valid N (listwise)	14				

The graphic presentation and interpretation of the results for catching, according to the SPSS system

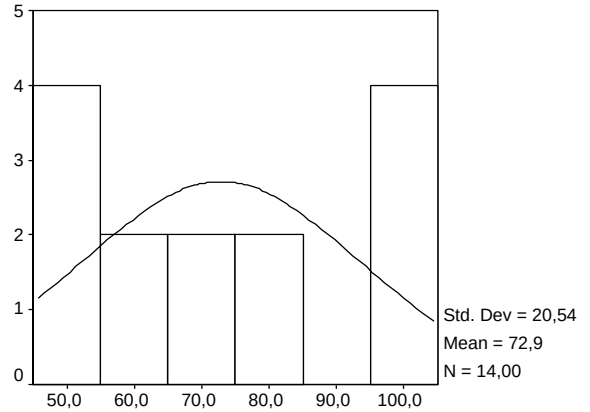
Initial testing
(april 15 – may 10 2007)



SDF - Prinderea mingii cu ambele mâini de jos

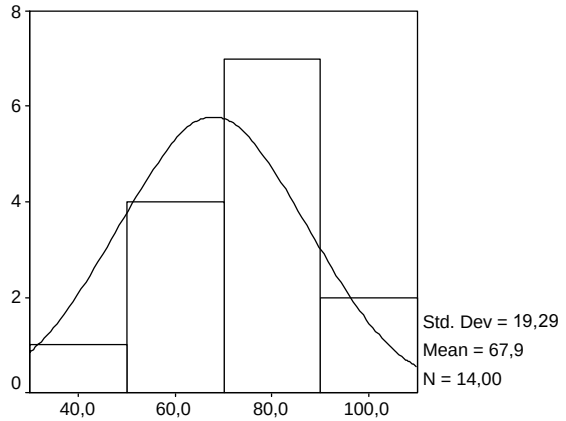
*Chart no. 1 From this chart we can observe that at the initial testing for **catching the ball with both hands down** we have a positive unimodal distribution of the subjects' results (inclination of the curve is to the right), grouped around the value of **62,9**%, their mean, (3 subjects - 40%, 5 subjects – 60%, 3 subjects – 80% and 3 subjects – 100%) and a standard deviation of **25,25**.*

Intermediary testing
(january 7 – january 30 2008)



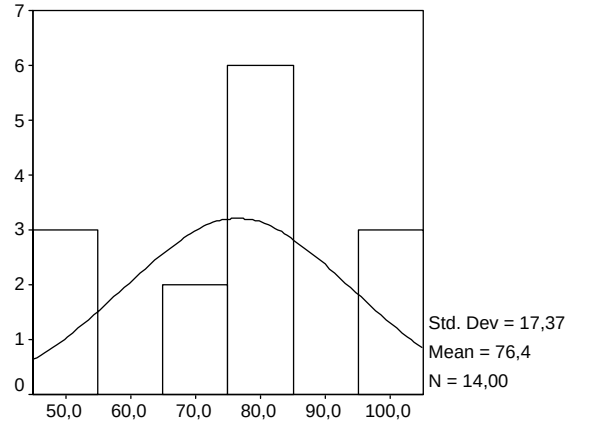
SDF - Prinderea mingii cu ambele mâini de jos

*Chart no. 2 From this chart we can observe that at the intermediary testing for **catching the ball with both hands down** we have a positive bimodal distribution of the subjects' results (inclination of the curve is to the right), grouped around the value of **72,9**%, their mean, (4 subjects – 50%, 2 subjects – 60%, 2 subjects – 70%, 2 subjects – 80% and 4 subjects – 100%) and a standard deviation of **20,54**.*



SDF - Prinderea mingii cu ambele mâini la piept

*Chart no. 3 From this chart we can observe that at the initial testing for **catching the ball with both hands at the chest level** we have a positive unimodal distribution of the subjects' results (inclination of the curve is to the right), grouped around the value of **67,9**%, their mean, (1 subject – 40%, 4 subjects - 60%, 7 subjects – 80%, 2 subjects – 80%) and a standard deviation of **19,29**.*

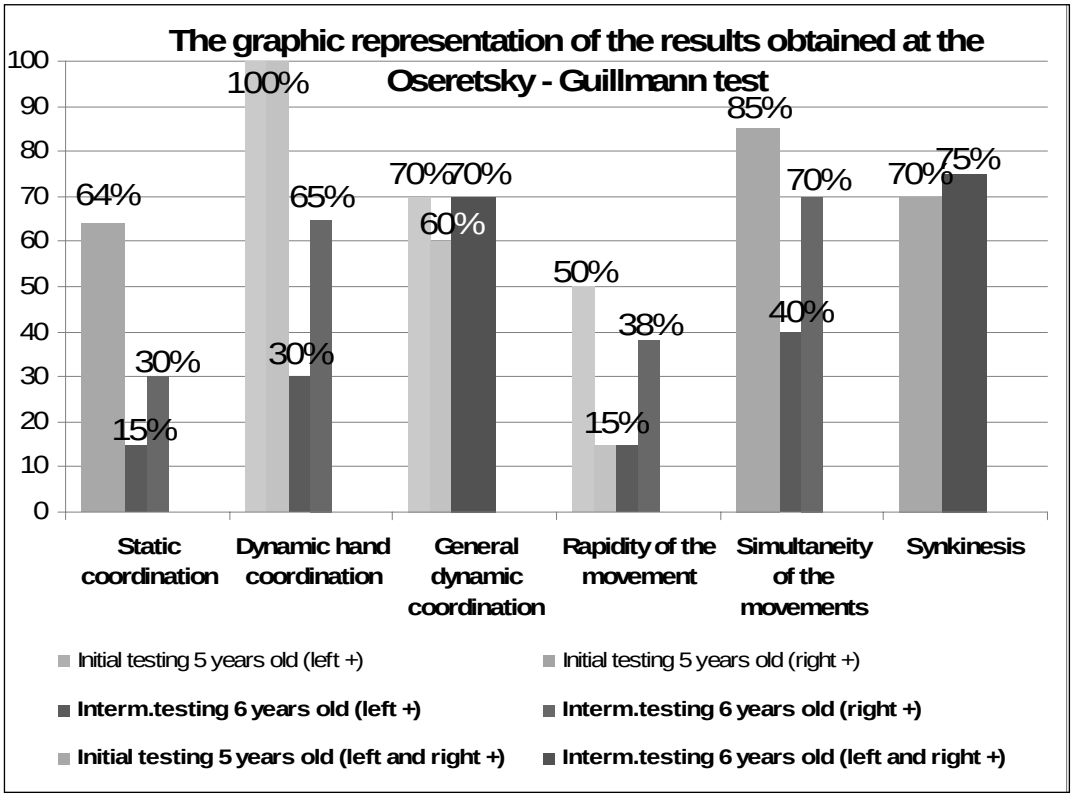


SDF - Prinderea mingii cu ambele mâini la piept

*Chart no. 4 From this chart we can observe that at the intermediary testing for **catching the ball with both hands at the chest level** we have a positive unimodal distribution of the subjects' results (inclination of the curve is to the right), grouped around the value of **76,4**%, their mean, (3 subjects – 50%, 2 subjects - 70%, 6 subjects – 80% and 3 subjects 100%) and a standard deviation of **17,37**.*

The conclusions of the graphic interpretation for the section *catching*:

- for the *initial testing*, we identify the smallest standard deviation with a value of *19,29* for *catching the ball with both hands at the chest level* and the lowest average *62,9%* for *catching the ball with both hands down*; and the highest standard deviation *25,25* for *catching the ball with both hands down* and the highest average *67,9%* for catching the ball with both hands at the chest level;
- for the *intermediary testing*, we identify the smallest standard deviation with a value of *17,37* for *catching the ball with both hands at the chest level* and the lowest average *72,9%* for *catching the ball with both hands down*; and the highest standard deviation *20,54* for *catching the ball with both hands down* and the highest average *76,4%* for *catching the ball with both hands at the chest level.*



The presentation of the results following the Oseretsky – Guillmann test

No. crt.	Last name/first name	Sex	Initial diagnosis	Intermediary diagnosis
1.	**B. B.**	F	slight motive delay	motive deficiency
2.	**B. L.**	F	motive deficiency	motive deficiency
3.	**B. A.**	F	motive deficiency	normal
4.	**C. C.**	M	motive deficiency	motive deficiency
5.	**F. A.**	M	motive deficiency	motive deficiency
6.	**P. D.**	M	motive deficiency	normal
7.	**N. I.**	F	motive deficiency	normal
8	**F. D.**	F	motive deficiency	normal
9.	**R. A.**	F	normal	normal
10.	**T. E.**	M	motive deficiency	normal
11.	**Ț. E.**	M	motive deficiency	normal
12.	**U. C.**	M	motive deficiency	motive deficiency
13.	**V. A.**	F	motive deficiency	motive deficiency
14.	**Z. A.**	M	motive deficiency	motive deficiency

General conclusions

Based the initial and intermediary evaluations and in concordance with the formulated hypothesis we can arrive at the following conclusions:

- we find through the analysis of the first hypothesis that the motive potential evaluation process can be considered a preventive physical therapeutic intervention, as the results indicate a motive potential that does not fit in the normal values of this age category
- analyzing the second hypothesis, we find that following the results obtained during the initiated evaluation stage, the next stage that must be accomplished is one of applying in a differentiate way instructive programs in order to correlate the chronological age with the corresponding motive potential of each individual, through preventive physical therapeutic interventions.

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THE EFFECTS OF SPECIFIC STRENGTH TRAINING IN ELDERLY PEOPLE WITH KNEE OSTEOARTHRITIS

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Abstract

This paper analyses the effects of exercise by elderly people with knee osteoarthritis (OA). Thirty patients aged 60-80 years were recruited, with clinical and radiographic evidence of knee OA stage Kellgren II and III. They have completed specific program of strengthening exercises and hydrotherapy during 12 days, 30 minutes daily. We have assessed degree of the pain intensity and joint movement, thigh circumference, muscle quadriceps strength at baseline and endpoint of the training program. Average degrees of the pain were: initial 7,0/final 4,6; joint range of movement: initial 116º/final 125º; thigh circumference 10 cm above the knee: initial 486 mm/final 492 mm; muscle quadriceps isometric strength: initial 83 kg/cm^2/final 95 kg/cm^2. Regular exercise has important role to preserve quality of life at older adults with knee OA.

Key words: *exercise, elderly people, knee osteoarthritis*

Introduction

The first decade of 21. century World Health Organisation (WHO) named as a "Bone and joint decade". The aim of this title was to emphasize the importance of locomotive system and moving itself in the human life. Also, it is awareness of organs for moving system increasing illnesses that are caused by bad living habits, hypokinesis and increase of average life age. While, at the beginning of XX century the estimated life age was 47 years, today in the developed countries is prolonged to 75 – 85 years, and in our areas it is average of 74 years – 77 for women and 71 for men (Vranešić et Krznarić, 2002). By getting older of the population arthrosis are more often. Among the western populations radiographic signs OA are visible within the majority of people older of 65 years and almost at all older than 75 years (Cooper, 1998). Due to that reason, the subject of this research was the implementation of adequate exercises, in other words using medical gymnastics that is hypothetically based at the perception of strong and balanced muscles significantly contribute to decrease of pain, preservation of stability and biomechanics relations within the knee joint and it is understandable that this is the remedy that can influence to increasing of knee functionality at the persons with OA illness.

Methods

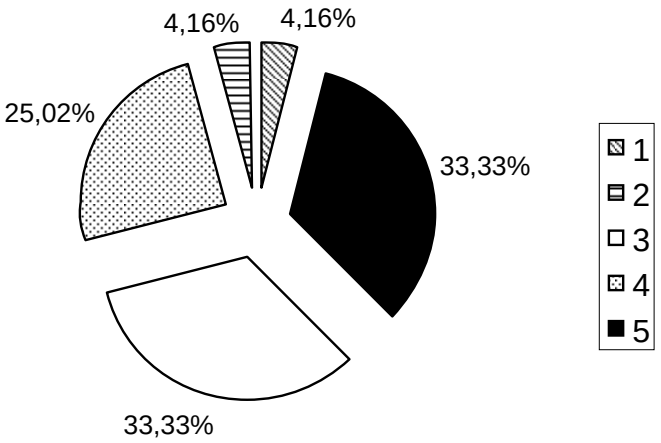
This research was conducted as longitudinal experiment with one group of examinees. Empiric-experimental method was used as a base method. The experiment was realized in the Special hospital for medicine rehabilitation Lipik and it lasted two weeks. Thirty (30) examinees who are suffering of OA (II-III phase/Kellgren) one or both knees, 60-80 years old, was encircled by this experimental treatment. All examinees are self movable with or without expedient. Except OA they have other chronically illnesses but those medical interferences are not against indication for implementation of the planned individually adjusted program of medical gymnastics and hydro gymnastics in the pool. Before beginning and after the end of the experiment for each examinee was definite the degree range of motions in knees, estimated pain (to VAS) and measured circularity of the upper leg 5 to 10 cm above the knee, and muscle quadriceps isometric strength. Medical gymnastics was implemented 30 minutes per day in the gym hall and in the pool with thermo-mineral water, individually adjusted regime under the supervision of physiotherapist. According to the collected information the relation between the values confirmed before the initial and during the final measurements and according the statistical index, same are assessed by T-tests effects of the implemented experimental treatment.

Results

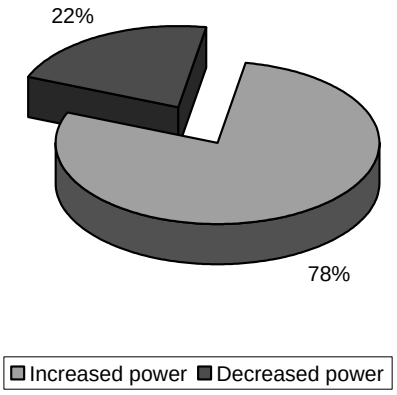
The total number of examinees included in the research was 30 – 21 female (70%) and 9 male (30%) elderly life age with the clinical and radiological picture OA at one or both knees that have fulfilled the criteria OA II and III degree per Kellgern. The average life age was 70 years (M70,0; SD 4,76) the range 61-80 years and more of 65% of examinees was in the age of 65-75 years old. Observing the distribution of frequency according to the age groups, age 60-65 years was 6 (20%) examinees, groups age 66-70 and 71-75 years made in each 10 (33,3%) examinees, and final group age 7-80 years has 4 (13,3%) examinees. After 12 days of implementation of programmed medicine gymnastics and exercises in the

pool 24 patients (80%) states decrease of painful component, same pain is registered by 5 (17%) patients and 1 patient (3%) stated that the pain is stronger. Out of 24 patients who stated on decrease of pain in knees after the implemented treatment one patient (4%) has pain smaller for 1 degree according to the visual analog scale, and 23 patients (96%) stated decreasing of pain for 2 or more degrees (Picture 1). After the medicine and hydro gymnastic cycles in duration of 12 days at 47 out of 60 tested muscles (or 78%) the increase of muscular strength is visible while at 13 muscles (22%) the measured strength was decreased than in the beginning (Picture 2).

Average degrees of the pain were: initial 7,0 (SD 1,41; range 5-10) / final 4,6 (SD 1,83; range 1-8); joint range of movement: initial 116º (SD 12,34; range 68º-140º) / final 125º (SD 9,98; range 100º-150º); thigh circumference 5 cm above the knee: initial 447 mm (SD 39,74; range 385-530 mm) / final 449 mm (SD 37,57; range 390-535 mm); thigh circumference 10 cm above the knee: initial 486 mm (SD 47,46; range 410-605 mm) / final 492 mm (SD 45,59; range 420-610 mm); muscle quadriceps isometric strength: initial 83 kg/cm^2 (SD 38; range 21-198 kg/cm^2) / final 95 kg/cm^2 (SD 40; range 25-200 kg/cm^2) (Table 1). It was achieved statistically significant decrease of pain, increase knee flexion, muscle strength, initial increase thigh circumference 10 cm above the knee (Table 2).



Picture 1. Number of degrees on decrease of pain according to VAS after 12th day implementation MG and HG



Picture 2. Relation on results of measuring strength of upper leg four-head muscle after 12th day

Table 1. Description table of the results on all observed variables based on accomplished initial and final measurements during the study
N = 30 for degrees of the pain, N = 60 for all others variables
1-initial measurement, 2-final measurement

	Min.	Max.	Max -Min	Mean	Std.Deviat.	Std.Error	Varianca
Degrees of the pain-1	5	10	5	7,0	1,41	0,202	2
Degrees of the pain-2	1	8	7	4,6	1,83	0,394	3,34
Total joint movement-1 (◦)	68	140	72	116,0	12,34	0,106	152,17
Total joint movement-2 (◦)	100	150	50	125,0	9,98	0,079	99,56
Total thigh circumference 5cm above knee-1 (mm)	385	530	145	446,8	39,74	0,088	1579,51
Total thigh circumference 5 cm above knee-2 (mm)	390	535	145	448,8	37,57	0,083	1411,33
Total thigh circumference 10 cm above knee-1 (mm)	410	605	195	486,3	47,46	0,097	2252,43
Total thigh circumference 10 cm above knee-2 (mm)	420	610	190	491,8	45,59	0,092	2078,67
Tot.m.quadriceps IM strength-1 (kg/cm2)	21	198	177	83,0	38,41	0,465	1475,03
Tot.m.quadriceps IM strength-2 (kg/cm2)	25	200	175	95,0	39,83	0,419	1583,40

Table 2. Results of T –test for small depending samples (both knees together)
1 – before treatment; 2 – after the treatment; N = 30
t – the value of T-test; df – degrees of freedom

	t	df	P
Degrees of the pain-1 Degrees of the pain-2	7,86	29	<.01
Joint movement-1 **Joint movement-2**	7,70	29	<.01
Thigh circumference 5cm above knee-1 Thigh circumference 5cm above knee-2	1,52	29	>.05
Thigh circumference 10cm above knee-1 Thigh circumference 10cm above knee-2	2,90	29	<.01
m.quadriceps IM strength-1 m.quadriceps IM strength-2	3,61	29	<.01

Discussion and conclusions

At intentional sample of elderly aged examinees the verifying of efficiency of medical gymnastics on knee functionality in OA was conducted and the positive impact was confirmed like in some of the earlier studies. Among the all methods of physical therapy by American society for physical therapy, exercise (98%) and TENS (73%) are the most often recommended for the healing of knee pain (Philadelphia panel 2001). Two-year randomized and controlled research among the 786 examinees (600 finished the study), both sex, older than 45 years, with OA of knee conducted in Nottingham resulted with statistically significant decrease of pain and increase of isometric strength of quadriceps after 6, 12, 18 and 24 months at the patients who exercised in comparison of the group who did not exercised and was not fallowed by regular phone contact (Thomas et al., 2002). By improvement of locomotive system state and decrease of pain the improvement of total psychophysical condition in elderly persons is visible. Epidemiological researches are pointing at downsizing of physical activity with getting older. The physical activity significantly increases during the retirement period (at 60-65 years of age), after several next years rapidly falls and the problem of keeping the regular habit of exercising is bigger with women (Rhodes, 1999). It is well known that less body weight relieves knees, the exercise increase muscular mass and strength so the reducing diet and exercise are the combination in prevention OA and during the restraining of pain in knees (Felson et al. 1992; 1995). Perić et al. (2006) have made clinical researches and radiological marks on 60 patients average age 60 years with the diagnosis OA of both knees. According to their results instability of knee joint was noticed with 11 examinees (18%), while crepitations in OA of knee did not showed statistically significant connection with the specific phase of illness. By strengthening of muscles with the people of elderly age who have advanced phase of knee OA, is possible to diminish a degree of instability in knees and risk of fall.

The results of the present study demonstrated that programmed exercises can produce statistical significant improvement in pain, knee flexion, muscle strength and function of the joint in older adults with knee osteoarthritis. Non-significant trend was noted by measurement thigh circumferences 5 cm above knee. Regular exercise has important role in preserve quality of life in older adults with knee osteoarthritis.

The positive effect of exercise is necessary to brighten and to emphasize through the different shapes of education of the ill ones including their families, friends, and act toward the changing of conscience within the wider population on need of regular exercising with the main aim on preserving the quality of living through the change of life style of persons of older age. By exercise it is possible to act in prevention way to the progression of knee OA symptoms and it is necessary to put additional efforts toward the implementation of that form of behaviour in everyday life.

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COMPLEX ASSESMENT AND REHABILITATION PROGRAMM IN THORACIC OUTLET SYNDROME IN ATHLETES

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Abstract

This paper presents a propose of a rehabilitation algorithm programm in infraspinatus syndrome at athlets, using a complex programm. Infraspinatus syndrome is the result of damaging of suprascapular nerve during overuse of soulder and is frequently at volleyball players. We propose a complex assesement of athlets using: physical assesment, functional assesment by specific tests like Hawkin test and Neer test and also other assesments using electrodiagnostic, electromiography by Myomed 134 equipment. Protocol of rehabilitation included conservator treatment that try to improvement motor skills of shoulder, muscle force, mobility and stability of shoulder, using electrotherapy and physical exercises. Results of our study showed to us a good evolutions of our patients regards functional, clinic and specific parameters.

Key words: *shoulder, diagnosis, complex physical therapy,Hawkin test, Neer test, motor skills*

Introduction

Infraspinatus syndrome is a part of cuff tendinitis and is at the border between neurologic aspects and thraumatic injuries of shoulder. Infraspinatus syndrome is defined as a condition of frequently painless atrophy of the infraspinatus muscle caused by suprascapular neuropathy. The syndrome typically(Agre JC, Ash N, Cameron MC, 1987; Antoniadis G,1996) causes symptoms that mimic those of rotator cuff tendinopathy, and the diagnosis is often overlooked until the condition fails to respond to a traditional rotator cuff treatment program. The athlets come to us for shoulder pain, limits of mobility that favorise development of stifness and instability. Most of situations can be treat by physical therapy, kinetic therapy and also drugs therapy, but also exist some situations in wich surgical intervention must to be done, because is need to made a reconstruction(Asami A Asami A, 2000) of rotator cuff. Infraspinatus syndrome is the result of overuse at shoulder joint in sports such as baseball, volleyball, and racquet sports, in wich when his or her arm is in an overhead or abducted position (Antoniadis G, 1996).Also this syndrome exist at nonathlets persons. Specific of this syndrome is presence of infraspinos atrophy. The incidence of this syndrome was in our studies and our medical practice, around 15-20% at volleyball players.

Etiopathogenics aspects in infraspinatus syndrome

The first point is the biomechanic aspect and anatomic structure of suprascapular nerve that has two sites of potential entrapment: suprascapular notch and spinoglenoid notch(Demirhan M,1998). Second site represent the most common site of entrapment. Involvement of this site induce isolated atrophy and weakness of the infraspinatus muscle that characterizes infraspinatus syndrome. During the movement of the scapula like protracts and retracts with functional use of the upper limb, some traction of the suprascapular nerve can be expected to occur at 1 or both notches. So this nerve will be expose to damaging sheer stress. All these aspects are base on few observations regards spinoglenoid ligament that becomes taut when the ipsilateral upper limb is adducted across the body or internally rotated and so suprascapular nerve is vulnerable to direct compression by the medial border of the spinati tendons at the spinoglenoid notch (Demirhan M, 1998; Ferretti A, 1998) when the upper limb is abducted and externally rotated. Many studies reveal an ischemia that can involve disorders of suprascapular nerve and that is caused by migration of posttraumatic microemboli from the suprascapular artery to the vasa nervorum. Because glenohumeral joint is the most mobile joint from human body, is posible to increase the risk of shoulder instability.(Bigliani LU, 1990) Why? Because during movement ligamentous structures and the fibrocartilaginous glenoid labrum provide additional static stability, particularly at the extremes of glenohumeral motion. The supraspinatus and infraspinatus muscles (Cummins CA, 2000) dynamically stabilizes the shoulder joint through a precise system of force couples and agonist-antagonist coactivation, keeping the humeral head centered in the glenoid socket. Suprascapular nerv disorders disturbs this mechanism and could potentially result in proximal migration of the humeral head with secondary impingement of the supraspinatus tendon.

Material and method

We made a study of 20subjects, average of age were 38years, most of subjects were athlets and only 3subjects have not been athlets. Most of them are typical patient, young athlets who reports vague posterior shoulder pain. The pain has an insidious onset and is described as a deep, dull, aching discomfort. Activities exacerbate symptoms including weakness and reduce endurance in performing overhead.

Assesment methods included: physical assesment and functional assesment(14,15) used specific test for shoulder mobility and stability.

Physical assesment showed to us: atrophy of infraspinatus muscle, sometimes in two cases we observed supraspinatus muscle involvement depend of the site nerve entrapment. Muscle test showed to us presence of weakness of shoulder during abduction and external rotation, pain during movement and limits of mobility (Kugler A, 1996; Kibler WB, 1998). We used some specific tests for functional assesment like:Neer test for explore the integrity of infraspinatus muscle during specific movement , internal and external rotation associate with arm flexion. If the pain increase or the movement is impossible the test is positive.

Hawkin test is use for explore also the integrity of rotator cuff muscles during arm flexion at 90^0 elbow flexion 90^0 and rotation, internal and external. Presence of pain or instability not permit the movements, and so the test is positive(Meister K, 2000). Others test including imagining assesment, like plain radiographic for exclude bony trauma, and also for exclude cervical spine disoders that can involve ranches of brachial plexus. Shoulder MRI may reveal supraspinatus or infraspinatus muscle edema(Bredella MA, 1999) in acute cases and atrophy with fatty replacement in more chronic cases.Also we used electrodiagnostic using Myomed 134 for electromyography(Bredella MA, 1999; Casazza BA, 1998; Hashimoto BE, 1994) that evidence a denervation , with positive sharp waves and fibrillation potentials.

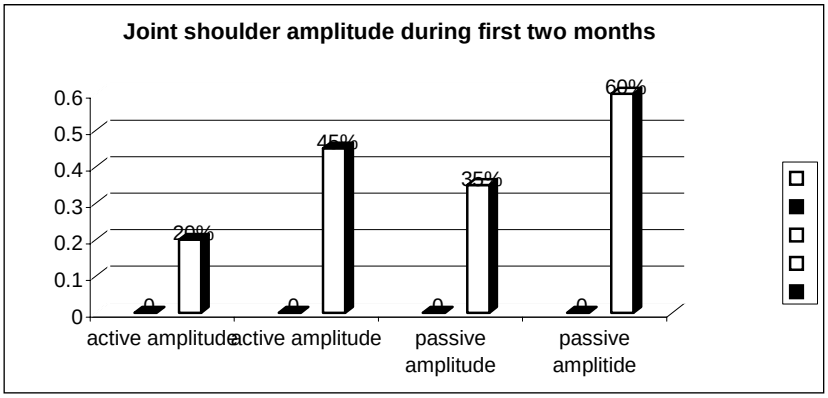
Propose of complex rehabilitation porgramme:

In our research we have two categories of subjects, one of them is in acute phase that needed surgical intervention and chronic phase. We exluded first lot and we apply a conservator rehabilitation programme at second lot. But even this lot present two phases: acute phase and recovery phase(Jones DS Jones DS, 1998; Kibler WB). Acute phase- has a rehabilitation programme that depend on severity of clinical phenomenous, because in absence of compression we used conservator treatment . So in this situation we poposed a programme of physical exercises for scapular stabilization, increase rotator cuff muscle tonus. So we obtain a possible prevent of impingement syndrome. Also we recomand this objectifes of rehabilitation, even after acute phase, because we can improvement flexibility of shoulder. We added also proprioceptive exercises(Coelho TD, 1994, Kugler A, 1996) for increas shoulder stability, muscle force, endurance and muscles balance around shoulder joint. Physical methods included ultrasonic waves and lasertherapy using Danson laser equipment and protocols for tendinitis disorders. Even most of authors dont present chronic phase of infraspinatus syndrome, we consider that this is the recovery phase. During this phase we prepare the athlets to return to play at soon at possible. Rehabilitation objectifes of this phase are: mentain shoulder mobility, prevention of muscltendinous retraction, promote scapular stabilization and shoulder stabilization, increase motor and muscle control, coordination.For increase muscle force and balance we used exercises with progressive weight begining from 500g, 8-10 repetitions, 3sets, but under the control of pain and cardiovascular status.For that reasons we used izotonic contraction, concentric and excentric contraction, and if is possible to use usually exercises that are the part from training programme of our athlets. The end of one rehabilitation programme must includ plyometric exercises for development muscle power. Plyometric method can improvement muscle force because it combine force and speed contraction, facilitate nervous control and muscle contraction. Also the phisiologyc base of this method is stretching at high speed or shortening at high speed contraction. So exist three phases: excentric, concentric contraction and abosorbtion of mechanic schok.

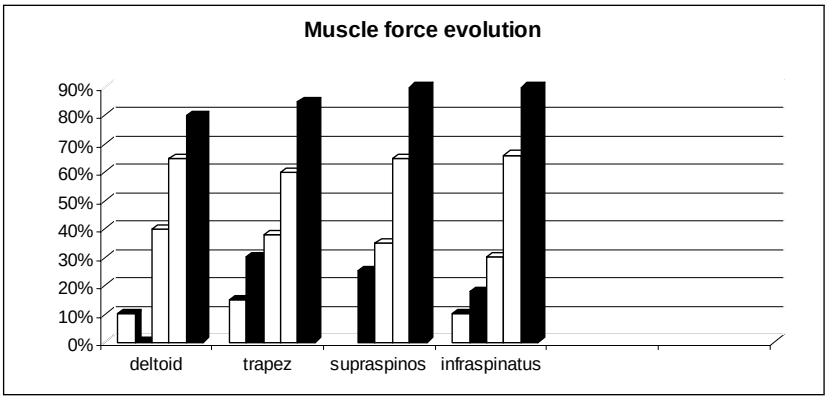
The recovery phase is during 6-8months even if the athlets begin the sport activity, we must to accord attention for continue the final rehabilitation programme, for prevent another disorders.Return to play come when our athlets did not have pain, instability or another discomfort. If all these persist our athlets return to play step by step. Of course we consider that is important to have a prophylactic programme that must includ warm –up and cool-down exercises and also is important to use orthetic devices during sport activity.

Results and discussion

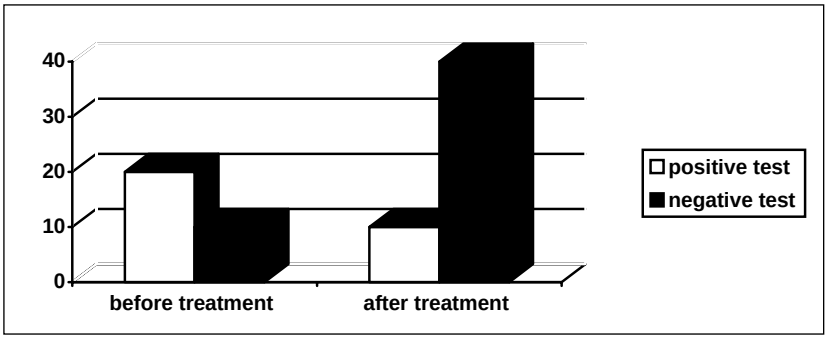
Present the dynamic evolution of specific test and pain because we consider that these are important for periodical assesment of our patients.



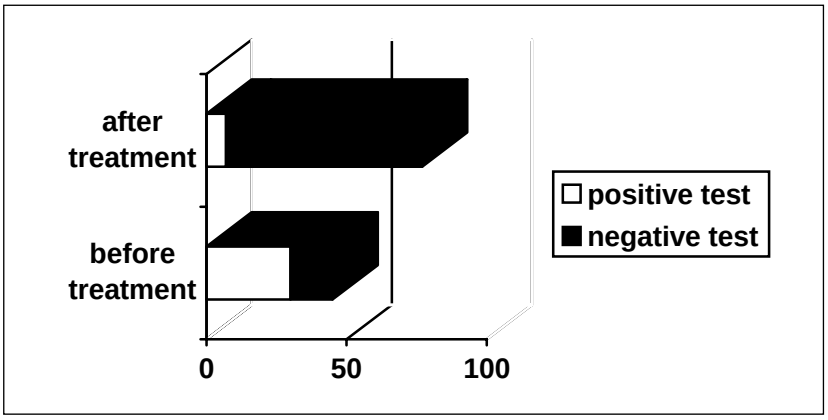
Graphic 1. Increase of joint amplitude during treatment



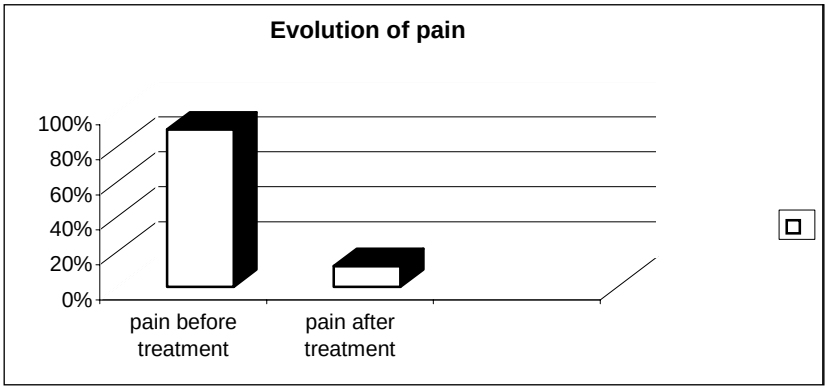
Graphic 2. Evolution of muscle force



Graphic 3. Evolution of Neer test



Graphic 4. Evolution of Hawkin test



Graphic 5. Pain evolution

How we seen is important to make a good assesment for decide wich is the best way for rehabilitation and for return to play. So we consider that specific assesment can help us to observe the dynamic evolution in infraspinatus syndrome. Much more if we apply earlier the rehabilitation protocol that we propose is possible to reduce the risk of recidive and the risk to increase shoulder injuries. Most individuals with suprascapular neuropathy are asymptomatic and compete with little to no discernible performance deficit. This observation complicates the issue of how to handle the return-to-playdecision.

In symptomatic athletes, a more restrictive course seems reasonable. Once the athlete can perform sport-specific skills in a pain-free manner, they can return to play. Athletes who undergo surgical decompression should participate in an appropriate postoperative rehabilitation program to restore their strength, flexibility, and endurance before returning to play.

No definitive study findings implicate specific spiking styles in suprascapular neuropathy; thus, providing technical advice about biomechanics to volleyball athletes with suprascapular neuropathy is difficult. Additional considerations remain unanswered; for example, the appropriate amount of skill training necessary to minimize the risk of volleyball shoulder is unknown.

The prognosis for a favorable clinical outcome is good. At the time of diagnosis, affected athletes report surprisingly little functional limitation. According to the literature, most cases respond favorably to either conservative treatment programs or, when indicated, surgical intervention, and most athletes were able to return to their prior level of sports participation.

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STATIC OR DYNAMIC STRETCHING AT THE BEGINNING OF A KINESITHERAPEUTIC SESSION. WHICH ONE IS BETTER?

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Abstract

The aim of this study was to compare the acute effects of dynamic and static stretching exercises on the elongation of the hamstring muscle. The study sample consisted of 14 kinesitherapy students, aged 22+/-1.2 years. They where divided into the *static* and the *dinamic* group. The groups underwent the same worm up routine before the stretching program. The flexibility of their hamstring muscle were measured with three tests before and afther they performed their stretching protocols. T-test for dependent samples showed good acute effects for both the methods. Since static and dinamic stretching exercises seems to produce good acute effects on static flexibility, when choosing which one to use one should focus on the characteristics of the person he is working with instead of looking at their acute effects.

Key words: *static, dinamic stretching, kinesitherapy session*

Introduction

Flexibility can be defined as the capability of a joint to move fluidly through its full range of motion (Alter, 1996). It implies the freedom to move without undue stress to the musculotendinous unit. It is therefore obvious that the development of such a capability to an optimal level, can very much improve the quality of life of a disabled person. It can allow a person to do simple things like bend to wear a shoe, without pain. An optimal level of flexibility can also help an individual to avoid poor biomechanics while walking or running, which can lead to constant pain of the back. Shorterly, it is an important ability that should be trained and developed to improve everyday life, especially for people with disabilities in whome this motor ability seems to lack, or people who suffer of muscular stiffness and had a lot of contractures. In a kinesitherapy session, stretching exercises are usually applied at the beginning, immedialety after a short worm up which allows the muscle tissue to achieve an optimal temperature for its elongation. Introducing a therapeutic session of a disabled person with stretching exercises (after a worm up routine) gives the opportunity to a person to get some exercise and prepare his muscle and joint for the incoming exercises aimed to develop strength, coordination or any other motor ability. For them, flexibility represents one of the main factors for a correct biomechanic function of the locomotor sistem. During a kinesitherapy session, a good level of flexibility allows them to perform the planned exercises in a better way (always within their capabilities), giving them the opportunity to improve better other motor abilities such as strength or endurance. To obtain the very best results of a stretching exercise different methods are used. The most well known methods to develop flexibility are static stretching, ballistic (dynamic) stretching, proprioceptive neuromuscular facilitation (PNF), muscle energy techniques, strain-countrastrain and functional techniques (Alter, 1996). Stretching exercises can also be analyzed as to wether they are free or resistive and be classified as passive, passive-active, active-assisted or active movements. Some of the mentioned stretching techniqes are more efficient in one than in other situations. For instance, dynamic stretching exercises are ofthen used to develop active flexibility in elite sport, while the static method has more ofthen a therapeutic aim (Schwellnus, 2001). The goal of this paper is to compare the acute effect of dynamic and static stretching exercises on the elongation of the hamstring muscle. It is in the interest of this work to see if the acute effects of this two stretching methods differs. The mentioned effects in fact represents the level of flexibility acchived at the beginning of a therapeutic session, meaning that this exercises prepare a person for the main part of the therapy. That is why the more effective stretching method should be used. From the biomechanical point of view, an effective stretching method leads to a relative good level of flexibility which allows the practitioner to execute the incoming drills more correctly (within his physical limitations). We compared the static and dinamic (ballistic) methods in order to see which one stretches better the muscle at the beginning of a kinesytherapy session.

Methods

The study sample consisted of 14 kinesitherapy students from the Faculty of Kinesiology, University of Zagreb, aged 22+/-1.2 years. They where divided into two groups of seven. Depending on the exercise they performed, we called one group the *static* group, and the other one the *dinamic* group. The groups underwent the same worm up routine

before beginning the testing and stretching protocol. They run at a heart beat of 120+/-12 for 10 minutes. Afther that, the flexibility of their hamstring muscle were measured with three tests. The MFLPRR and the MFLPRK tests for the evaluation of passive, and the MFLPLK test for the evaluation of active flexibility. For the MFLPRR test the subjects had to sit with straight legs with the angle in the hip being 45^0 and than bend the trunk forward. The MFLPRK test consisted in a standing straight-leg toe touch exercise performed on a bank where the subjects had to bend their trunk maximally. The MFLPLK test measured the dinamic flexibility by registering the hip angle while lifting a straight leg from a liyng position on the back. Afther the testing procedures each group performed their stretching program. The static group had to sit with straight legs and lean forward. They had to maintain this position for 30 sec. They performed this drill 3 times in one set. The drill lasted for 30 sec. and there was 4 sets, meaning that the practitioner of the static group stretched their hamstrings for 6 minutes. The dinamic group performed the same exercise but in a dinamic way. Instead of holding the same position for 30 sec., they had to rebaund 30 times. Each participant, regarderless if he belonged to the *static* or *dinamic* group, spent 6 minutes in a stretch position. A large number of studies aimed to register the effects of different stretching methods included stretching program with the same number of repetition and sets for all the groups (Gadjosik et all., 1993), resulting in a different time spent into a stretched position for each group. This leaded one group (usually the static one) in advantage. We planned a biggest number of repetition for the dinamic group (30 rebounds) only because the stretched position for this group lasted 1 second (1 rebaund), while for the static group it lasted 30 sec. (hold the position). The effects of the two different stretching methods, were tested with the t-test for dependent samples. Statistica for Windows (Version7.0) was used for statistical analysis.

Results

The changes in the results of the measured tests for the *static* and the *dinamic* group are to be seen in table 1 and 2. The data shows that both the participants of the *static* and *dinamic* group improved their results significantly. They both achieved better results in the first two tests (MFLPRR and MFLPRK) which measures static flexibility of the hamstring muscle. On the other hand, they had statistically better results in the test MFLPLK which measure dinamic flexibility, only when performing it with the right leg.

Table 1. Changes in the results of the measured tests after (II) the planned stretching exercises for the static *group tested with the t-test for dependent sample.*

Variable	Mean	Std.Dv.	Diff.	Std.Dv. Diff.	T	df	P
MFLPRR I	68,64286	12,75932					
MFLPRR II	73,71429	12,60427	-5,07143	3,186861	-4,21033	6	*0,005621*
MFLPRK I	8,19048	10,50151					
MFLPRK II	11,90476	7,60900	-3,71429	3,286778	-2,98988	6	*0,024324*
MFLPLK I right	92,85714	10,87446					
MFLPLK II right	88,33333	9,62250	4,523810	3,814481	3,137747	6	*0,020125*
MFLPLK I left	90,00000	13,19371					
MFLPLK II left	89,76190	13,31348	0,238095	4,241393	0,148522	6	*0,886797*

Table 2. Changes in the results of the measured tests after (II) the planned stretching exercises for the dinamic *group tested with the t-test for dependent sample.*

Variable	Mean	Std.Dv.	Diff.	Std.Dv. Diff.	T	df	P
MFLPRR I	59,33333	15,86167					
MFLPRR II	66,88571	14,69028	-7,55238	4,493693	-4,44661	6	*0,004345*
MFLPRK I	5,500000	11,66151					
MFLPRK II	7,952381	10,98851	-2,45238	1,909320	-3,39827	6	*0,014527*
MFLPLK I right	83,80952	12,19875					
MFLPLK II right	87,61905	10,62218	-3,80952	3,691116	-2,73062	6	*0,034158*
MFLPLK I left	86,66667	11,38550					
MFLPLK II left	88,09524	11,56418	-1,42857	3,107424	-1,21633	6	*0,269535*

T-test for dependent samples thus, showed that the performed exercises produced a difference between the results achieved before, and the one achieved afther the stretching protocol for the dinamic as well as for the static group. Such results points out the efficency of both the used methods.

Discussion and conclusions

The results shows the quality of both static and dinamic stretching exercises for the acute improvement of static flexibility. In the same time, neither the static or ballistic method can drastically improve dinamic flexibility. Probabily that `s because for the improvement of dinamic flexibility, besides working on the developement of the antagonists (stretched muscle) flexibility, one should work on the improvement of the strength of the agonists (muscle producing the movement). In fact, dinamic flexibility of one muscle strictly depends on the strength of its agonist to produce a movement. Since both the tested stretching methods seems to produce statistically significant improvement of flexibility, at least for what concerns their acute effects, one should choose the method to use by taking in consideration the characteristics of the individual he is working with. For instance, while working with a healthy athlete it may be better to choose dinamic stretching exercises since the movements that the athlete will produce after this exercises (on training or during a metch) will be dinamic. It therefore seems logic to prepare the body for what is next. On the other hand, while working with people with disabilities, when choosing the method to use one should take into considertion their health status. For example, some disabilities such as cerebral palsy, usually goes with contractures or forced contraction of the muscle. When a sudden stretch is aplied to a muscle (like during a dinamic stretching exercise), a reflex action is set into motion that causes the muscle to contract. As a resoult, muscular tension will increase, making it more difficult to stretch out the connective tissues and defeating the very purpose of the stretching procedure (Alter, 1996). When working with people with contractures one should first relax the muscle and than lenghten it, so it could be better to use some static instead of dinamic stretching exercises. Another argument against dinamic stretching, especially when working with people with people with muscle tightness is the fact that if a tissue is stretched too fast, it can be strained or ruptured causing pain and impairment of ROM (range of motion). When stretching slowly, a muscle can achive the same length but in a longer period of time. Mechanically speaking, the muscle is not required to absorb the same amount of energy per unit of time. Static stretching allows maximum control of the movement leading to less muscle soreness and it can provide more qualitative relief from muscular distress (Schwellnus, 2001). Static stretching also requires minor energy expenditure so that a person could save it for the next drill. On the other hand, one should take into consideration even the fact that static stretching can be boring leading to minor motivation to exercise (Weineck, 2001). Besides, Evatt et all. (1989) found out that when performing only static stretching exercises, an individual can downtrain or reduce the amplitude of the stretch reflex. Since this reflex is an important protective mechanism for the muscle and the joint, with this downtraining, a person may be prone to stretching beyond their safety limits, causing injury (Alter, 1996).

Looking at the results of this paper and at the argument per and against the two studied stretching methods, one can conclude that since both the static and dinamic method seems to produce good acute effects on static flexibility, when choosing which one to use one should focus on the characteristics of the person he is working with instead of looking on their acute effects which has already been proven. The presented study is a pilot study, therefore there is a need to undergo a much larger study with a bigger number of subjects in order to confirm or reject the achieved results. In a further study it is also possible to look for the acute effects of other stretching methods used in kinesitherapy like the PNF method.

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MEASUREMENT OF BODY COMPOSITION IN SPORT

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Abstract

Several methods are recommended to use for measurements body composition in sport. All these methods are indirect. The measurement mistakes are relatively high. Skinfold thicknesses measurements and bioelectrical impedance analysis are simple methods for testing relatively large groups. Using lipometer is also a promising tool. More correct are dxa scanning or air displacement plethysmography (Bod Pod). Athletes strive for low body weight because it gives them a competitive advantage. On the other side "anorexia athletica" is a health problem. In the sport practice it is recommendable to use longitudinal measurements, where the body composition of athletes is measured several times during the different training periods using the same method and equipment.

Key words: *fat mass, fat percentage, lean body mass*

Exercise training programmes confer considerable adaptation on the morphology of the human body affecting bone, lean and fat tissue. Normally exercising may induce specific development of muscle groups for certain sports affecting muscle mass (Stewart 2001). The influence of exercise on body composition is diverse, in part because different assessment techniques of varying accuracy and precision are used to quantity exercise-related change on body composition. However, many exercise interventions are blended with other treatments, especially dietary modification.

Studies of body composition of living man require reliable measurements. In vivo, body composition can only be measured indirectly. The general model for body composition is the two compartment model, i.e. Fat mass (fm) and fat-free mass (ffm). There is nowadays a great variety of methods available with different assumptions and limitations. In selecting, a method for use in any subject group, there is clearly a balance to be struck between information, cost, an convenience, which are unique to each set of circumferences.

The following methods are used for the measurement of body composition:

Hydrodensitometry

Underwater weighing, or hydrodensitometry, has long been accepted as ′gold′ standard technique for determining total body volume. In this technique, the weight of the body is determined in air and again when the subject is fully submerged. Application of Archimedes's principle provides the body volume and, following correction for the residual lung volume and air in the gastro intestinal tract, the body density is obtained. The ′% body fat′ can be estimated from the body density using one of the many equations developed by various researchers. Not withstanding the concerns with the accuracy of hydrodensitometry, the technique has been extensively used to estimate % body fat. However, its application is limited to subjects/populations for whome underwater weighing is possible. Generally, it may be difficult or impossible for the elderly, children and some patient groups. A relatively recent technique of air displacement plethysmogragh for the measurement of body density obviates the need for underwater weighing.

Air displacement plethysmograph

A relatively new device (Bod Pod: life measurement instruments) utilizes this technique. The device is comprised of a ′test′ chamber and a ′reference′ chamber, which are separated by a diaphragm. The subject is seated in the test chamber and the diaphragm oscillated to produce a slight change in volume and pressure in each chamber.

Three-dimensional (3D) body scanning

3D body scanning and digital photographic anthropometry are relatively new techniques which can be used to measure body volume and hence body fat. There are a number of lasers or light-based 3D body scanners available. Although relatively new, this technique offers great potential to the assessment of body composition. Further development is needed to obtain the accuracy and precision required for estimation of body fat.

Dual-energy X-ray absorptiometry (DXA)

Differential absorption of x-rays by bone and soft tissue is the basis for the original development of single photon absorptiometry to measure bone mineral density (bmd) or body composition. Dxa is based on the fact that the components of the body can be grouped into three groups-bone mineral, fat and fat-free soft tissue, according to their attention properties. The precision of a particular dxa device for the assessment of whole-body composition is generally good.

Computed tomography and magnetic resonance imaging

The application of computed tomography (CT) as well as magnetic resonance imaging (MRI) and spectroscopy (MRS) represents important advances in human body composition studies. They are also the only methods available for detailed measurement in internal tissues and organs. These applications are now also used to measure the quality of various tissues including bone and skeletal muscle. The application of CT and MRI in body composition is growing very fast. CT and MRI are now considered the most accurate methods available for in vivo quantification of total and regional adipose and skeletal muscle tissue.

Bioimpedance analysis

Bioimpedance analysis (BIA) at a single frequency (usually 50 khz) or at multiple frequencies is one of the most common techniques applied to the measurements of body composition. It is relatively inexpensive, portable and does not require extensive operator training. However, care needs to be taken with its application and an understanding of its limitations is necessary if the results are to be correctly interpreted. The underlying principle is that when an electrical current passes through the body it will mainly pass through water-containing tissues since bone and fat have a large impedance and do not conduct significant current. BIA measurements are very dependent on the muscle groups involved and the intensity of exercise, changes in skin blood flow and heat production, and amount of fluid loss. Lukaski et al. (1990) performed BIA measurements in 104 female and male varsity athletes under two experimental conditions: a controlled state (no preceding exercise and $\geq$ 2 h after a light meal) and an uncontrolled state (without regard to immediately preceding exercise, level of hydration, or absorptive state). Ffm was lower by 0.8 kg in an uncontrolled states. Even though the changes in BIA were modest, these studies show that measurements of r and xc are influenced by recent exercise. Thus, to reduce measurement errors in the method, BIA should not be performed within several hours of moderate to strenuous exercise, and hydration status should be completely corrected.

Anthropometry

Many anthropometric measures have been proposed and used for the assessment of total or regional body composition. This section deals only with two of the more common anthropometric methods-body mass index (BMI) and the skinfold thickness measurements. Body mass index (body weight in kg/height in meters squared) is primarily used to identify subjects as underweight, normal, overweight or obese. The world health organization provides a classification of overweight/obesity based on bmi. For adults, a BMI > 25 kg m^{-2} is classified as overweight and a bmi > 30 kg m^{-2} as obese. The BMI can also be used to classify normal and underweight subjects with a BMI < 18.5 kg m^{-2} being underweight and 18.5-25 kg m^{-2} being the normal range. Skinfold thicknesses at specific body sites provide reasonable correlation with % body fat. However, variations in the distribution of subcutaneous fat between individuals mean that multiple sites need to be sampled in order to obtain an accurate predictor of % body fat. The variability in the ratio of subcutaneous fat to total body fat also needs to be considered. Although the measurement of skinfold thicknesses is relatively simple, the necessary skills need to be developed and practiced of accurate and precise measures are to be made. Considerable variability between operations has been noted. Reasons for this variability include:

- The callipers used-different callipers may use different pressures resulting in a systematic difference;
- Differences in location of the anatomical sites; and
- Technique of grasping the skinfold.

The measurement of skinfold thicknesses remains one of the most commonly used technique for assessing body ´fatness´.

Lipometer

The lipometer is an optical device for measuring the thickness of a subcutaneous adipose tissue layer. It offers a non-invasive, quick, precise, and safe way of measuring a fat layer. The lipometer illuminates the interesting layer, measures the backscattered light signals and from these it computes absolute value of subcutaneous adipose tissue layer thickness (Möller et al., 1994).

Measurement for the thickness of sat-layers by lipometer has been performed at 15 original body sites in mm. The lipometer uses light-emitting diodes, which illuminate the interesting sat-layer, forming photodiode measures the

corresponding light intensities backscattered in the subcutaneous adipose tissue. These light signals are amplified, digitized, and stored on computer (Möller et al., 1999).

Summary

In vivo body composition measurements are always indirect, based in one or more assumptions concerning the nature of the body components of fat mass and fat-free mass including water, protein and bone. Examples of indirect methods, based in assumption derived from carcass analysis, are densitometry and the measurements of total body water.

The body structure of the successful athlete is the product of natural selection over successive generations and training adaptation in the current generation, termed morphologic optimization (Norton et al. 1996). All equations for the prediction of fat mass are population specific and do not necessarily represent athletes, unless they have been specifically validated using athletic groups. Exercise has been shown to exert differential effects on subcutaneous adipose tissue, described as the fit-fat distribution (Nindl et al. 1996) with less fat situated on the torso relative to other regions. Sinning (1985) showed that only 3 of 18 existing generalized predictions of fatness were valid for athletes when using densitometry as the criterion. Muscle mass influences athletic performance more directly than fat mass. It is not easy to measure correctly muscle mass in athletes as a part of lean body mass, for this purpose some anthropometric equations or dxa scans are recommended.

Many world-class athletes are alarmingly underweight, and several cases of anorexia nervosa have come to light. Athletes strive for low body weights because it gives them a competitive advantage. Athletes who use drastic food or fluid restriction to lose weight may experience negative health and performance consequences, including loss of lean tissue mass and the preturbance of immune and endocrine functions.

If it is necessary to reduce body mass, weight change is best attempted during the off-season, and energy intake should be modified with an emphasis on adequate intakes of carbohydrate and protein. However, during times of high intensity or volume training energy needs must be met to maintain body weight, replenish glycogen stress, and provide adequate protein for the building and repair of tissue. Strategies to decrease body mass and/or fatness should adhere to safe approaches that will negatively affect health or performance (Sudi et al. 2004).

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CHANGES IN QRS AMPLITUDE AND MOTOR PERFORMANCE IN JUVENILE FEMALE ATHLETES DURING 12 MONTHS OF INTENSIVE TRAINING

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Abstract

The aim of this study was to analyse changes in QRS amplitude and motor performance in junior female athletes during the 12 months of training in aerobic gymnastics. Somatometric and motor parameters, heart rate (HR), blood pressure (BP) and 12-lead ECGs were recorded in 12 female athletes, aged 13–17 years (average 13.8±1.2) at 3-month intervals over a period of 1 year. The difference between the mean QRSmax values at the beginning and at the end of the study was 0.6 mV ($p<0.001$), the difference between the initial and final values of SLI was 0.5 mV ($p<0.01$). The motor performance test results indicated no significant changes in all parameters as we expected. Comparison of pre- and post-tested parameters showed statistically significant changes in pull-ups and tandem walking ($p<0.01$), in sit-ups and long jump ($p<0.05$), no significant changes in modified push-ups, shuttle run 4x10m, shuttle run 20m, and static balance.

Key words: *ECG, QRS voltage, motor performance tests, juvenile female athletes*

Introduction

Regular and long term physical training results in increase of sport specific performance level, often accompanied by an increase of left ventricular mass (LVM), which is known as physiological left ventricular hypertrophy (LVH), or athlete´s heart (Oakley, 2001; Fagard, 2003). 12-lead ECG in athletes frequently shows an increased QRS voltage and these QRS changes are attributed to the physiological adaptation of the heart that occurs as a consequence of systematic physical training. However, the increased QRS amplitude is observed only in a proportion of athletes with increased LVM (Peronnet et al, 1980; Somauroo et al., 2001). There is also poor agreement between the QRSvoltage and the size and morphology of the left ventricle (Somauroo et al, 2001; Kansal, 1983). A similar decrease in QRS amplitude is also observed in the experimental model studies of exercise-induced left ventricular hypertrophy in rats (Bacharova et al, 2004; Kirchhof et al, 2007).

In this study, we tested the hypothesis that the early period of intensive physical training is associated with a decrease in QRS amplitude. Therefore, we also analysed the changes of motor performance in female junior aerobic gymnasts during their one-year training cycle.

Methods

A group of 12 girls aged 13 - 17 years (average age 13.8 years) was followed up for 12 months. This group entered a newly designed intensive training program in competitive aerobic gymnastics three months prior to the study period. Before entering the aerobic gymnastic program, most of the girls practiced early stage rhythmic or artistic gymnastics, or modern dance with a low level training load (maximum 3 hours per week). The girls were routinely screened in 3-month intervals. None of the girls had any history or symptoms of underlying cardiovascular disease, or of a family history of premature death from cardiovascular disease. None was taking any form of prescribed cardiovascular drug treatment. During the study period, the number of training sessions was five to ten per week (2 hours per training session, 4 to 5 days per week). The overall design of the training programme contained the following components: aerobic activities (about 30 % on average), an aerobic activities (about 20 % on average), dynamic strength (10 %), dynamic and static strength (10 %), flexibility and coordination (about 30 % on average). The following anthropometric parameters were measured and calculated:

- *body weight, height, body mass index (BMI);*
- *body fat percent (BF%) calculated as BF% = 0.365 × (TS + SSS + SIS + MCS) + 0.62, where TS is the triceps skinfold width, SSS is the subscapular skinfold width, SIS is suprailiacal skinfold width and MCS is medial calf skinfold width;*

- *absolute active body mass (ABM) calculated as ABM = bodyweight . (BF% × BW/100);*
- *relative active body mass (%ABM), calculated as %ABM = 100 . BF%.*

Blood pressure was recorded in sitting position after 5 minutes of rest, using the automatic barometer OMRON M4-I, Omron Matsusaka, Japan. Then standard 12-lead ECG was recorded in supine position using the electrocardiograph SEIVA EKG, Czech Republic. Each ECG was recorded for 15 s, the average value of the first three QRS complexes were used for further calculation. All electrocardiograms were evaluated by one blinded researcher. The following QRS voltage parameters were calculated and analyzed:

- *the Sokolow-Lyon index, calculated as the sum of SV2 plus RV5,6*
- *the approximated maximum spatial QRS vector magnitude (QRSmax), calculated using the following formula:* $QRSmax = \sqrt{RV5^2 + RaVF^2 + SV2^2}$

The group underwent pre- and post- cycle motor performance tests as well (Moravec et al, 2002; Suni et al, 1996): *Backwards Tandem Walking; Static Balance; Modified Push-ups; Pull ups to bar; Sit-ups in 60s; Standing Long Jump; Shuttle Run 4x10m, and Shuttle Run 20m.*

Data are presented as mean and standard deviation (SD), or standard error of the mean (SEM), respectively. The differences between the values at particular time intervals were tested using the Friedman test. A probability value $p < 0.05$ was accepted as significant. This study was approved by the Ethics Committee of the Faculty of Physical Education and Sports of the Comenius University, Bratislava.

Results

Table 1 presents the basic statistics of the anthropometric variables in the study group. At the end of the study period the height of the girls increased by an average of 1 cm, this increase was statistically non-significant as compared to the initial values. In addition, the values of body weight, BMI and %ABM increased significantly during the follow-up period compared to the initial values. The values of HR, as well as of systolic BP, did not change significantly during the study period with respect to the initial values (Table 2). The changes in the QRS voltage criteria under study are shown in Figure 1. The mean values of QRSmax and of SLI decreased gradually in the study period, and the values at the end of the study period differed significantly with respect to the initial measurements. The difference between the mean QRSmax values at the beginning and at the end of the study period was 0.6 mV ($p<0.001$), and the difference between the initial and final values of SLI was 0.5 mV ($p<0.01$).

*Table 1. Anthropometric variables: body weight (BW), height, body-mass index (BMI), the body-fat percentage (BF%), the absolute active body-mass (ABM) and the relative active body-mass (%ABM), in the group of female athletes at the beginning and the end of the study period (mean ± SD are presented; *p<0.05).*

	Height [cm]	BW [kg]	BMI [kg/m2]	BF%	ABM [kg]	%ABM
1st measurement	159.7±4.3	46.2±5.5	18.0±1.5	12.4±2.4	40.7±4.1	87.6±2.4
Final measurement	160.4±4.6	48.8±4.8*	18.9±1.3*	12.3±2.3	42.7±3.5	87.7±2.3*

Table 2. The values of systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR) in the group of female athletes at the beginning and the end of study period (mean ± SD are presented).

	SBP [mm Hg]	DBP [mm Hg]	HR [bpm]
1st measurement	116.8 ±7.0	67.1±7.9	77.3±14.2
Final measurement	115.8 ±6.9	66.1±6.5	75.8±14.8

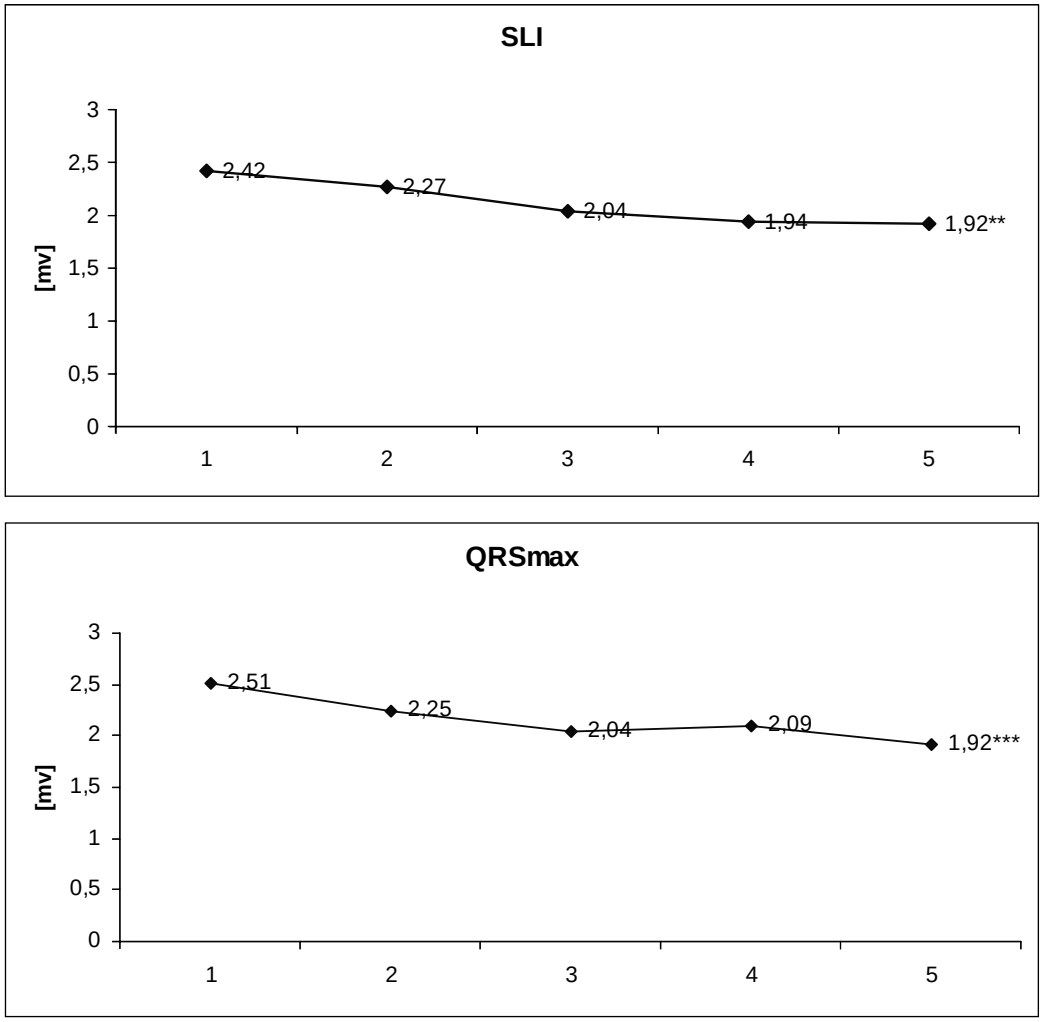

*Figure 1. Values of Sokolow-Lyon index (SLI) and of approximated maximum spatial QRS vector magnitude (QRSmax) during the follow-up period. Values are presented as mean, **p < 0.01, ***p < 0.001 (1= 1st measurement; 5 = Final measurement).*

The results in motor performance tests obtained during one-year training cycle showed that there were no significant changes in all tests as we expected. Comparison of pre- and post-tested parameters showed statistically significant changes in static strength of upper body - Pull-ups; dynamic balance – Tandem walking ($p<0.01$); in strength of trunk muscles – Sit-ups; and explosive power – Long jump ($p<0.05$), and no significant changes in modified Push-ups, Shuttle run 4x10m, Shuttle run 20m, and Static balance (Table 3). Therefore, we suppose that motor performance changes during the follow up period were affected by many factors, including the intensity, type and specific content of the training, which differ very much from the short- and long-term goal of individuals as well.

*Table 3. Motor performance test variables in the group of female athletes during the study period (mean ± SD are presented; *p<0.05; **p < 0.01 vs. 1st measurement; 1= 1st measurement, 5= Final measurement).*

	1	2	3	4	5
Sit-Ups [n/30s]	55.50±8.28	57.83±4.59	58.92±4.98	57.83±7.00	61.33±7.05*
Pull-Ups [s]	46.22±13.95	49.68±16.68	42.58±14.61	56.66±20.58	56.83±15.44**
Push-Ups modified [n/40s]	27.25±8.29	23.33±2.61	24.42±2.61	22.96±4.05	24.42±3.61
Shuttle Run 4x10m [s]	11.47±0.40	11.97±0.58	11.67±0.50	11.58± 0.48	11.67±0.45
Shuttle Run 20m [n]	39.20±13.66	38.00±12.90	38.70±12.13	37.00±13.60	39.00±12.00
Tandem Walking [s]	6.97±1.02	6.88±0.84	6.08±1.01	6.07±1.13	5.45±0.63**
Static Balance [s]	22.62±16.92	28.12±20.77	27.82±15.64	30.18±18.82	26.60±15.45
Long Jump [cm]	188±13.43	188±10.37	197±10.84	198±10.23	193±11.45*

Discussion and conclusions

The main results of this study were the significant decrease in the QRSmax and SLI values, respectively. These findings are in contrast with the findings of increased QRS amplitude in athletes. Increased QRS voltage is more frequently found in highly trained athletes as compared to sedentary controls (Bjornstad et al, 1991; Sharma et al, 1999), and was shown to be enhanced with increased level of training (Bjornstad et al, 1993). However, the proportion of athletes exceeding the upper normal limits is up to 47 percent in highly trained athletes (Oakley, 2001), The nature of exercise in aerobic gymnastics can be defined as combined exercise; therefore, changes in both LVM and LV dimensions could be expected. So far, no data have been obtained specifically since this discipline has been established rather recently (the first World Championship organized by the International Federation of Gymnastics was held in 1995).

Echocardiography was not performed to quantify the changes in LVM and in the morphology of the heart since only a slight increase in LVM might be theoretically expected in this study, which would not explain the decrease in QRS voltage. In this study, we did not use a control group to avoid biases possibly arising from the different constitutional characteristics, incomparable life style, physical load and psychological stress between competitive athletes and sedentary controls. Furthermore, the number of girls was relatively small, which could additionally lead to a bias by selection in the control group.

To conclude, in our study we showed that a 12-month competitive training programme in young female athletes did not lead to the classically expected increase in QRS voltage, supported by increase in motor abilities as well. On the contrary, the results were different and confirmed the hypothesis that there would be a decrease in the QRS amplitude at the early stages of intensive training as an early sign of the rebuilding of myocardium, reflecting the changes in electrical properties of myocardium at the early stage of LHV development.

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MORPHOLOGICAL DIFFERENCES BETWEEN DOMINANT AND NON-DOMINANT BODY SIDE IN CROATIAN TENNIS PLAYERS

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Abstract

During the past decade the physical stress in competitive tennis has been constantly increasing. The aim of this research was to establish how busy tournament schedules and hard training programs affect morphological differences between dominant and non dominant body sides of tennis players. The study included eighteen elite Croatian tennis players (18 to 28 years of age), ranked among 30 best national players. They where measured by 12 anthropometric variables. The data were processed by the SPSS package for Windows, ver. 11.5. The central and dispersive parameters were computed (mean, SD, MIN, MAX). To determine the differences between variables of dominant and non dominant side t-test was used. The results showed that the long term tennis training and competition have influence on some morphological differences between dominant and non dominant side of tennis players. Significant differences appears in upper body segments (upper arm extended girth, upper arm flexed girth, forearm girth, hand width, wrist diameter) while it seems that tennis training and competition do not produce significant differences in lower body segments. It can be concluded that differences in upper body segments highlight the importance of upper-body compensatory exercises in order to prevent injuries, extend competitive carrier and increase the quality of training program.

Key words: *tennis, asymethry, morphology*

Introduction

Tennis is among the world's most popular sports. Over the past decades high participation rates, in addition to large competitive pressures on players, have raised overall performance at the elite level. Improvements in performance, particularly at the high performance level, largely depend on applying scientific knowledge to increase the quality of specific training programs. As the demands of professional tennis have increased, a player's physical capabilities have a larger impact on their level of success (Morante, 2006).

Diagnostic procedures now days are of great importance in the carrier of tennis player, from the aspect of better insight into the status of morphological characteristics, motor and functional abilities, as well as from the aspect of preventing injuries. In spite of this, few studies have been conducted to examine the body structure and characteristics of tennis players.

The objective of this study was to evaluate morphological characteristics of top level tennis players in Croatia and to analyze differences between dominant and non dominant body sides.

Methods

Eighteen Croatian tennis players (18 to 28 years of age) participated in this study. They where all ranked by the Croatian tennis Association and have ranking among 30 best national players. They had been all involved in training for tennis competition of a minimum of eleven years. The total of 12 anthropometric measurements was applied in accordance with the International Biological Program. Body height and mass, arm span, hand width, wrist diameter, elbow diameter, knee diameter; upper arm extended girth, upper arm flexed girth, forearm girth, thigh girth and calf girth were measured. The arm and leg measurements were measured on right and left side of the body.

The obtained data were processed by the SPSS package for Windows, ver. 11.5. The central and dispersive parameters were computed (mean AM, standard deviation - SD, MIN, MAX). To determine the differences between variables of dominant and non dominant side of body t-test was used.

Results and discussion

The means, standard deviations, minimum and maximum for the morphological characteristics of the Croatian tennis players are presented in Table 1.

The average standing height of tennis players (186,35 cm) is highly above the average values for normal population of this age in Croatia but also above the normative values of world top senior players 183,5 cm (www.atptennis.com, 22.10.2007). The body height may be a great advantage in tennis and it is regarded the most important morphological trait (Filipčič, Filipčič, Leskošek, 2004), especially when playing on the fast surfaces. That is why taller players can perform a stroke at a higher level hit point (the contact point of a racket and the ball) when performing service, forehand, backhand, volley and smash strokes. Other authors concluded that the body height over 180 cm significantly affects the power of the serve (Schonborn, 2001; Zmajić, 2003) what is again very important when playing on fast surfaces (grass, hard court), because it gives opportunity to put more time pressure on opponent at the beginning of point. Besides the pronounced body height, a big arm span, as registered, may also be advantageous. The measurements of body mass are lower when comparing to top ATP players 80,5kg (www.atptennis.com, 22.10.2007). Tennis players in this study had 9,76% of body fat, on average, which is below the standard values for tennis players (12-16%). These values are to be expected because a high percentage of body fat is detrimental in terms of successful performance.

Table 1. Descriptive statistic parameters of morphological characteristics of Croatian tennis players

	AM	SD	Minimum	Maximum
BODY HEIGHT (cm)	186,35	7,10	172,70	200,50
BODY MASS (kg)	78,20	7,20	64,90	89,00
%FAT	9,76	3,32	7,80	15,60
ARM SPAN	189,00	9,15	175,00	206,00
HAND WIDTH L	8,5000	0,24	7,9	8,8
HAND WIDTH R	8,8333	,49	8,0	9,5
WRIST DIAMETER L	5,7500	0,34	5,1	6,4
WRIST DIAMETER R	6,0333	0,33	5,3	6,5
ELBOW DIAMETER L	7,03	0,44	6,20	7,98
ELBOW DIAMETER R	7,30	0,43	5,77	7,82
KNEE DIAMETER L	9,65	0,50	8,25	10,52
KNEE DIAMETER R	9,74	0,43	8,74	10,42
UPPER ARM EXTENDED GIRTH L	29,20	2,09	26,20	34,10
UPPER ARM EXTENDED GIRTH R	30,15	2,29	27,00	36,00
UPPER ARM FLEXED GIRTH L	31, 55	2,34	28,00	36,30
UPPER ARM FLEXED GIRTH R	32,83	2,38	29,20	37,80
FOREARM GIRTH L	26, 61	1,20	25,20	29,00
FOREARM GIRTH R	28,52	1,45	25,50	31,50
TIGH GIRTH L	57,68	2,68	52,70	62,00
TIGH GIRTH R	57, 57	2,75	52,80	61,80
CALF GIRTH L	37,50	2,02	33,30	42,70
CALF GIRTH R	37, 67	1,97	33,90	42,80

From the results it is obvious that there are some morphological differences between body sides. In order to determine significance of the differences between dominant and non dominant body sides of tennis players t-test was used (Table 2.).

Table 2. Differences between dominant and non dominant body side measurements

	t-value	p
HAND WIDTH	4,81046	0,000
WRIST DIAMETER	7,03537	0,000
ELBOW DIAMETER	2,503	0,022
KNEE DIAMETER	1,396	0,179
UPPER ARM EXTENDED GIRTH	4684	0,000
UPPER ARM FLEXED GIRTH	4,998	0,000
FOREARM GIRTH	5,649	0,000
TIGH GIRTH	,199	0,245
CALF GIRTH	1,104	0,284

Force production in tennis, as in many other ground-based reaction sports, involves the transfer of ground reaction forces through ankle, lower-and upper-legs, trunk, upper body and eventually to the racket. Therefore, the forces at the shoulder and arm in tennis player result from the summation of the kinetic chain activity that starts with the ground reaction force in legs and proceeds to the upper body, including the shoulder and arm (Chandler, 1998). Long term tennis training and competition affects some morphological differences between dominant and non dominant side of tennis players. A significant difference appears in upper body segments while it seems that the tennis training and competition do not affect significant differences in lower body segments. In this study the significant differences appears in upper arm extended girth, upper arm flexed girth, forearm girth, hand width and wrist diameter.

It is recorded that the dominant hand can be up to 20% stronger then non dominant hand (Kannus, 1994). These differences lead to morphological differences. It was recorded that dominant arm can also be larger in girth up to 20%. This is understandable because the large forces generated in the legs are passing through hips and trunk (as a centre of rotation and transfer link) to the shoulder and arm. Muscular imbalance in unilateral sport such as tennis can be considered normal up to 10%, from 10% - 20% possibly abnormal and from 20% or greater probably abnormal (www.isokinetics.net, 26.04.2008.). These findings highlight the importance of compensatory exercises in order to prevent high percentage of muscular imbalances between body sides. That is very important from the aspect of preventing injuries, extending competitive, professional carrier and increasing the quality of specific training programs.

Conclusion

Long term tennis training and competition have influence on some morphological imbalances between dominant and non dominant body side in tennis players. Significant differences appear in upper body segments while it seems that the tennis training and competition didn't affect lower body segments. Differences in the upper body segments highlight the importance of upper-body compensatory exercises in order to prevent injuries, extend professional carrier and increase the quality of training program.

Diagnostic procedures are very useful and they can provide the necessary information for the development of specific training program designed to maximize competitive performance and reduce injuries.

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ASSESMENT OF THE STRENGTH IN JUDO THROUGH THE POWER AGAINST THE CORPORAL WEIGHT

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Abstract

The use of lineal transductors has added new variables such as Power to the assessment of athletes' physical shape. In our study, we have tackled the importance of Power in the judokas' performance and whether there is a zone in the power-charge curve in which this variable has discriminating ability according to performance level. Thus, we have evaluated 53 judokas (24 women and 29 men) through a Progressive Test of Strength based on each judoka's corporal weight (cw). We have chosen the Rowing lying pronus exercise due to the importance of traction in judo. We have used a single-factor ANOVA treatment with performance level as independent variable and power as dependent variable. The results of our study conclude that the power changes significantly when the charge is equivalent to the corporal weight according to the performance level both in men and women ($p = 0.038$ and $p= 0.002$ among the Very Good and Average level judokas, in men and women respectively), whereas the Maximum Power or the Power in the zone of the 1RM does not change significantly from a statistical point of view, and therefore it is not so useful as point of reference of the judokas' strength level, or as a base on how to carry out training sessions.

Key words: *maximum power, performance, lineal transductors*

Introduction

There are a number of qualities that are determinant for the performance in judo such as power and anaerobic capacity, aerobic power, and types of Strength such as Explosive Strength, Isometric strength, etc. Although there is general agreement with regard to the importance of strength and resistance, and their interaction with one another, some authors such as Carratalá and Carratalá (1997), and Carratalá, Pablos, Carqués y Pablos, (2003), highlight that strength is a basic capacity in order to achieve success in top-level sports.

Several studies show that the reduction in the application's time of the strength (explosive strength) is of paramount importance to cause unbalances, execute the appropriate gestures to project the adversary or avoid being projected (Carratalá and col., 2003 and 1997; García, 2004; Hasegawa and col., 2006; Iglesias and col., 2000; and Padial, 2006). This author also says that "in order to succeed in competition the arms must have: high values of explosive strength; an amount of time to show the FDM below 80 ms; and high values of resistance to Strength". Iglesias and col. (2000) put the stress on the close relationship they find between the Explosive Strength and the Maximum Strength because of the high resistances the judokas have to face (both for mmii and mmss). However, it is really difficult to analyse this Explosive Strength or maximum output of strength per time unit (González-Badillo and Rivas, 2002) without very accurate technology, thus it is more frequent to find the assessment of power as point of reference.

Given that strength in judo must be shown at maximum speeds to catch the opponent off guard, this factor incorporating strength and speed may be discriminating. Thus, we wanted to analyse the behaviour of power in judokas and its relationship with the performance level. Since traction, depending on the flexor musculature, is a key muscular action in judo, we have chosen the assessment of power in this action, measured through the Rowing lying pronus exercise.

Methods

53 Spanish judokas participated in this study (24 women and 29 men) of different weight categories (–48 to –70 kg in women, –60 to –90 kg in men), with a minimum level guaranteed by the participation in qualifying championships for the Absolute Spanish Championship of 2007. The sample was divided into three groups of level according to the results and an assessment given by the technicians (*table 1*).

Table 1. Basic characteristics of the final sample (L = 53)

	Age	Weight	% Weight Compet	% Fat	% MM	Years comp.	Years practi.	H/week Train.	Average Level (N=21)	Good Level (N=20)	Very Good Level (N=12)
Men N = 29	21.14 ±3.32	74.53 ±9.79	1.02 ±0,40	11.36 ±2.10	58.22 ±7.16	10.23 ±3.44	16.07 ±3.63	13.71 ±4.52	**13**	**9**	**7**
Women N =24	21.54 ±4.85	58.86 ±9.16	1.02 ±0.043	12.89 ±2.41	55.00 ±6.14	8.33 ±3.91	15.79 ±4.64	12.44 ±4.65	**8**	**11**	**5**

Anthropometric data was collected such as: corporal weight (CW), height, fatty folds and muscular perimeters and the percentages of fatty mass (%F, Faulkner's formula), kilograms and percentages of muscular mass (using Martin's formula) were determined. The power assessment was carried out through a strength transductor (Real Power Ergo Tester Globus), based on a Progressive Test in the lying pronus Rowing exercise in horizontal bench. The progression was established on percentages of corporal weight: bar, 40, 55, 70, 85, 100, 115, 130%, and more, of corporal weight, and the repetition with the greatest power was chosen (between 3 and 1 maximum repetitions per series). In each series, the perception of the effort was measured through the Robertson scale (in Naclerio, 2005), to adjust the last series. At the end of the test (usually in speeds <0.4 m/s; EP around 8) the weights were adjusted in smaller levels until the 1RM was reached. Since in this final stage of the test there was no coincidence in the percentages, the comparative analysis was carried out only in the six series as far as the corporal weight, charge mobilized practically by all the athletes assessed (*table 2*).

Table 2. Charge zones (% of CW) on which the 6 first series of the test have been carried out, as far as the cw

1st	2nd	3rd	4th	5th	6th	**SERIES** (% charge)	
14.16%	39.95%	55.86%	70.99%	86.11%	**100.91%**	Men	**On the CW**
18.69%	39.70%	54.98%	69.89%	85.16%	**98.31%**	Women	

The results were included in a SPSS 15.0 database; 15.0.1. Version, separately for men and women. A one-way ANOVA analysis was used with the performance level as independent factor, and strength, power and speed in each of the series as dependent variables. Tuckey was used among the Post-Hoc test, based on Levene's homogeneity Test, taking equal variances, and Games-Howell when different variances are taken.

Results

Table 3 shows the statistical descriptive concerning average Maximum Strength in the1RM, average Maximum Power, average speed and Zones or percentages of charge on which they have been obtained, in both sexes.

Table 3. TPF_{pc}. Mean and typical deviation in the lying pronus Rowing exercise. Comparative by sex

Lying pronus Rowing	**MS** (N/kg)	**V. Mean in 1RM** (m/s)	**Max.W** (w/kg)	**V. Mean in Max.W** (m/s)	**% 1 MP**	**% CW**	**S deficit in Max.W** (%)
Men (n=28)	13.28 ±1.38	0.35 ±0.08	9.26 ±1.40	1.32 ±0.23	38.50 ±12.03	50.33 ±11.82	45.67 ±10.78
Woman (n=26)	10.72 ±1.46	0.28 ±0.06	5.99 ±1.08	1.05 ±0.27	47.99±14.32	43.36±16.55	44.19 ±11.97

As for Power behaviour, the power in the charge of 1RM has been studied, in the charge equivalent to the corporal weight, in the charge of the Maximum Power of the whole test (MP), and in the 5 remaining series carried out below the corporal weight (*table 2*). Table 4 shows the mean and typical deviation of the results, broken down according to zones: upper part, power in 1PM; medium part, power against Corporal Weight; lower part, maximum Power of each athlete and charge on which it is obtained. Table 5 completes the information with mean and deviation of the 5 series carried out below the corporal weight, in order to verify the way in which judokas apply their strength when facing slightly lighter charges, and therefore, faster. Graph 1 shows the Power-Charge curves in the six series, including that of the CW.

As shown (tables 4 and 5; graph 1), the differences in power for each series are clear between men and women, but with an average profile very similar between series. It also shows that the mean of the MP (9.26±1.40 y 5.99±1.08 w/kg

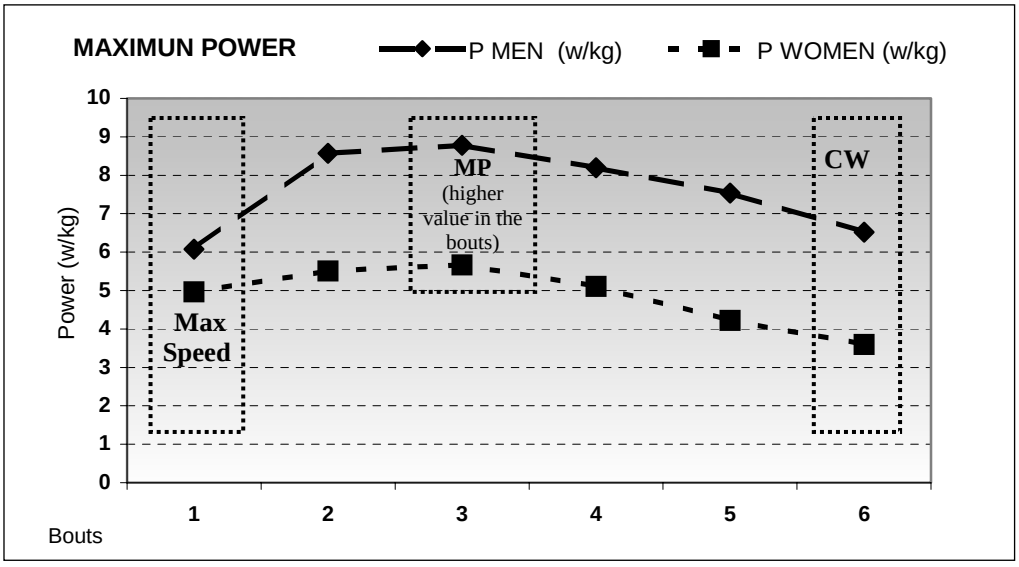
for men and women respectively) is greater than the greatest MP mean obtained in any of these six series. This is due to the fact that even if the 3rd series shows the highest power values both for men (8.78±1.47 w/kg) and women (5.67±1.06 w/kg); in fact there is dispersion with regard to the series in which each athlete shows this maximum power.

Table 4. Mean and typical deviation of Power according to zones: 1RM; CW and charge of the maxP. Comparative according to sexes.

	MEN (N= 27)	**WOMEN** (N=23)
P mean in 1RM (w)	349.22±84.44	173.61±43.05
P mean in 1RM relating to cw (w/kg)	4.67±0.92	2.97±0.56
P mean against cw (w)	483.54±118.29	207.26±63.70
P mean against cw relating to cw (w/kg)	6.52±1.43	3.60±1.05
P maximum peak (w)	1088.24±192.39	530.130±113.2411
P max peak in Wat per weight kg	14.67±2.02	9.15±1.70
P maximum mean (w)	685.11±120.36	346.83±72.58
P maximum mean relating to cw (w/kg)	9.26±1.40	5.99±1.08
% cw in which the MP lies	50.33±11.82	43.36±16.55
% 1 RM in which the MP lies	38.50±12.03	47.99±14.32

Table 5. Mean and typical deviation of power and speed in the first 5 series. Comparative according to sexes

	MEN (N= 27)	**WOMEN** (N=24)
P1 – P mean relating to cw in the **1**st series (w/kg)	6.08±1.40	4.97±1.01
P2 – P mean relating to cw in the **2**nd series (w/kg)	8.57±1.56	5.51±1.33
P3 – P mean relating to cw in the **3**rd series (w/kg)	8.78±1.47	5.67±1.06
P4 – P mean relating to cw in the **4**th series (w/kg)	8.20±1.17	5.11±1.04
P5 – P mean relating to cw in the **5**th series (w/kg)	7.54±1.14	4.22±1.32

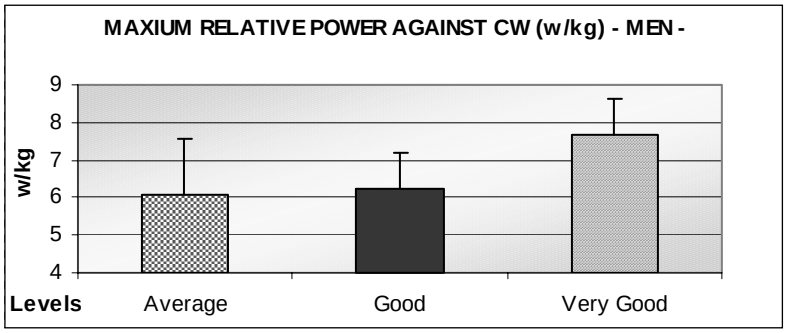


Graph 1. Speed and power mean relating to the six first series of the TPF_{pc}. Comparative according to sexes.

As for the importance of Power according to the performance level, we have confirmed that there are no differences statistically significant in men neither with regard to the power showed when facing the charge of the 1RM or Maximum Strength; nor with regard to the greatest Maximum Power developed by each athlete in the whole test. However, the power shown with the charge equivalent to the corporal weight has shown significant differences between the group of Very good and Average athletes ($p<0.05$; *table 6, graph 2*).

Table 6. Maxium Relative Power applied when facing a charge equivalent to the cw, in watts/kg. Men.

Dependent Variable	Level Groups	N	Mean	Typical Deviation	Minimum	Maximum
Maximum Relative power against cw (w/kg)	Average	13	6.0492	1.52469	4.20	8.46
	Good	6	6.2083	.99268	4.61	7.40
	Very Good	7	7.6514	1.00234	6.53	9.04
	Total	27	6.5196	1.40438	4.20	9.04
Homogeneity	**Level Group (I-J)**			**Diff. Mean (I-J)**	**Std. Error**	**Sig.**
Tukey HSD	Very Good	Average		1.60220(*)	.60930	**.038**



Graph 2. Means and deviation of the average relative Power against CW. Men.

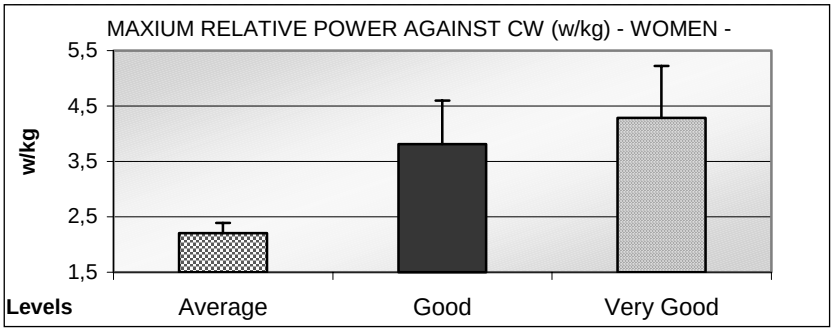
As for women, the one-way anova treatment reveals significant differences according to the sports level with regard to Power in the charge of the 1RM or MS, but between the Good and Average athletes (p = 0.022; table 7). It shows again significant statistics in power in the charge equivalent to the corporal weight (table 8, graph 3) between the Very Good and Average athletes (p = 0.02); and between the Average and Good (p = 0.07). Again, it is no significant according to the performance level in the Maximum Power.

Table 7. Power applied in the 1RM, in w/kg. Women.

Dependent Variable	Level Groups	N	Mean	Típycal Deviation	Minimum	Maximum
Power in the 1RM (w/kg)	Average	7	2.514	.3338	2.1	3.1
	Good	11	3.200	.5967	2.1	4.0
	Very Good	5	3.120	.3493	2.7	3.5
	Total	23	2.974	.5586	2.1	4.0
Homogeneity	**Level Group (I-J)**			**Diff. Means (I-J)**	**Std. Error**	**Sig.**
Tukey HSD	Good	Average		.6857(*)	.2348	**.022**

Table 8. Maxium Relative Power applied when facing a charge equivalent to the corporal weight, in w/kg. Women.

Dependent Variable	Level Groups	N	Mean	Typical Deviation	Mínimum	Maximum
Power against cw (w/Kg)	Average	4	2.2050	.18448	2.05	2.47
	Good	10	3.8120	.78648	2.15	4.82
	Very Good	5	4.2860	.93786	3.44	5.68
	Total	19	3.5984	1.04812	2.05	5.68
Homogeneity	**Level Group (I-J)**			**Diff. Means (I-J)**	**Std. Error**	**Sig.**
Tukey HSD	Good	Average		1.60700(*)	.44830	**.007**
	Very Good	Average		2.08100(*)	.50833	**.002**



Graph 5. Means and deviation of the average relative Power against CW, in w/kg of weight. Women.

Discussion and conclusions

Traditionally, the improvement of MP is considered an important objective in strength-power sports such as Judo. In fact, the zone in which each athlete shows the MP is considered their Muscular Performance Threshold (González-Badillo and Rivas, 2002); and it is frequent to find the results of this variable and the zone in which it lies in relation to the 1RM as point of reference for the physical shape. However, our study shows that MP has no discriminating ability in Judo according to performance; and that its isolated value has no informative value. On the contrary, our data puts stress on the importance of Power against the charge equivalent to the corporal weight, both for women and men, and points to a key and discriminating variable in judo. Thus, we conclude that it is essential in the Strength assessment of judokas; it must be used as a point of reference of their physical shape; and it can be used to carry out training sessions correctly.

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LIPIDS PROFILE OF UNIVERSITY UNDERGRADUATE STUDENTS WITH VARIOUS LEVELS OF PHYSICAL ACTIVITY

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Abstract

The authors investigated the height, weight, percentage of fat and some parameters of lipid metabolism in Faculty of Sport (n=55) and Faculty of Manufacturing Technology students (n=65). In both group average levels of somatic and lipids parameters were within the normal range for young people The differences between PE and FMT students were not significant, except percentage of fat that was considerable higher in FMT group. The physical education student values of TCH, LDL and AI were lover than that of FMT students but only a value of AI were significant at p< 0,07. The FMT group had higher percentages of participants with increased TCH, lower HDL levels as well as moderate probability to develop CVD.

Key words: *students, physical activity, lipid profile, risk factor, atherosclerosis*

Introduction

The research interest about physical activities intensified in latest years by finding of connection between obesity, hyperlipemia, cardiovascular disease (CVD) and physical inactivity. It is stated that regular physical activity can prevent noticeable increment of the body weight in young subjects with age, with consequent metabolic adjustments, and further regular exercise can retard development of atherosclerosis (Lippi et al, 2006, Filipova et al., 2006). It is quite apparent that regular physical activity has positive influence on concentration of cholesterol in plasma mainly on it s distribution in individual lipoprotein fractions. Physically active individuals showing lower risk of developing CVD. Some epidemiological studies postulates that identification of individuals at risk in children and adolescent age and consistent educational influence aimed at risk factors creates a base for primary prevention against serious CVD in later years (Eisnmann, 2002). Considering above mentioned from the health and lifestyle point of view university students is very valuable group for us to study.

The purpose of this study was to evaluate levels of plasma lipids in male undergraduates students with various levels of physical activities. The study is a part of the research project VEGA No. 1/363306.

Methods

Fifty-five physical education students (PE) from the Faculty of Sport in Prešov (x age 19,48) respectively sixty –five students from the Faculty of Manufacturing Technologies (FMT) in Prešov (x age19,85) were participated in this study. The physical examination included weight, height, skinfold for identifying the percentage of fat (Pařizek's method). Before testing venous blood samples were taken after a 12 hour fast and analysed in accredited ADL s.r.o.lab by standard method ISO IEC 17025:2005 for total cholesterol (TCH), HDL-cholesterol (HDL), triglyceride (TG). LDL-cholesterol (LDL) was calculated according Friedewald and aterogenic index (AI was calculated (TCH-HDL/HDL for evaluation the risk of aterosclerosis (level to 3 low, 3-4 moderate probabilities. Result of evaluation are expressed as mean (SD). Results of measurements between the students group were compared by unpaired Student's t- test.

Results

The results of investigation with the t- value, level of significance are summarized in Table 1.

Table 1. Statistical characteristic of weight, height, % of fat and lipids profile of undergraduate students

Parameters	Students of PE No=55 Mean SD	Students of FMT No=65 Mean SD	t- value
Age	19, 48 1,57	19,8 0,95	0,265
Height (cm)	175,33 7,54	175,70 5,77	0,016
Weight (kg)	72,23 8,43	74,53 12,01	1,704
Body Fat (%)	13,06 3,32	16,84 4,99	4,82**
TCH (mmol/L)	3,66 0,94	3,88 0,76	1,620
HDL (mmol/L)	1,40 0,32	1,38 0,26	0,572
LDL (mmol/L)	2,02 0,46	2,19 0,69	1,555
TG (mmol/L)	0,94 0,44	0,93 0,42	0,188
Index (TC-HDL/HDL	1,68 0,53	1,87 0,66	1,810

TCH= total cholesterol; HDL= high density lipoprotein cholesterol; LDL= low density lipoprotein cholesterol; TG= triglycerides

Table 1 shows that in both group average levels of somatic and lipids parameters are within the normal range for young people (Lippi et al. 2006, Filipová et al. 2006,

The groups significance ($p < 0,001$) was found in body fatness only. Fatness of FMT students were significantly higher compared to PE students. Regular physical activities PE students influenced body composition. Values of body fatness were within the recommendations for particular age group. On the other hand moderate level of obesity was observed in three FMT students (4, 6%, >26% body fat), 29,2 % students (19) were overweight (21-25% body fat).

The physical education student values of TCH, LDL and AI were lover than that of FMT students but only a value of AI were significant at $p < 0,07$. HDL and TG level in both groups were almost identical. Analysis within the groups showed individuals with higher- risk level of TCH, HDL and AI. Based of numerous studies recommended values for CVD prevention of TCH for individuals younger than 30 years of age is as follow 4,66mmol/L, above 30years of age 5,17mmol/L respectively HDL <1,04mmol/L (Brtkova et al., 1992; Lippi et al. 2006; Filipova et al. 2006). Lipid parameters of PE students were within the recommendation. Contrary some of the parameters of FMT students indicated risk values for developing of CVD. Particularly four students had values >5,17mmol/L and eight values >4,66mmol/L, HDL values <1,04 had three students. By the AI (>3) five students exhibit moderate probability of developing CVD.

Discussion and conclusion

The results of our investigation suggest different results of lipid profile in PE and FMT groups. The professional orientation of PE students showed favourable lipid profile, despite the mean values in both subgroups did not exhibit significant differences. In comparison with other studies we did not find higher values of HDL between more then less active students. Our findings are similar with the results of our previously done study (Brtkova et al. 1992). In our view intensity and duration of physical activity of PE students is not at sufficient level to positively influence HDL levels. Based on Kodama et al. (2007) minimal weekly exercise volume for increasing HDL level was estimated to be 900 kcal of energy expenditure per week or 120 minutes of exercise per week. Univariate regression analysis indicated that every 10 minute prolongation of exercise per session was associated with an approximately 0,036mmol/L increase in HDL.

When we evaluate connection between physical activity and plasma lipid changes we have to take into account other possible contributory factors which may cause difference in plasma lipid (genetic, diet, lifestyle etc.)

Based on our study we can conclude that PE students presenting more favourable lipid profile as compared to FMT students. The latter group had higher percentage of participants with increased TCH, lower HDL levels as well as moderate probability to develop CVD. There is compelling evidence that improved physical activity, especially during childhood and adolescence decrease CDV risk factors and enhances cardiovascular health. There, childhood or adolescent health- promotion programs involving regular and aerobic exercise may help to reduce the increasing prevalence of later cardiovascular complications (Lippi et al. 2006).

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CHARACTERISTICS OF BODY ADAPTATION IN YOUNG FEMALE SWIMMERS

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Abstract

Research purpose to determine characteristics and relevant interrelations of physical development, physical fitness, and definite features of functional capacity exhibited by young girls who train swimming regularly to achieve outstanding sports results.

We studied eighteen female swimmers (group I - eight 13-15-year-old, group II - ten 16–18-year-old girls) whose regular training duration ranged from 4 to 12 years. We explore their physical development, single muscular contraction power (SMCP), anaerobic alactic muscle power (AAMP), and anaerobic glycolytic special power (AGSP) on a swimming ergometer worked by hands for 60 s. The body mass, muscle mass and leading hand force of 13-15 and 16–18-year-old female swimmers differed reliably. The absolute indices of SMCP, AAMP and AGSP also develop, and the relative indices per 1-kg body mass stabilise. Muscle mass accounts for short work power and anaerobic glycolytic special 60 s work power exhibited by young female swimmers.

Key words: *body adaptation, young female swimmers*

Introduction

Various physical activity provoke specific adaptive changes in a human body (Ashenden *et al*., 2007). A developing organism responds to physical activity in a large variety of ways (Bauchard *et al*., 1997; Buchhelt *et al*., 2007; Jürimäe *et al*., 2007). Complex phenomena take place in a maturing body, however, studies suggest that the underlying factors of the change of physical and functional powers are age and movement-involving activities (Naughton *et al*., 1992; di Prampero, 2003). Swimming is trained in a specific environment by performing movements in water with the swimmer's body positioned horizontally. Thus, relevant effects on the human body are highly specific (Atlaoui *et al*., 2007). There are many studies about cardiorespyratory responses in swimmers (Enqian, 2004; Schmitt *et al*., 2006; Keskinen *et al*., 2007). Data on the interrelation of various physical and functional indices exhibited by young female swimmers are scarce, although such investigation into adult female swimmers has been carried out. Therefore, there is a need to examine young female swimmers who train almost every day. Such exploration is necessary to assess the ongoing changes in their physical development, physical fitness, functional powers, and the interrelation of these indices. We hope that this inquiry will reveal characteristic features of young female swimmers' development and relevant interrelations with special performance.

Research purpose: to determine characteristics and relevant interrelations of physical development, physical fitness, and definite features of functional capacity exhibited by young girls who train swimming regularly to achieve outstanding sports results.

Research subject: basic characteristics and relevant correlations of physical development, physical fitness, and functional capacity demonstrated by 13-18 - year-old girls who train swimming regularly.

Methods

We studied eighteen 13-18-year-old female swimmers whose regular training duration ranged from 4 to 12 years. The first group included eight 13-15-year-old, the second group consisted of ten 16–18-year-old young Lithuanian female swimmers.

To explore their physical development, we measured the body height, body mass, hand force and muscular mass (Norton *et al*., 1996). To examine female swimmers' physical fitness, we measured the height of vertical jump. We determined single muscular contraction power (SMCP), anaerobic alactic muscle power (AAMP), and anaerobic glycolytic special power (AGSP) on a swimming ergometer worked by hands for 60 s. Psychomotor reaction time (PRT) and movement frequency (MF) per 10 s was determined.

Mathematical statistics methods were used to manage and analyse the material. Arithmetic means (X) were calculated. The distribution of indices was evaluated on the grounds of standard deviations (S) and relevant variance coefficients

(V). To determine the reliability of difference among the index means, Student's t criterion for independent samples was used. Pearson's linear correlation method was employed to find relations among characteristics under study. The correlation coefficient r = 0.44 -0.55 was considered reliable at $p < 0.05$, r = 0.56 - 0.68 at $p < 0.01$, and r = 0.69 and over at $p < 0.001$, i.e. 99.9 per cent.

Results

The numbers of the second group, compared to the first one, were on average only 4.14 cm higher. The difference was not statistically reliable ($t = 1.85$, $p > 0.05$). Height index scatter of both groups was very low (2.01 and 3.55 per cent) (Table 1).

The first group showed a 17-cm and the second group 11.5-cm area of variance. The 9.73-kg body mass difference between the group means was statistically reliable ($p < 0.001$), and the group index scatter was low – never above 10 per cent. The leading hand force group means differed by 5.77 kg ($p < 0.05$). In the first group, hand force variance was low (V = 8.08 per cent), with a relevant scatter area of 7 kg. The second group showed a much higher variance (V=18.64 per cent), and in this case the area of dissipation was 20 kg. Muscle mass mean was much higher in the second group. The difference among the groups was 5.56 kg ($p < 0.001$). The scatter of these indices was not high in both groups. Vertical jump means differed slightly between the groups ($p > 0.05$).

The index variance in the groups was medium. SMCP absolute indices differed greatly between the groups ($p < 0.005$), but the difference between the means of relative indices was statistically unreliable ($p > 0.05$). The second group exhibited a very high variance of these indices; however, the variance was lower in the first group.

AAMP data analysis gave a similar picture. The absolute parameters between the group means differed greatly ($p < 0.001$), but the difference between the relative indices was minimal (0.66 W/kg) ($p > 0.05$). AGSP absolute indices were also higher in the second group, however, the relative ones were almost identical. The variance of these indices was medium (10.47 to 18.71 per cent).

The difference between the PRT index group means was not reliable. The relevant index scatter was low. However, the difference between MF per 10 s means (6.97 movements) reflecting the liability of the central nervous system was statistically reliable ($p < 0.05$). Correlation analysis of the characteristics of young female swimmers (n=18) showed the strongest relation between body mass and muscle mass (r = 0.944). A reliable correlation was found among the height, body mass indices. Muscle mass was related to hand force, the SMCP, AAMP, and AGSP absolute indices. However, it was not reliably related to the relative indices of 1-kg body mass power. A strong correlation was found among the SMCP, AAMP and AGSP indices, both absolute and relative ones, although the working duration differed very much. High jump indices were reliably related to SMCP indices, both absolute and relative ones. PRT shoed a rather weak correlation between the AAMP and vertical jump indices. MF per 10-s indices correlated only with the AAMP absolute indices.

Discussion

The generalisation of relevant findings carried out against the background of data exhibited by Lithuanian girls not engaged in sports provides a basis to argue that girls under our study did not differ much, in terms of height, from the general peer standards, group means being higher than medium ones. Body mass means demonstrated by both groups took an intermediate position between medium and higher than medium ratings. Hand force mean in the first group showed a higher than medium rating scale with only one girl getting a high rating for her hand force. In the second group, the mean value of this index also showed a higher than medium rating with three girls getting high ratings. Thus, the investigation showed that the most powerful young female Lithuanian swimmers, from the point of view of their basic physical development indices, did not differ much from official standards, however, they exhibited a slight superiority in their hand force ratings (Heyward, 1998; Hussey *et al*., 2007). There are also sufficient grounds to contend that training swimming does not affect significantly the development of body mass and height, however, regular physical activity involving tools and swimming strengthens the muscular system which results in increased hand power.

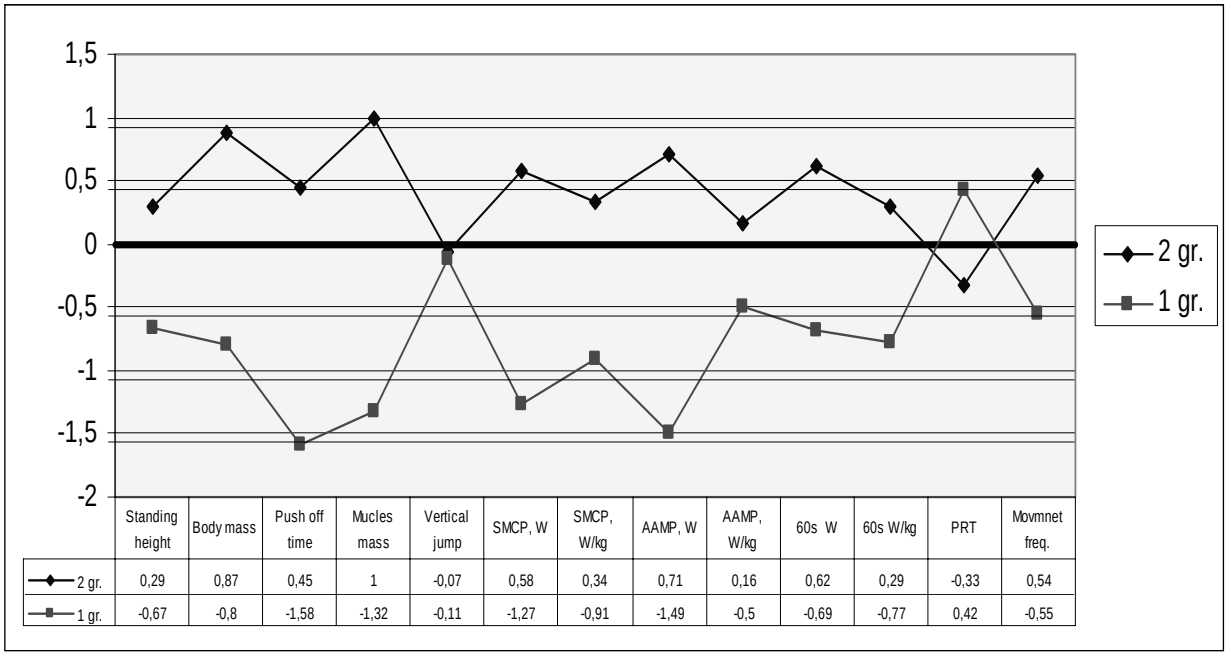
Table 1. Statistical data on the indices of physical development, physical and functional capacity, psychomotor function in the study groups I and II of swimmers

Indices	Height, cm	Body mass, kg	Hand force, kg	Muscles mass, kg	Vertical jump, cm	SMCP		AAMP		AGSP		PRT mls	Movement frequency 10 s
						W	W/kg	W	W/kg	W	W/kg		
I (n=8)													
X	167,31	51,19	25,13	26,45	40,50	776,38	15,27	628,75	12,42	106,44	2,10	206,38	67,13
S	5,94	4,12	2,03	2,34	5,93	159,65	2,25	61,76	0,74	15,45	0,22	14,12	6,98
V	3,55	8,05	8,08	8,85	14,64	20,56	14,73	9,84	5,96	14,51	10,47	6,84	10,72
II (n=10)													
X	171,45	60,92	30,90	32,01	39,40	1139,50	18,97	793,90	13,08	143,70	2,40	196,40	74,10
S	3,45	5,08	5,76	2,48	6,79	279,39	5,12	103,70	1,70	26,89	0,44	13,43	5,72
V	2,01	8,38	18,64	7,74	17,23	24,48	26,29	12,94	12,99	18,71	18,33	6,84	7,72
t	1,854	4,378	2,690	4,8414	-0,361	3,262	1,897	3,963	1,029	3,475	1,737	-1,531	2,333
p	0,082	0,000	0,016	0,0002	0,7229	0,005	0,076	0,001	0,319	0,003	0,102	0,145	0,033

Abbreviations: SMCP – single muscular contraction power; AAMP – anaerobic alaktatic muscular power; AGSP – anaerobic glycolytic special power; PRT- psychomotor reaction time.

Body mass changes of elite level swimmers, was studied by Cox (1998). It must be noted that the absolute indices of physical fitness differed significantly between the groups of younger and older girls, although their capacity to perform vertical jump, and their relative SMCP, AAMP and AGSP indices per 1 kg body mass did not show any essential difference.

This indicates that physical fitness increases with a rapid development of body mass and muscle mass. Growth parameters have impact to vertical jump performance (Branta, 2007). Standardisation of the investigation into both groups reveals characteristic features of female swimmers' development. With the increase of young female swimmers' height, mass, and muscle mass, the growth of their absolute physical fitness indices, the relative indices per 1 kg body mass, however, are almost stable. Changes in PRT are insignificant (Fig. 1).



	Standing height	Body mass	Push off time	Mucles mass	Vertical jump	SMCP, W	SMCP, W/kg	AAMP, W	AAMP, W/kg	60s W	60s W/kg	PRT	Movmnet freq.
2 gr.	0,29	0,87	0,45	1	-0,07	0,58	0,34	0,71	0,16	0,62	0,29	-0,33	0,54
1 gr.	-0,67	-0,8	-1,58	-1,32	-0,11	-1,27	-0,91	-1,49	-0,5	-0,69	-0,77	0,42	-0,55

Abbreviations: SMCP – single muscular contraction power; AAMP – anaerobic alaktic muscular power; 60s W - AGSP – anaerobic glycolytic special power; PRT- psychomotor response time

Figure 1. Profile of standardized indices shown among the study indices in young female swimmers

Correlative research demonstrated a high interrelation between the body mass and physical fitness indices. Attention should be drawn to a strong correlation between overall body mass and a special power of swimmers' arm work. This correlation indicates that the development of young female swimmers' body mass is one of the key factors contributing to the increase of special performance of female swimmers (Vikander and Stallman, 2003). A relation between muscle mass and special performance has been noted while examining adult swimmers and other sportsmen whose competitive activity lasts up to 2 minutes.

Conclusions

The mean height of 13-15 and 16–18-year-old female swimmers did not differ much, however, their body mass, muscle mass and leading hand force differed reliably. Their physical development indices equalled to standard ones established for Lithuanian girls of relevant age groups. Hand force indices exhibited by the girls under study exceeded the standard ones.

With the increase of young female swimmers' body mass and muscle mass, the absolute indices of SMCP, AAMP and AGSP also develop, and the relative indices per 1-kg body mass stabilise.

Muscle mass accounts for short work power and anaerobic glycolytic special 60 s work power exhibited by young female swimmers. Development of this particular characteristic by employing special exercises provides for the development of special performance.

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LEPTIN AND PHYSICAL EXERCISE IN POSTMENOPAUSAL WOMEN

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Abstract

Aim of this study was to investigate the effect of regular exercise practice on plasma leptin levels (PLL's) in 22 overweight or moderately-obese postmenopausal women. Body composition, dietary habits, estimated VO_2max (VO_2max_{est}) and PLL's were taken both at the beginning and at the end of 3 months walking training. No dietary suggestions were given during the study. Each woman walked 4 times a week, for 50 min, at 50-60% of her heart rate reserve. Physical exercise practice determined a decreasing percentages fat mass (FM%) (p=.008) and PLL's (p=.000) and an increasing VO_2max_{est} (p=.000) values. Multiple regression model confirmed the negative relationship between VO_2max_{est} and PLL's. No significant variations were found in dietary habits. Physical exercise practice affects positively PLL's in postmenopausal women independently from FM%.

Keywords: *estimated VO_2max, adipocytokine, walking training, fat mass*

Introduction

Postmenopausal condition is associated with overweight in the great part of women. Excessive body fat (FM%), especially when centrally distributed, is associated with an increasing risk for diabetes, coronary heart disease, hypertension, ischemic stroke and several cancers. This is due to hypertriglyceridemia, hyperglycemia, hyperinsulinemia and hyperleptinemia, playing a central role in the development of the metabolic syndrome. Adipose tissue is widely related with an increasing plasma leptin levels (PLL's) because of fat tissue which is its main source. The main role of leptin is providing feedback information on body's fat stores to hypothalamic receptors, that coordinate food intake and body weight homeostasis. High PLL's determines leptin resistance, broking its healthy physiological function. In postmenopausal women, the reduction of high PLL's is very important, because leptin is related both to cardiovascular risk factors (i.e. endothelial dysfunction, hypertension, atherosclerosis) and risk of cancers, independently of FM%, increasing the risk of death, already normally amplified from the physiological hormonal changes accompanying menopause. It has been well documented in literature that physical exercise practice, dietary habits modification and weight loss are the main suggestions to provide for the reduction of PLL's. Even though, the aim of this study was to investigate the effect of regular exercise practice on PLL's, in postmenopausal women, independently from fat mass modification.

Methods

Twenty-two postmenopausal sedentary women (52.59±3 years) were enrolled through public advertisement in general physicians office. Inclusion criteria were: postmenopause, FM% major than 25, no estrogen replacement with hormone therapy, no diabetes, no antihypertensive treatment, no cardiovascular and orthopedic diseases limiting walking training and no diet in the previous two years of the study. Women were considered postmenopausal if they had ceased menstruating for at least 12 months. Body composition, dietary habits, estimated VO_2max and resting heart rate were taken both at the beginning and at the end of three months of walking training. Blood test was also performed. Blood was drawn after overnight fasting, at the beginning of the medical examination, between 08:00 and 10:00 a.m., and serum was frozen in -70 °C. Leptin was measured by commercially available *ELISA-test* (dbc-Diagnostics Biochem Inc., Canada). Body weight and height were measured to the nearest 0.1 kg and 0.1 cm respectively, with the subjects dressed in light clothing and without shoes, using a stadiometer and a balance-beam scale respectively (seca 220, seca, Germany). Waist circumference (WC) was measured at the smallest circumference between the rib cage and the iliac crest; and hip circumference (HC) was measured at the level of the widest circumference between the waist and the thighs. Anthropometric tape (seca 200, seca, Germany) was used and standing position was requested during the measurements in both cases. Body composition was assessed by multi-frequency electrical bioimpedance (Human-Im PLUS, Ds Medica,

Italy) and data were processed by software *Human-Im PLUS 4.0 version* (Ds Medica, Italy). Dietary habits and caloric intake were estimated by a dietician from three day dietary records, covering two weekdays and one weekend day with *WinFood-due* software (Medimatica, Italy). *Rockport Fitness Walking Test* was used to estimate maximal oxygen uptake (VO_2max_{est}). All the previous analysis were performed by the same expert researcher, under standardized condition, in the University Centre of Sports Medicine of the Chieti-Pescara University (Italy). Each woman was trained to take own resting heart rate by the radial pulse: for three consecutive mornings, they took and recorded in a chart their heart rate before getting up from bed. The average of their sum was used as resting heart rate to calculate exercise intensity with *Karvonen's formula.* Women walked four times a week, at the same hour, for 50 min at 50-60% of their heart rate reserve; two of four walking sessions were supervised by an exercise trainer. Exercise intensity was calculate again after six weeks of training. Compliance to training sessions was checked both through training dairy than exercise trainer. Walking training was the only intervention; no dietary suggestions were given during the study. Statistical analysis were performed by *SPSS Version 15.0 for Windows software* (SPSS Inc, Illinois).

Results

Table 1 shows physiological modifications of parameters investigated: FM% and PLL's decrease, and VO_2max_{est} increase. No significant variations are in dietary habits. We perform a multiple regression model to understand if walking training affects positively PLL's taking under control other influencing variables, such as FM% and energy intake. VO_2max_{est} is taken as a proxy variable for walking training effect. In table 2 the results of multiple regression model, performed on post intervention values, are shown.

Table 1. Descriptive statistics

	Sample *N = 22*		
	Pre	Post	*p*
Weight (kg)	69.23 ± 15.78	68.80 ± 14.88	.224
Fat mass%	37.50 ± 7.75	35.94 ± 7.35	.008
Waist circ (cm)	88.41 ± 13.26	87.68 ± 11.65	.285
Hip circ (cm)	105.22 ± 11.94	105.48 ± 10.64	.655
Waist/Hip	.838 ± .060	.830 ± .068	.265
Protein (%)	16.66 ± 2.49	16 ± 3	.260
Fat (%)	38.86 ± 7.28	37.79 ± 9.31	.549
Carbohydrate (%)	44.35 ± 7.74	47.33 ± 9.91	.152
Calories	1828.92 ± 277.70	1906.89 ± 312.65	.240
VO_2max_{est} (ml/kg/min)	23.75 ± 5.61	33.58 ± 5.96	.000
Leptin	34.98 ± 16.70	24.10 ± 14.70	.000

Table 2. Coefficients estimation for the regression model: Leptin on FM%, VO_2max_{est}, Calories

	Coefficients estimation	Std. Error	*t*	*p*
FM (%)	0.779	0.225	3.458	0.003
VO_2max_{est} (ml/kg/min)	-1.092	0.361	-3.027	0.007
Calories	0.017	0.007	2.315	0.032

Discussion and conclusions

A positive modification of body composition, VO_2max_{est} and PLL's are the effects of walking training at the end of the study (Table 1). In fact, FM% and PLL's decrease, while VO_2max_{est} increases. Body composition improvement, which is important for health enhancement in postmenopausal moderately-obese and leptin resistant women, is determined by both the walking training, and the absence of any spontaneous change in dietary habits, including energy intake and macronutrient composition of women's meals. Because literature indicates that PLL's are highly correlated with FM% from the lean to very obese, both in women than in men (Considine et al., 1996), FM% reduction could explain leptin trend, covering, if present, the independent effect of exercise on PLL's. Using multiple regression model, we carried out the relationship between predicted VO_2max and PLL's, independently of FM%, after the training but not before. These results confirm the healthy effect of exercise even if body composition is not bettered, reinforcing the question "*is most*

important fitness or fatness level?". Exercise affects positively PLL's because improves haematic level of insulin, cortisol, catecholamines, estrogen, testosterone, DHEA and growth hormone, all directly or indirectly related to leptin production independently of body FM% (Kraemer et al., 2002). Exercise training was also founded inversely related with leptin, independently of changes in insulin sensitivity (Pasman et al., 1998). That is, the increase of leptin sensitivity without weight loss is the main result in young women after 12 weeks of aerobic exercise (Hickey et al., 1997), such as leptin and cardiovascular fitness had a significant inverse relation in prepubescent girls and boys (Roemmich et al., 1998). The results of this study are in line with the literature concluding that cardio-respiratory fitness attenuates the health risk attributable to an elevated FM% at all ages. The main study limitations are the number exiguity of participants, the estimation of VO_2max and the absence of others haematic parameters reinforcing our findings.

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HABITUAL PHYSICAL ACTIVITY OF ELEMENTARY SCHOOL TEACHERS

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Abstract

There are many scientific evidences linking physical activity to numerous health improvements and substantial benefits that can be gained. The aim of this study is to establish the level of habitual physical activity in elementary school teachers. The sample comprises 147 female teachers working with children in the first four classes in elementary schools. The teachers were from 3 different European countries: Croatia (N=33), Slovenia (N=64) and Norway (N=50). The level of their habitual physical activity was determined by Baecke questionnaire. Three indices were calculated: sport index, work index and leisure index. The obtained data were analysed by standard statistical procedures, with statistical software package STATISTICA for Windows. Basic descriptive statistical parameters – arithmetic mean and standard deviation – were calculated for the whole sample and for the sub samples from different countries. The significance of the calculated differences for each index (WI, SI, and LI) between groups was checked by use of t-test. Compared to average employed female population of the same age teachers have higher values of all indices. In comparison with average employed population teachers are more involved in sport and they are also more active in their leisure time. Significantly higher value of sport activity level was observed in Norway teachers who also had the greatest leisure time index.

Key words: *teachers, physical activity, baecke questionnaire*

Introduction

World health organisation has already established the main factors influencing health those being socio-economic factors, way of life and physical environment (WHO, 2002). The risk factors in relation with the way of life are nutrition, physical inactivity, smoking, alcohol consumption and use of drugs.

There are many scientific evidences linking physical activity to numerous health improvements and substantial benefits that can be gained. Regular physical activity greatly reduces the risk of dying from coronary heart disease. It reduces the risk of developing diabetes, hypertension, and even colon cancer. Physical activity fosters strong muscles, healthy bones and joints and may favourably affect body fat distribution and prevent obesity. In older adults it helps maintain function and greater quality of life.

As the benefits of regular physical activity are recognized the need for interventions which can promote this healthy behaviour has increased. Teachers who are working with children are probably one of the important targets for these interventions because of their great influence on children's behaviour. Dealing with this it leads to the aim of this work which is to establish the level of habitual physical activity in elementary school teachers.

Methods

The sample comprises 147 female teachers working with children in the first four classes in elementary schools. Their mean age was 38.04 years. The teachers were from 3 different European countries: Croatia (N=33), Slovenia (N=64) and Norway (N=50). The level of their habitual physical activity was determined by Baecke questionnaire which is comprised of 16 items dealing with different aspects of physical activity. The answers are the grounds for the calculation of three basic indices: sport index (SI), leisure index (LI) and work index (WI). The highest possible value of the index was 5.0 and it indicates the highest physical activity, while the lowest physical activity was indicated with the value of indices of 1.0.

The obtained data were analysed by standard statistical procedures, with statistical software package STATISTICA for Windows. Basic descriptive statistical parameters – arithmetic mean and standard deviation – were calculated for the whole sample and for the sub samples from different countries. The significance of the calculated differences for each index (WI, SI, and LI) between groups was checked by use of t-test. To test the differences between the variables work index, sport index and leisure index, MANOVA was used.

Results and discussion

The results are presented in tables. In Table 1. basic statistic descriptive parameters of work index (WI), sport index (SI) and leisure index (LI) for a total sample and in Table 2. for the teachers from Croatia, Slovenia and Norway are presented. Differences between indices obtained in different countries were tested by the means of Student T-test and the t-values and their significance are presented in Table 3.

During past decades many studies about habitual physical activity were conducted. The various surveys differ in the means by which they were conducted, in the wording of questions, in the time of year, in population sampling frames, in response rates, and in definitions of physical activity - all of which may cause differences in the results. But even with these differences, the data from the several data collection systems reveal a number of consistencies in patterns and trends in self-reported leisure-time physical activity. For this investigation Baecke questionnaire was used because of its previous positive confirmation in scientific investigations (Mišigoj-Duraković, 1999.).

Table 1. Basic statistic descriptive parameters of work index, sport index and leisure index of teachers

index	AM	SD	Min	Max
WI	2.86	0.27	2.12	3.87
SI	2.56	0.82	1.00	4.75
LI	3.32	0.56	1.75	4.75

Analyzing the results presented in Table 1. it is obvious that the lowest average value has the sport index, while leisure time index is the highest on average. Sport index also has the greatest variability; it differs from the lowest possible value of 1.0 to almost the highest possible value (4.75 of possible 5.0). Compared to average employed female population of the same age teachers have higher values of all indices. In comparison with average employed population teachers are more involved in sport and they are also more active in their leisure time. On the other side when they are compared with physical education teachers both indices showing physical activity level engagement in free time teachers working with kids in first four classes are less active, especially when it comes to sport activity level (Mišigoj-Duraković et all., 2004.).

Table 2. Basic statistic descriptive parameters of work index, sport index and leisure index of teacher

index	AM	SD	Min	Max
CROATIA (age – 40.3 y)				
WI	2.64	0.28	2.12	3.25
SI	2.20	0.83	1.00	4.75
LI	3.28	0.55	2.25	4.75
SLOVENIA (age – 36.4 y)				
WI	2.97	0.31	2.37	3.87
SI	2.64	0.82	1.25	4.50
LI	3.14	0.58	1.75	4.25
NORWAY (age –38.8 y)				
WI	2.97	0.23	2.12	3.37
SI	2.84	0.71	1.25	4.50
LI	3.53	0.55	2.25	4.75

In Table 2. results were presented for different countries where investigation was conducted. It is obvious that there are similarities and differences among teachers from different countries. The significance of these differences are presented in Table 3.

Teachers were working with children at the age 6 to 10 and, as it was professionally homogeneous sample, it was expected that there would not be any difference in their work index. But there were significant differences between teachers in Croatia and teachers from Slovenia and Norway. According to their answers Croatian teachers experienced lower work load than their colleagues from Slovenia and Norway and their work index is significantly lower. The reason for this could be found in their age – Croatian teachers are a bit older than others so maybe their greater experience influence that they have lower work load.

Table 3. Student t-test and its significance for the differences between indices of different countries

index	CROATIA/ SLOVENIA		CROATIA/ NORWAY		SLOVENIA/ NORWAY	
	t-test	p	t-test	p	t-test	p
WI	**-5.18**	**.00**	**-5.74**	**.00**	0.14	.89
SI	**-2.49**	**.01**	**-3.73**	**.00**	-1.33	.18
LI	1.17	.25	**-2.02**	**.04**	**-3.65**	**.00**

Significantly higher value of sport activity level was observed in Norway teachers who also had the greatest leisure time index. It is obvious that Norway teachers are more physically active than their colleagues from Slovenia and particularly Croatia. Most investigations carried out so far revealed that in female population physical activity show decrease after the age of 30-35, and than an increase after the age of 45. It seems that teachers in Norway do not follow this trace and that they are more active in their free time.

Conclusion

During recent years society in general has become more inactive. This is especially noted in children who are naturally active but as they grow older they become more inactive. In some countries even in their school curriculum changes were done and physical education classes have decreased. As a result many negative effects on health status of people are observed.

One of the big problems in the most countries is obesity which is shown even in very young children. Many scientists think that the reason for increased obesity prevalence lies not in biology but in environment. Among the environmental factors one of the most apostrophised is the lack of physical activity. Teachers working with children, especially at the beginning of their education, in the first classes, have great influence on them and on their way of life. That is the reason why it is important that teachers with their own habits show to children what is good for their health. It is hard to expect that someone who is not physically active at all can influence on development of this habit in someone else.

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DIFFERENTIATING FACTORS IN ELDERLY FALLERS AND NON-FALLERS OF MASCULINE GENDER

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Abstract

In order to reduce the number of falls it is necessary to identify the most serious risk factors. Elderly fallers are usually characterised by a lower muscular strength of the lower body, lower walking speed and worse general health. A tendency of the stability limit to lower was noted in people who fell in the previous year. The value of this parameter decreases with age, therefore it may be an indicator of efficiency of functioning of the balance maintaining system.

The aim of the study was to find factors which differentiate falling and non-falling elderly men.

In total 27 generally healthy men aged over 75 years took part in the study. The participants were divided into two groups – those who fell and those who did not fall in the period of one year before the study.

Their height and body mass were measured and BMI index was calculated. Using the electric bioimpedance method (Akern RJT system – BIA 101/S) the value of fat mass was assessed (FM%). Then the value of maximum sways on a stable posturographic platform was established. A computer posturographic system PE produced by the Military Institute of Aviation Medicine in Warsaw (a platform with four tensometric force transducers) was used. On the basis of the obtained values of sways the sway area was calculated

To study psychomotor fitness reaction time of decision was measured by "Decision Test" (Vienna Test System, software for psychological diagnosis - product of Schuhfried, Austria). This test needs correct and fast reaction suitable right or left leg or hand on particular signal (some colour or high or low tone).

Functional fitness was measured on the basis of selected tests from "The Senior Fitness Test" (Rikli and Jones 2001): lower body strength, agility/dynamic balance, flexibility and aerobic endurance. Last, to compare the elderly F and NF, we used Statistica 7.0 and performed a Mann–Whitney test.

The BMI and FM do not differentiate fallers from non-fallers. No differences were found in terms of reaction time between the groups. The men who fell in the year preceding the study were characterised by a lower strength of the lower body part and a lower level of aerobic endurance ($p<0.05$). No relationship was found between the falls and joint mobility. The sway area does not differentiate between the fallers and non-fallers.

The complexity of the multiple mechanisms underlying postural control does not allow for clear indication of the risks of stability loss. The group of the studied male fallers aged over 75 was characterised by a lower strength and endurance of lower body muscles compared to non-fallers.

Key words: *differentiating factors elderly fallers, non-fallers man*

AEROBIC POWER AS RELATED TO PHYSICAL MATURITY IN 12-YEAR-OLD MALE ROWERS

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Abstract

This study examined the differences in aerobic power between 47 rowers of the same chronological age (12-year-olds), but of varying levels of physical maturity. Peak oxygen uptake (VO_2peak, in L/min) proved to be greater in the mid-pubertal group than in both the early-pubertal (+19.7%) and pre-pubertal (+24.8%) groups. When expressed in mL/kg/min, VO_2peak was +12.1% greater in the mid- and pre-pubertals than in the early-pubertals. However, when compared using the appropriate scaling procedure, the VO_2peak in mid-pubertals was +14.5% greater than in the early-pubertals, and +9.1% greater than in pre-pubertals. This suggests that factors other than body mass explain the greater aerobic power in more physically mature individuals. Allometric scaling of VO_2peak yielded a scaling coefficient for body mass of 0.68 (95% CI = 0.51-0.87), which reinforces the view that, in children, VO_2peak increases relative to body mass raised to the power of 0.67 rather than in direct proportion with body mass.

Key words: *VO_2peak, tanner stages, allometric scaling, rowing*

Introduction

Children and adolescents function in a society that puts great emphasis on chronological age, especially for youth sports. When children and adolescents within the same chronological age are grouped into categories that contrast differing levels of physical maturity, available data illustrate clear maturity gradients. The influence of the maturation process upon physiological responses to exercise is an important issue in the field of pediatric exercise science; therefore, both biological and chronological age should perhaps be taken into account when assessing the physical responses of young athletes.

Rowing is predominately an aerobic type of sport. The ability to perform aerobic exercise is associated with the individual's maximal oxygen uptake (VO_2peak), which is widely recognized as the best single index of aerobic fitness (Astrand et al., 2003). Traditionally, VO_2 is expressed as an absolute value (i.e. in L/min) and as a ratio standard, or per kilogram of body mass (i.e. in mL/kg/min). By expressing VO_2 as a ratio standard, it is assumed that VO_2 is "normalized" and the influence of body mass is removed. Previous studies have demonstrated that the expression of performance variables as a simple ratio with body mass does not adequately normalize data for body size (Nevill et al., 1992). Allometric scaling models have been shown to be more appropriate for partitioning out the effects of body size in both children and adults (Welsman and Armstrong, 2000; Malina et al., 2004).

Because the impact of maturation upon physiological responses to exercise is a vital issue in the field of pediatric exercise science, this study was designed to examine the differences in VO_2peak between rowers of the same chronological age (12-year-olds), but of varying levels of physical maturity. Body mass was controlled using both the conventional ratio standard and the allometric relationship specific to the data set.

Methods

All 12-year-old members of so-called "rowing schools" affiliated with five different rowing clubs in Zagreb, Croatia were invited to participate in the study, and the sample eventually comprised 47 rowers aged 12.5 ± 0.3 years (mean ± SD; range: 12.0 – 12.9 years). The prerequisites for inclusion in this study were the following: (1) they participated in rowing training for at least six months prior to their visit to the Human Performance Laboratory; (2) they reported regular attendance (>75% of the total number of practices within the past six months), and (3) they reported no medical problems. Due to the age of the subjects and the nature of the testing procedures, each subject's parents (or legal guardians) and coaches were asked to give their consent following an explanation of the nature and purpose of the experiment and of the risks associated with participation. This explanation was in compliance with the Declaration of Helsinki.

The age of the subjects was computed from date of birth and date of examination and rounded to the nearest decimal. Sexual maturity was visually assessed using indices of pubic hair developed by Tanner. All observations were made by the same pediatrician. The subjects were classified in three categories based on their pubertal stage (Malina et al., 2004): one pre-pubertal group (subjects classified into Tanner stage 1), one early-pubertal group (subjects classified into

Tanner stage 2), and one mid-pubertal group (subjects classified into Tanner stages 3 and 4). In accordance with the recommendations of the International Biological Programme, body height, body mass, triceps and calf skinfolds were measured. The percentage of body fat was estimated according to the method developed by Slaughter et al. (1998). Lean body mass was calculated by subtracting estimated body fat from total body mass.

The rowers completed an incremental maximal treadmill test (Runrace Competition HC1200, Technogym, Italy). The test began with three minutes of walking at 3 km/h. The treadmill speed was increased by 1 km/h each minute (running started at 7 km/h) until the point of voluntary exhaustion. A constant inclination of 1.5º was used. The expired air was collected and analyzed using a breath-by-breath gas exchange system (COSMED Quark b^2, Italy) equipped with Quark b^2 6.0 PC software support. The heart rate of each subject was monitored using a short-range radio telemetry system (Polar Electro, Finland). Cardio-respiratory parameters were calculated automatically and printed every 30 seconds. The highest values were calculated as the arithmetic means of the two consecutive highest 30-second values. The subjects' rate of perceived exertion was monitored each minute using the Borg's rating of perceived exertion scale.

SPSS 11.5 for Windows statistical package was used in order to process and report the data. Differences in anthropometric characteristics, as well as in parameters of maximal aerobic exercise among the three age groups (i.e. the pre-pubertal, early-pubertal and mid-pubertal groups), were compared using a one-way ANOVA with Bonferroni post-hoc tests. Peak oxygen uptake was expressed in absolute units (L/min), as well as the ratio standard mass-related units (mL/kg/min). In addition, comparisons of VO_2peak independent of body mass were made using the allometric model. More specifically, the following equations were used to determine a common exponent for the relationship between VO_2peak and body mass:

$$VO_2peak = a \cdot body\ mass^k \text{ (eq. 1)}$$

where a is the mass coefficient, and k is the reduced exponent, the numerical value of which can be obtained from the log-log plot of the experimental data, as the logarithmic expression is a straight line:

$$\log(VO_2peak) = \log a + k \cdot \log(body\ mass) \text{ (eq. 2)}$$

Thus, VO_2peak is estimated after having adequately controlled for differences in body size (body mass in this example).

Results

Tables 1 and 2 present the descriptive data for the rowers classified according to pubertal stage. The one-way ANOVA revealed a significant main effect in all measured anthropometric variables among the pre-, early-, and mid-pubertal groups with the exception of percent body fat. In terms of body mass, both early- ($p<0.05$) and mid-pubertal ($p<0.01$) rowers were heavier than pre-pubertal athletes. In terms of lean body mass, mid-pubertal rowers were superior to both early- and pre-pubertal athletes ($p<0.01$), with the early-pubertals being superior to the pre-pubertals ($p<0.05$).

The one-way ANOVA revealed a significant main effect in VO_2peak ($p<0.01$), VO_2peak in ratio with body mass ($p<0.01$), and VO_2peak expressed as mL/kg$^{0.67}$/min ($p<0.01$) among the pre-, early-, and mid-pubertal groups. The Bonferroni post-hoc tests identified the mid-pubertal group as having significantly greater VO_2peak ($p<0.01$) values than the early- and pre-pubertal groups. In addition, VO_2peak in ratio with body mass was significantly greater ($p>0.05$) in the pre- and late-pubertal groups than in the early-pubertal group. When VO_2peak, expressed as mL/kg$^{0.67}$/min is observed, significant differences are noted between the pre- and mid-pubertal groups ($p<0.05$) and between the early- and mid-pubertal groups ($p<0.01$).

Table 1. Age, physical characteristics and peak oxygen uptake of 12-year-old rowers by puberty stage

	Group by puberty stage		
Variable	Pre-pubertal (n=14)	Early-pubertal (n=15)	Mid-pubertal (n=18)
Age (yrs)	12.4±0.3	12.4±0.3	12.6±0.3
Body height (cm)	153.4±6.2	160.5±5.3	167.5±7.0
Body mass (kg)	44.1±9.0	51.8±7.3	59.8±7.4
Lean body mass (kg)	34.6±6.2	40.0±3.6	48.0±5.5
Percent fat (%)	21.1±4.5	22.2±6.0	19.6±5.1
VO_2peak (L/min)	2.21±0.26	2.41±0.28	3.02±0.29
VO_2peak (mL/kg/min)	51.3±7.0	46.9±5.4	50.9±5.1
VO_2peak (mL/kg$^{0.67}$/min)	176.7±16.7	166.3±13.0	194.4±14.7

Allometric scaling procedures identified a body mass exponent of k=0.68 (95% CI = 0.51-0.87). This exponent does not differ significantly from the theoretical k exponent of 0.67 as predicted by theory of geometric similarity [see Astrand et al. (2003) for details]; therefore, VO_2peak, expressed as mL/kg$^{0.67}$/min was compared in subjects exhibiting varying levels of physical maturity.

Discussion and conclusions

Few studies allow for possible comparisons of VO_2peak values; in a similar study conducted by Armstrong et al. (1998) 12-year-old boys produced VO_2peak values somewhat below those of the subjects in the present study. The difference may be explained by the fact that the general population of 12-year-old boys was examined, as opposed to the present study which examined young athletes. VO_2peak in 12-year-old rowers is greater in the mid-pubertal group than in both the early-pubertal (+19.7%) and pre-pubertal (+24.8%) groups. When expressed as a ratio standard (i.e. in mL/kg/min), VO_2peak is +12.1% greater in the mid- and pre-pubertals than in the early-pubertals. However, when compared using the appropriate scaling procedure, the VO_2peak in mid-pubertal rowers is +14.5% greater than in the early-pubertals, and +9.1% greater than in pre-pubertals. This suggests that factors other than body mass explain the greater aerobic power (as assessed by VO_2peak) in more physically mature individuals of the same chronological age. Of course, cross-sectional studies can only indicate differences among the respective groups, whereas the changes are inferred.

Allometric scaling of VO_2peak in the present study yielded a scaling coefficient for body mass of 0.68 (95% CI = 0.51-0.87). The dimensional scaling of geometrically similar individuals suggests that VO_2peak, should be proportional to body mass raised to the power of 0.67 (Astrand et al., 2003). These findings are clearly in line with that theoretical exponent and also with earlier studies (Nevill et al., 1992). This finding reinforces the view that, in children, VO_2peak increases relative to body mass raised to the power of 0.67 rather than in direct proportion with body mass (i.e. mass$^{1.0}$). Mass exponents other than 0.67 have previously been reported in children, but may be attributed to the modeling of small sample groups. According to Welsman and Armstrong (2000), the factor contributing most to diversity in the obtained mass exponents in previous studies using children appears to be sample size. It has been suggested that meaningful exponents can only be obtained when modeling large groups, where the range of body mass is extensive.

Relatively few studies have examined the relationship between VO_2peak and the maturation process, but the available data indicate that, in boys, VO_2peak increases with greater levels of physical maturity. Among factors that may contribute to the more mature boys' higher VO_2peak, Armstrong et al. (1998) state that higher hemoglobin concentrations are found in more mature individuals. Data on the relationship of VO_2peak to maturity are sparse, probably due to the complex ethics and logistics of maturity assessment.

Sexual maturity as assessed by indices of pubic hair have been shown by previous studies to be related to VO_2peak, with more mature boys demonstrating higher VO_2peak values than those of less mature boys. In accordance with the results of the present study, VO_2peak in ratio with body mass has been shown to remain unchanged with maturation. Few studies have investigated VO_2peak in relation to maturation using alternate statistical approaches for accounting for body size differences. Armstrong et al. (1998) state that imposing the ratio standard on data sets, instead of deriving the appropriate exponent from statistical modeling, probably clouds the interpretation of the development of VO_2peak in relation to body size during maturation.

In conclusion, using a log-linear scaling model to adequately control for body mass, significant differences in VO_2peak among 12-year-old rowers of varying stages of puberty and, consequently, varying levels of maturity have been demonstrated. In previous studies, these differences may have been masked by the inappropriate use of VO_2peak in ratio with body mass (mL/kg/min). Further research is needed in order to further explain the above-mentioned differences among groups of rowers exhibiting differing levels of maturity independent of body mass.

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FUNCTIONAL CAPACITY PARAMETERS OF FEMALE TENNIS PLAYERS AGED 12 TO 14

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Abstract

The aim of this study was to determine the normative values for physiological variables of female tennis players aged 12 to 14. The subjects, 32 female tennis players, underwent a progressive treadmill running test to volitional exhaustion, with breath-by-breath measurement of expired gasses, ventilation and heart rate. From test data, the gas exchange anaerobic threshold (v_{AT}), maximal running speed (v_{max}) and maximal oxygen uptake (VO_2max) were determined, as measures of aerobic fitness, and the distance run from v_{AT} to VO_2max (d_{an}), as a measure of anaerobic capacity. The values were calculated separately for the entry (12-13 years) and for the exit (13-14 years) age category. The older age group of players achieved a significantly higher running speed at the v_{AT} (11.6±1.3 : 10.5±1.1 km/h, $p<0.05$), as well as at exhaustion (14.5±1.1 : 13.3±1.2 km/h, $p<0.05$), when compared to the younger girls. The higher values of v_{AT} and v_{max}, despite identical VO_2max (50.3±5.2 mlO_2/min/kg) and VO_2 at v_{AT} (86% VO_2max), indicate a significantly better running efficiency in older girls. The d_{an} was also higher in the older age group (651±177m : 579±168m), although the difference did not reach statistical significance ($p>0.05$). The presented tables with centile values for the measured variables will help the young athletes and their coaches in the process of selection for the sport, and in the process of planning and control of optimal training strategies.

Key words: *tennis, aerobic capacity, anaerobic capacity, anaerobic threshold, growth*

Introduction

The development of competitive tennis in the last decade stipulated also the evolution of technological, tactical, technical, psychological and other components of the game. The increasing dynamics and tempo of the game, as well as the growing number of young players involved in tennis training and competition, demand excellent fitness, and specific morphological and functional traits of players. Very high training and competitive loads already at prepubertal age, along with great financial investments, enhanced the interest of experts – coaches, fitness trainers and physicians in the persuit of the optimal model of an elite tennis player and the best determinants of planning and programming. It is of great importance to define the parameters during growth and development that provide success in the game of tennis. For this purpose, several laboratory and field tests are used to assess functional and motor abilities of tennis players. The share of various energy systems in tennis was estimated to be approximately 70% for the phosphagen (alactic) anaerobic system, 20% for the glycolitic (lactic) anaerobic system and 10% for the aerobic energy system[2]. However, the involvement of specific energy systems in the tennis game depends upon several factors, like type and speed of the playing surface, individual style of play, sex and age category. In female tennis, the share of the aerobic system is considered to be somewhat higher, due to lower intensity and longer duration of points. While very few data in the literature can be found reporting the values of physiological and fitness parameters for professional female players, for younger age categories, to our knowledge, there are no data available. The purpose of this study was to determine the values for physiological variables of female tennis players aged 12 to 14, that could be used as normative values for this age category. The results obtained, and the normative tables derived from this study will enable the evaluation of aerobic and anaerobic energy capacities of female tennis players aged 12 to 14. An objective evaluation of subjects is indispensable in the processes of selection for the sports discipline, planning and programming of athletic training, as well as for determination of an optimal game plan. Graphical presentation of the obtained results will simplify the determination of player's rank regarding the physiological and fitness capacities required for this age category.

Methods

Thirty two female tennis players competing in the age category 12 to 14 participated in the study. Basic characteristics of the subjects are presented in Table 1, separately for first (12-13 y, FIR) and second (13-14 y, SEC) year category. All subjects had to fulfill following criteria: to be actively competing in the 12-14 age category, ranked on the rank-list of the Croatian Tennis Association, healthy during the testing and to be involved in a regular tennis training program. Almost half of the players that participated in this investigation played on the WTA Tour, in later years after maturation.

Table 1. Basic physical characteristics of the subjects

	FIR	SEC
Age *(yrs)*	13,1 ± 0,4	14,2 ± 0,4*
Body mass *(kg)*	49,1 ± 6,8	54,5 ± 7,4*
Body height *(cm)*	161,6 ± 5,9	169,6 ± 5,3*
Arm span *(cm)*	162,5 ± 8,9	171, 0 ± 7,6*

Values are means ± SD; *significant at p<0.01

Incremental running test (VO_2max test)

All subjects were familiarized with treadmill walking and running for a period of at least 15 minutes prior to their first data collection. The incremental running test was performed on a motorized, calibrated treadmill (Run Race, Technogym, Italy), and preceded by a short warm-up and stretching procedure. Gas exchange data were measured *breath-by-breath* using a Quark b^2 metabolic measurement cart (Cosmed, Rome, Italy). Before each test, the gas analyzers were calibrated using gases of known concentration, and the flow meter was calibrated using a 3-L syringe. Before the running test, spirometry was performed on the same metabolic cart. Heart rate was recorded during the tests using a HR monitor (Polar Electro, Kempele, Finland). The starting speed of 3 km $\cdot h^{-1}$ was maintained for 3 min after which the speed was increased by 1 km $\cdot h^{-1}$ every 60 s. The subjects walked the first four stages (up to 6 km $\cdot h^{-1}$), and continued running from 7 km $\cdot h^{-1}$ until volitional exhaustion. The last half or full stage the subject could sustain (for either 30 or 60 s) was defined as the subject's maximal speed. During recovery, the subjects walked at 5 km $\cdot h^{-1}$ for 5 minutes. Graphical determination of the aerobic and anaerobic gas exchange thresholds for running (AeT_r, AnT_r) was done by the V-slope method[11]. When indeterminate, the V-slope method was supported with inspection of the respiratory exchange ratio (RQ), ventilation and ventilatory equivalents for O_2 and CO_2 (VE/VO_2, VE/VCO_2, Figure 2). The highest oxygen uptake for any 30-s period recorded in the incremental running test was defined as peak VO_2. The distance run (in meters) from the anaerobic threshold up to maximal running speed (d_{an}) was used as a measure of anaerobic capacity.

Data collection and analysis

The sample of variables consisted of one selective, four anthropometric and 15 parameters for evaluation of functional capacities:

- (FIR, SEC) Belonging to either the first (12-13) or second (13-14) age category
- (AGE) Cronological age (yrs)
- (BM) Body mass (kg)
- (BH) Body height (cm)
- (AS) Arm span (cm)
- (FVC) Forced vital capacity (L)
- (FEV_1) Forced exspiratory volume in the 1. second (L)
- (VO_2max) Maximal oxygen uptake (L O_2 / min)
- (VO_2max/kg) Relative maximal oxygen uptake (ml O_2/min/kg)
- (HR_{max}) Maximal heart frequency (1/min)
- (v_{max}) Maximal running speed (km/h)
- (BF_{max}) Maximal breathing frequency (1/min)
- (VE_{max}) Maximal ventilation (L/min)
- (VO_2/HR) Maximal oxygen pulse (ml O_2)
- (v_{AT}) Load (running speed) at the anaerobic threshold (km/h)
- (VO_{2AT}) Relative oxygen uptake at the anaerobic threshold (ml O_2/min/kg)
- (HR_{AT}) Heart frequency at the anaerobic threshold (1/min)
- (HR_{reg}) Upper border of the regeneration zone heart frequency (1/min)
- (HR_{ext}) Upper border of the extensive aerobic intensity zone heart frequency (1/min)
- (d_{an}) Distance run in the anaerobic zone during the incremental test (from v_{AT} to v_{max}) (m)

The results are presented as means ± SD for all subjects. The normality of appropriate data sets was confirmed by the Kolmogorov-Smirnov test. Paired t-tests were used to make comparisons between the two age groups. A value of $P < 0.05$ was established a priori to determine statistical significance. For the most important variables that define the

aerobic and anaerobic energy capacity, the decils where determined separately, for each age group (FIR and SEC) of tennis players.

Results

The results of the incremental treadmill test and the spirometry values are presented in Table 2, separately for each age group of tennis players. A statistically significant difference between the entrance and exit age group was found for the following variables: forced vital capacity, forsed exspiratory volume in the 1. second, maximal oxygen uptake, maximal running speed, maximal ventilation, maximal oxygen pulse, and running speed at the anaerobic threshold.

Table 2. The values of functional variables for the FIR and SEC age groups (mean±SD)

	FIR	SEC	p
FVC *(L)*	3,43 ± 0,46	3,93 ± 0,46*	0,006
FEV_1 *(L)*	3,14 ± 0,42	3,48 ± 0,50*	0,049
VO_2max *(L O_2/min)*	2,45 ± 0,31	2,72 ± 0,31*	0,022
VO_2max/kg *(ml O_2/min/kg)*	50,3 ± 5,2	50,3 ± 5,2	0,985
HR_{max} *(1/min)*	201 ± 7	198 ± 7	0,279
v_{max} *(km/h)*	13,3 ± 1,2	14,5 ± 1,1*	0,012
BF_{max} *(1/min)*	61 ± 8	58 ± 8	0,422
VE_{max} *(L /min)*	90,2 ± 13	103,9 ± 14*	0,009
VO_2/HR *(ml O_2)*	12,6 ± 1,6	14,2 ± 2,2*	0,025
v_{AT} *(km/h)*	10,5 ± 1,1	11,6 ± 1,3*	0,030
VO_{2AT} *(ml O_2/min/kg)*	43,3 ± 5,5	43,6 ± 5,7	0,899
HR_{AT} *(1/min)*	183 ± 10	180 ± 10	0,409
HR_{reg} *(1/min)*	136 ± 11	137 ± 10	0,898
HR_{ext} *(1/min)*	165 ± 9	163 ± 8	0,583
d_{an} *(m)*	579 ± 168	651 ± 177	0,296

The centils for the main variables that evaluate the aerobic and anaerobic (d_{an}) energy capacities are shown in Table 3, separately for the first year and second year age groups.

Table 3. Centil values for tennis players of the first (F) and second (S) year age group

		10	20	30	40	50	60	70	80	90
VO_{2max} *(LO_2 /min)*	F	2.84	2.71	2.61	2.52	2.45	2.37	2.28	2.19	2.05
	S	3.12	2.98	2.88	2.80	2.72	2.64	2.56	2.46	2.33
VO_{2max}/kg *(mlO_2/min/kg)*	F	56.4	55.5	53.6	52.4	50.2	48.5	48.0	45.7	44.5
	S	55.3	53.3	52.9	50.8	50.5	48.4	47.0	46.4	45.4
v_{max} *(km/h)*	F	14.89	14.35	13.96	13.62	13.62	13.00	12.66	12.27	12.27
	S	15.96	15.46	15.10	14.79	14.50	14.21	13.90	13.54	13.04
v_{AT} *(km/h)*	F	11.95	11.46	11.11	10.81	10.52	10.24	9.94	9.59	9.10
	S	13.19	12.63	12.22	11.87	11.55	11.23	10.88	10.47	9.91
d_{an} *(m)*	F	800	742	650	650	550	550	433	417	367
	S	840	833	717	700	675	650	550	500	480

Discussion and conclusions

According to the growth charts for the general population[8], the girls in the current investigation showed higher mean values of body mass and height, but still within expected parameters (approx. 70th percentile for age). As expected, 14-year-olds were significantly taller, heavier and displayed a larger arm span compared to 13-year-olds (Table 1).

We suppose that the differences between the entering and exiting age group in some spirometry and aerobic capacity parameters (FVC, FEV_1, VO_2max, VO_2/HR, VE_{max}, v_{max} i v_{AP}) are predominantly influenced by factors of growth and maturation, which is evident from the statistically significant difference in anthropometric characteristics between the

entering and exiting age group (Table 2). Despite a significantly higher absolute oxygen uptake in the older age group, the relative VO_2max was identical in both groups, which is in accordance with the results of other studies[3,4,5,9], showing no increase of the VO_2max/kg for this age span.

It is interesting to note that an almost identical VO_2max/kg was also achieved at the anaerobic threshold in both age groups (at 86% of VO2max), although the running speed at the threshold, as well as v_{max}, was significantly higher in the older age group (p=0.03). This indicates a significantly higher running economy in the older age group. Although the age of menarche was not determined in this study, it is probable that in the 12-13 age group most of the girls were tested before the appearance of menarche, while in the 13-14 age group most girls were tested after the apperance of menarche. An even higher difference was present for the maximal running speed achieved in the incremental test (13.3 km/h : 14.5 km/h, p=0.01); v_{max} is a measure of aerobic endurance, but also partially depends on the size of the anaerobic capacity, due to the relatively short duration of the test (6-10 minutes from the starting running speed). Therefore, we may assume that the difference in v_{max} achieved is in part caused by a higher anaerobic capacity in the older girls, indicated also by the difference in the distance run from the anaerobic threshold to exhaustion (578.6 m : 650.8 m). This difference does not reach statistical significance (possibly due to sample size), but shows a trend towards higher values with increasing age. The duration of training may also influence the results and the differences between the age groups. We suppose that the outgoing year tennis players have been involved in the training process on average one year longer than their younger contestants, so we may assume that an overall higher volume of training may have had an influence on the value of physiological variables and fitness level.

In conclusion, within the 12-14 age category, female tennis players of the exiting (13-14) year show a significantly higher running speed at the anaerobic threshold than one year younger (12-13) players, despite identical average values of relative VO_2max and VO_2 at the anaerobic threshold, indicating a significantly higher running efficiency in the older age group. A parameter of anaerobic endurance (d_{an}) does not differ significantly between age goups, although showing a trend towards higher values with increasing age. The presented tables with centile values for parameters that evaluate energy capacities will help the young female athletes and their coaches in the process of selection and performance prediction, as well as developement of optimal training programs.

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WEIGHT STATUS IN PREPUBERTAL CHILDREN IN SLOVENIA

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Abstract

The main aim of this study was to analyze weight status in children on the basis of body mass index (BMI) and triceps skinfold thickness (TSF). The sample included 5613 children, aged 6 to 12 years from Slovenia. Children were classified as non-overweight, overweight and obese according to age and sex specific BMI cut-off points. The results show that 18.3% of boys and 18.5% of girls are overweight and 6.5% of boys and 6.7% of girls are obese. The Chi-square test show that there is a significant difference ($p<0.001$) in TSF according to weight status. TSF and weight status of prepubertal children are closely related. The criterion for the determination of weight status on the basis of BMI is well defined.

Key words: *non-overweight, overweight, obesity, body mass index, triceps skinfold thickness*

Introduction

The prevalence of overweight and obese children varies considerably depending on the country: Latvia 2-3%, Slovakia 10%, the Netherlands 14%, Germany 16%, Denmark 18%, Sweden 18%, France 18%, Poland 19%, Spain 30%, Greece 31%, Malta 35% and Italy 36% (IOTF, 2005). Most children who are overweight or obese seem completely healthy. But numerous studies have shown that obese children suffer more often from cardiovascular diseases, type 2 diabetes, asthma, mental, orthopedic and other health problems (Reilly, Methven, McDowell, et al., 2003).

Overweight and obesity are mostly estimated by using Quetelet's body mass index (BMI). A good indicator of the amount of body fat is skinfold thickness, which shows the peripheral distribution of subcutaneous fat In childhood and adolescence, girls' skinfold is a little thicker than that of the boys (e.g. Kavak, 2006).

Bandini, Vu, Must, et al. (1997) observe that the triceps skinfold (TSF) predicts the amount of body fat in 68%, whereas BMI predicts it in 38%. TSF is closely associated with the overall quantity of body fat. BMI and the sum of skinfolds are very similar criteria for determining obesity, as they correspond in 92% of cases (Kruger, R., Kruger, H.S., MacIntry, 2006). The first National Health and Nutrition Survey (NHANES I) find out that in the population of children and adults aged from 6 to 74, the Pearson correlations between BMI and TSF ranged from 0.6 to 0.9 and that there were no systematic differences in the correlation according to age (Must, Dallal, Dietz, 1991).

Because of their great effects on health, overweight and obesity occurring in children have to be treated very seriously. In Slovenia, there has been no comprehensive analysis of the overweight and obesity of children up to date. Therefore the main purpose of the study was to analyze overweight and obesity in children on the basis of BMI and TSF.

Methods

Participants. The study was carried out on a random group sample of children from Slovenia in 2006. The study included 5613 children from the first to the sixth class of primary school. 2601 of children were from city schools and 3012 from rural schools. There were 2841 boys and 2772 girls, aged 6 to12 years. Children and their parents agreed to participate in this research. Written consent was obtained from the children's parents.

Measurements. For measuring body height Martin's anthropometer was used, with the accuracy of 0.1 cm, for measuring the body mass a calibrated medical balance scale was used, with the accuracy of 0.1kg. On the basis of obtained measures BMI was calculated. Left TSF was measured with a skinfold caliper.

Criterion for definition of overweight and obesity. Weight status was defined using BMI in kilograms per square meters (kg/m^2). Children were classified as non-overweight, overweight and obese according to age and sex specific BMI cut-off points as proposed by Cole, Bellizzi, Flegal, et al. (2000). On that study the centile curves were drown that at age 18 years passed through the cut-off points of 25 and 30 kg/m^2 for adults overweight and obese.

Statistical analysis. SPSS 12.0 was used for statistical analysis. Chi-square test was used to analyse differences between weight status and gender, age, school environment and TSF.

Results

Table 1 shows the results of the Chi-square test of the differences between the sexes, school environment and school class in relation to the weight status. The sample comprised 18.3% of overweight boys and 18.5% of girls, and 6.5% of obese boys and 6.7% of obese girls. The results show that there are no significant differences between the boys and the girls (p=0.930). The Chi-square test shows that there are no statistically significant differences in the weight status between children from urban schools and those from rural schools (p=0.775). Statistically significant difference occur only between classes (p=.001). The share of children with normal body weight (80.1%) is highest in the first class, and lowest (71.6%) in the fifth class. Conversely, the share of overweight children is lowest in the first class (14.5%) and highest in the fifth class (21.2%). The situation is slightly different with obese children, the proportion of whom is the lowest in the sixth class (4.6%) and the highest in the third class (8.0%). The common share of overweight and obese children is the lowest in the first class (19.9%), followed by the fourth class (23.5%), the second class (25.7%), the sixth class (25.8%), the third class (27.3%) and the fifth class (28.4%).

Table 1. Prevalence of non-overweight, overweight and obesity according to gender, school environment, and class

Variables		Non-overweight		Overweight		Obesity		p
		n	n%	n	n%	n	n%	
Gender	Boys (n=2841)	2136	75,2	520	18,3	185	6,5	0,930
	Girls (n=2772)	2073	74,8	513	18,5	186	6,7	
School	Urban (n=2601)	1957	75,2	469	18,0	175	6,7	0,775
	Rural (n=3012)	2252	74,8	564	18,7	196	6,5	
Class	1. Class (n=951)	762	80,1	138	14,5	51	5,4	0,001
	2. Class (n=1026)	762	74,3	185	18,0	79	7,7	
	3. Class (n=965)	702	72,7	186	19,3	77	8,0	
	4. Class (n=1097)	839	76,5	192	17,5	66	6,0	
	5. Class (n=944)	676	71,6	200	21,2	68	7,2	
	6. Class (n=630)	468	74,3	132	21,0	30	4,8	

Table 2 shows the results of the Chi-square test according to weight status and the skinfold thickness of children. For this purpose, the participants were divided according to TSF into six groups with a 5 mm span. The Chi-square test show that there is a significant difference (p=0.001) in skinfold thickness according to weight status. Skinfold thickness lower than 5 mm is only present in children with normal body weight. The percentage of the children with normal body weight decreases with the increased skinfold thickness, so it is only 0.2% when the skinfold thickness is higher than 26 mm. Conversely, 35.4% of obese children belong to the group with skinfold thickness over 26 mm, a lot of them (31.3%) also to the group with skinfold thickness between 21 and 25 mm. 40.4% of overweight children belong to the group with skinfold thickness between 16 and 20 mm.

Table 2. Differences in TSF according to weight status

TSF (mm)	Non-overweight		Overweight		Obesity	
	n	n%	n	n%	n	n%
> 5 mm	178	6.0	0	0	0	0
6-10 mm	1496	50.5	30	3.7	4	1.4
11-15 mm	994	33.5	228	28.3	24	8.2
16-20 mm	248	8.4	326	40.4	70	23.8
21-25 mm	42	1.4	162	20.1	92	31.3
26 < mm	6	0.2	60	7.4	104	35.4
χ^2=2398,02; p=0,001; V=0,543						

Discussion and conclusions

On the basis of BMI we analyzed the weight status in pre-pubertal children and observed the differences according to sex, age and school environment. The results show that 18.3% of boys and 18.5% of girls are overweight and that 6.5% of boys and 6.7% of girls are obese, which is slightly more than reported by Planinšec, Fošnarič and Pišot (2006). The comparison of the results of our study with other European countries shows that the prevalence of overweight and obesity is smaller in some of the countries (Latvia, Germany, France, Slovakia, Finland, the Netherlands, Denmark, Sweden

and Poland), approximately equal in Norway, Great Britain and Croatia, and higher particularly in the Mediterranean countries (Brettschneider, Bünemann, 2005; IOTF, 2005).

The prevalence of overweight and obesity differs a lot according to the school class, even by up to 8.5% if we compare the children of the first class (19.9%) and of the fifth class (28.4%). Here we observe that the trend of change is irregular, which is contrary to our previous findings according to which the proportion of children who are overweight and obese gradually decreases from the age of six to the age of eleven (Brettschneider, Bünemann, 2005). The results also showed that there are no significant differences according to weight status between the children from urban and rural schools. The results of researches are quite different in this respect. Some find that there are more overweight children in rural areas, which is explained by a more modest choice of food and less possibility for physical activities. In other studies, on the contrary, it is found that the percentage of overweight children is higher in urban areas (Planinšec, et al., 2006), which is explained as the consequence of modern lifestyle, involving less physical activity for urban children. In numerous studies, the comparison between boys and girls shows that the prevalence of overweight and obesity is approximately the same for boys and girls and that there are no significant differences (Planinšec, et al., 2006), which was also the finding of our study.

There are significant differences in TSF of children according to weight status. The results clearly show that TSF and weight status are closely associated and that the criterion for the determination of weight status on the basis of BMI is well defined, as it adequately classifies children according to the fat mass measured by TSF.

Promoting healthy lifestyle in children will have a significant role in prevention of obesity. Preventive efforts focused on physical activity and nutrition in childhood will have long-life health benefits. A realistic approach to the prevention of physical inactivity and obesity requires incorporation of environmental, behavioral, psychological and cultural factors. A health educational intervention needs to be given in educational and health institutions, local communities and families.

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STRUCTURE OF GENDER DIFFERENCES IN DISTRIBUTION OF SKIN FOLDS IN CHILDREN AT EARLY SCHOOL AGE

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Abstract

Cross-sectional study was conducted on a sample of 93 boys and 106 girls at the age 7 to 9. The children, who attend two primary schools in Zagreb, were divided into subsamples by age and gender. The research was conducted with the aim of establishing the status of morphological characteristics – indicator of skin folds, fat percentage and body mass index of boys and girls at the age 7 to 10 and difference of the system of morphological characteristics with respect to age and gender.

It is concluded that there is significant gender dimorphism at early school age where growth and development and related changes of morphological significance are more dominant in girls. A higher discriminative coefficient of the system of skin folds between age groups is evident in girls which can be related with a closer age to adolescent development. The proven gender dimorphism should be taken into consideration when determining the burden in all organizational types of work with these age groups.

Key words: *morphological implication, children, primary education, gender dimorphism*

Introduction

Growth and development is determined by chronological, physiological age and gender. It is defined with a set of endogenous (genetic, hormonal) and exogenous (nutrition, physical activity, socioeconomic, psychological, climatic, and other) factors. Gender dimorphism in most of the parameters of growth and development begins to significantly show throughout sexual maturation and to the onset of puberty girls and boys develop parallel in most characteristics. Before the puberty there are peculiarities in some morphological and functional characteristics (Medved et al 1993; MacMaster et al 2007). The puberty growth spurt begins and ends earlier in girls. The first manifestations of puberty are related with the onset of maximal growth and menstruation sets in at the end of the maximal growth (Tanner, 1986). The research of Matković (1990) shows greatest increase in height for the Croatian girls at the age 11 to 12 and for the boys at the age 13 to 14 and the same trend of change is registered for the body mass, too. The aim of this research is to establish status, dynamics and structure of skin folds change, fat percentage and body mass index for girls and boys at the age of 7 to 9.

Methodology

Cross-sectional study was conducted on the sample of 93 boys and 106 girls of two primary schools in Zagreb. The sample was divided by age (7 to 7.99, 8 to 8.99) and by gender. Anthropometric surveys were conducted according to directions of the International Biological Program (IBP), (Weiner, Lourie, 1969). The sample of variables is made up of the following variables: height, body weight, fist skin fold, subscapular skin fold, abdominal skin fold, triceps skin fold, calf skin fold. Body mass index (BMI) was calculated from body weight and height - (body weight / height^2). Fat percentage was calculated from subscapular skin fold and triceps skin fold by Slauther et al (1988) equation. The data were analyzed using methods of descriptive statistics, normal distribution was tested with the Kolmogorov-Smirnov procedure. Differences of mean results were analyzed using "t"-test and "U"-test (depending on distribution normality). Structure differences were analysed by means of linear and canonical discriminative analysis using the statistical program Statistica 7.1. licensed for the University of Zagreb.

Results

Upon applying methods of descriptive statistics using the Kolmogorov-Smirnov test, in the subsample of boys, the hypothesis on the abnormal distribution for variable fist skin folds was proven for all age subgroups (max D=0,29; p<0,05 – age 7; max D=0,25; p<0,05 – age 8; max D=0,24; p<0,05 – age 9), but in the oldest age group 9 abnormalities were proven for subscapular and abdominal skin folds (max D=0,24; p<0,05). Skewness was positive, which means that the

results are grouped in the zone of lower values. Using the Kolmogorov-Smirnov procedure, in the subsample of girls, the hypothesis on the abnormal distribution for variable fist skin folds was proven for all age groups (max D=0,30; p<0,01 – age 7; max D=0,29; p<0,01 – age 8; max D=0,33; p<0,01 – age 9). Subscapular skin folds showed abnormality in age group 7 (max D=0,29; p<0,05) and age group 8 (max D=0,26; p<0,05). Skewness is positive for variable fist skin folds and subscapular skin folds for all three age groups which means that results are grouped in the zone of lower values on the x-axis.

Basic descriptive indicators of tested characteristics are given in Table 1. and significant difference of means between subsamples defined by gender for all age groups in Table 2.

Table 1. Descriptive data of morphological characteristics, body mass index and body fat percentage in boys and girls from 7 to 9 years of age

Boys	**Age 7**		**Age 8**		**Age 9**	
Variable	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev.
Height (cm)	132,62	6,26	136,07	5,75	141,13	5,15
Body weight (kg)	31,13	6,05	33,60	7,31	35,98	7,12
Fist skin fold (mm)	2,14	0,89	2,13	1,34	2,00	1,36
Subscapular skin fold (mm)	6,18	3,38	7,29	5,79	6,88	5,87
Abdominal skin fold (mm)	9,05	5,86	10,32	7,69	10,43	9,31
Triceps skin fold (mm)	9,73	4,26	10,52	6,03	11,03	6,86
Calf skin fold (mm)	7,10	4,53	8,71	6,63	8,25	7,45
BMI (kg/m^2)	17,55	2,31	18,01	2,79	18,00	3,06
Fat percentage	14,71	6,40	15,39	7,60	15,22	7,32
Girls	**Age 7**		**Age 8**		**Age 9**	
Variable	Mean	Std.Dev	Mean	Std.Dev	Mean	Std.Dev.
Height (cm)	129,41	4,35	135.93	5,97	140,78	6,94
Body weight (kg)	27,98	3,80	33,60	7,42	36,14	7,38
Fist skin fold (mm)	1,68	0,82	2,06	1,51	1,65	0,87
Subscapular skin fold (mm)	7,19	4,90	10,26	8,60	9,42	6,36
Abdominal skin fold (mm)	9,54	6,94	12,69	8,29	13,12	7,82
Triceps skin fold (mm)	10,43	5,53	13,00	6,38	14,02	5,33
Calf skin fold (mm)	9,04	7,03	12,21	9,70	9,15	6,04
BMI (kg/m^2)	16,69	1,90	18,05	3,02	18,04	2,74
Fat percentage	15,62	7,36	18,82	7,27	20,03	6,90

Table 2. Significance of mean differences in subsamples of boys and girls at the age 7, 8 and 9

	Age 7		**Age 8**		**Age 9**	
Variable	"t"/U*	p	"t"/U*	p	"t"/U*	p
Height	2,14	0,0377	0,10	0,9221	0,26	0,7974
Body weight	2,23	0,0304	0,00	0,9975	-0,10	0,9169
Fist skin fold	*215,00	0,0511	*494,00	0,5077	*748,50	0,2675
Subscapular skin fold	*250,50	0,4549	*383,00	0,0384	*597,00	0,0157
Abdominal skin fold	-0,26	0,7937	-1,20	0,2363	*614,50	0,0250
Triceps skin fold	-0,49	0,6255	-1,62	0,1103	-2,23	0,0283
Calf skin fold	-1,09	0,2794	-1,68	0,0988	-0,60	0,5533
BMI	1,44	0,1556	-0,06	0,9496	-0,07	0,9458
Fat percentage	-0,45	0,6555	-1,87	0,0658	-3,08	0,0028

It was proven significant differences in subsamples by gender at age 7 in variables height and body weight which have showed significantly more values at boys. Later at older age groups, girls grow more rapidly and that same difference does not exist. While at age 7 there are still not significant differences in measurements of skin folds, at age 8 there is significant more subscapular skin folds at girls then boys. Then at age 9 there are significantly more subscapular skin folds, abdomen skin folds and triceps skin folds and fat percentage at girls.

The results show significant differences in subsamples by gender at the age of 7 in body height and weight with higher values in boys than in girls. While at the age of 7 there are still not significant differences in skin fold thickness, from the age of 8 girls begin to accumulate more fat subcutaneously, on the trunk and afterwards on the lower limbs too. Then at age 9 there are significantly more subscapular skin folds, abdomen skin folds and triceps skin folds and fat percentage at girls. These results could be explained with expecting puberty growth spur in near future especially referring to dynamics of skin folds and fat percentage change. Fat percentage in subsample of boys and girls is shown graphically (Figure 1.).

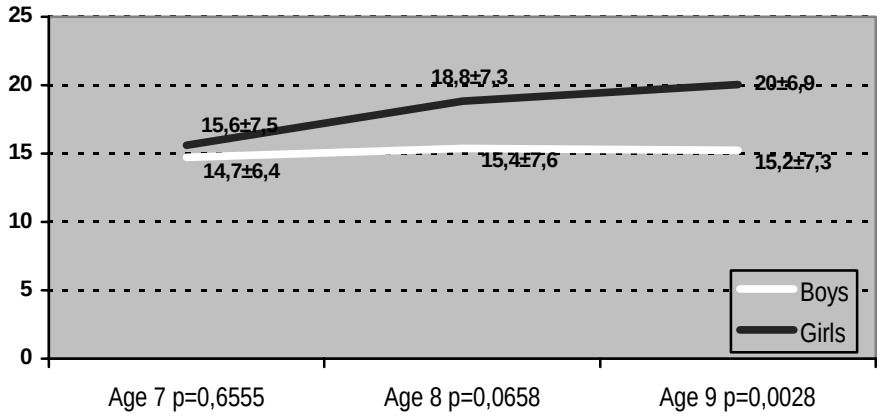

Figure 1. Fat percentage in boys and girls by age groups

Descriptive indicators of body mass index show stable average values throughout the observed period. Linear discriminative analysis of skin fold system in subsamples defined by gender is shown in Table 3. Significance of differences grows with age.

Table 3. Discriminative analysis of skin folds system in subsamples at age 7, 8 and 9 defined by gender

	Eigen- value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
Age 7	0,28	0,47	0,78	10,13	5	0,0716
Age 8	0,21	0,42	0,82	11,51	5	0,0421
Age 9	0,37	0,52	0,73	24,29	5	0,0002

Factor structure of a statistically significant function.

	Age 8	**Age 9**
Fist skin fold	0,05	-0,23
Subscapular skin fold	-0,46	0,34
Abdominal skin fold	-0,32	0,26
Triceps skin fold	-0,47	0,41
Calf skin fold	-0,46	0,11
Centroids	**Age 8**	**Age 9**
G_1:0	0,47	-0,61
G_2:1	-0,44	0,60

At the age of 8 subscapular, upper and lower limb skinfolds have the highest correlation with the discrimination function. At the age of 9 triceps and then subscapular skinfold show the highest contribution to the discriminative function. According to the projection of centroids skin folds system expectedly dominates in girls subsamples. Canonical discriminative analysis was conducted separately through subsamples of boys and girls by age and is shown in Table 4.

Table 4. Discriminative analysis of skin folds system in subsamples of boys and girls defined by age

Boys	Eigen- value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
0	0,03	0,18	0,94	4,93	10	0,8959
1	0,02	0,15	0,98	2,05	4	0,7265
Girls	Eigen- value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
0	0,21	0,42	0,80	21,43	10	0,0183
1	0,03	0,18	0,97	3,21	4	0,5228

Factor structure of canonical discriminative functions (girls)

	Root 1	Root 2
Fist skin fold	-0,17	-0,78
Subscapular skin fold	0,07	-0,91
Abdominal skin fold	0,25	-0,79
Triceps skin fold	0,39	-0,89
Calf skin fold	-0,23	-0,84

Centroids of canonical discriminative functions (girls)

	Root 1	Root 2
G_1:7	-0,41	0,27
G_2:8	-0,36	-0,21
G_3:9	0,54	0,01

While Canonical discriminative analysis of the skin folds variables system in subsamples of boys and girls age 7 to 9 have not shown statistical significance, in subsample of girls there has been isolated one statistically significant canonical discriminative function (p=0,0183). Its factor structure shows domination of triceps skin fold and abdomen skin fold but correlation direction and centroid projection show domination of the skin folds variable system towards older girls' age groups, who are closer to adolescent development.

Conclusion

Gender dimorphism is noticeable in area of body fat already at the age of 8. A trend of change at age 7 to 9 in body fat parameters is significant only in girls. The structure of gender differences in skinfold measurements is changing with age and at age 9 triceps skin folds dominates with its contribution to the discriminative function. Differences in body fat percentage become more significant at age 9, as a reflection of preadolescent development.

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ANTHROPOMETRIC CHARACTERISTICS AND GAIT TRANSITION SPEED IN HUMAN LOCOMOTION

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Abstract

The purpose of this study was to investigate the relationship between anthropometric parameters and the preferred transition speed (PTS) in human locomotion, in both genders. The studies exploring body measures as determinants of the PTS are biased toward longitudinal dimensions, as the relationships between the PTS and transverse body dimensions have not been examined so far. Longitudinal and transverse anthropometric parameters were measured in 54 PE students (23 males, 31 females), and an exercise test was performed for determination of the PTS. Correlation coefficients between the anthropometric variables and the PTS were calculated, and a stepwise multiple linear regression analysis was derived. Weak to moderate correlations between several body size and body shape variables and the PTS were found. In males, a significant negative correlation of the bitrochanteric diameter/height (BD/H) ratio with the PTS was found ($r=-0.61$, $p<0.01$). In females, calf girth was significantly negatively correlated with the PTS ($r=-0.55$, $p<0.01$). The results of this study suggest that gait transition speed in humans is related to transverse and longitudinal body dimensions, and that sexual dimorphism in body size and shape should be taken into consideration for proper interpretation of the PTS.

Key words: *human locomotion, gait transition speed, anthropometry, gender differences*

Introduction

Walking and running are two distinctive patterns of human terrestrial locomotion. Walking is the gait used at low speeds of locomotion, whereas running takes place as the speed becomes higher. As speeds of locomotion increase or decrease, a spontaneous gait transition (walk-to-run, or run-to-walk) occurs - usually at, approximately, 2 m/s (7.2 km/h) in both genders. This intensity is commonly referred to as the preferred transition speed (PTS). PTS has been extensively studied and different factors have been proposed as determinants of the gait transition. It has been hypothesized that the spontaneous gait change occurs as a means of minimizing metabolic energy consumption (Raynor et al., 2002). Also, several biomechanical, neuromuscular and anthropometric factors have been put forth as possible mechanisms for triggering the transition in human gait (Hreljac, 1995; Raynor et al., 2002). However, the correlation of anthropometrical variables with gait transition speed in humans has, up to date, not been thoroughly examined. Most of the studies have primarily focused on longitudinal dimensions, finding only weak to moderate correlations with the PTS (Hreljac, 1995). The aim of this study was, therefore, to investigate the relationship between anthropometric characteristics (parameters of both longitudinal and transverse body dimensionality) and the gait transition speeding in men and women.

Methods

Subjects

Fifty-four PE students volunteered to participate in this study: 23 males (19.5 ± 0.8 years, 179.9 ± 7.1 cm, and 75.5 ± 10.4 kg), and 31 females (20.0 ± 1.2 years, 167.3 ± 6.0 cm, and 61.3 ± 7.2 kg). At the time of the testing all participants were physically fit and free of any disease or injury that could affect the results. Prior to participation, all subjects signed informed consent forms, containing the explanation of the measurement procedures, the aim of the study and potential risks involved.

Anthropometric measurements

Nine traits pertaining to body size were measured, according to the standards of the International Biological Program: body mass; body height; bitrochanteric diameter; bicristal diameter; leg length (recorded as the distance between the trochanterion and the floor); lower leg length (recorded as the distance between the tibiale laterale and the floor); thigh girth; calf girth; foot length.

Determination of the preferred transition speed

All subjects were familiarized with treadmill walking and running for a period of at least 15 minutes prior to testing. The testing was performed on a motorized, calibrated treadmill (Run Race Technogym, Italy), and preceded by a short warm-up and stretching procedure. During the testing, an experimenter controlled the speed of the treadmill on the treadmill controller panel, which was not visible to the subject. The incremental protocol to determine walk-to-run transition started with walking on the treadmill at the speed of 5-6 km/h, and was progressively increased by 0.1-0.5 km $\cdot h^{-1}$ every 5-30 s (depending on the evaluation time needed for the subject). At each speed, the subjects were requested to determine which gait modality (walking or running) felt most natural. If not sure, the subject could alternate walk and run several times until making the final decision. The process was continued until a speed was reached at which running felt more natural than walking; this speed was defined as the preferred transition speed between walking and running. The same procedure was repeated, but in reverse order, with a starting running speed of 9-9.5 km $\cdot h^{-1}$, that was progressively decreased by 0.1-0.5 km $\cdot h^{-1}$ every 5-30 s for determination of the PTS between running and walking. The entire procedure was repeated three times in random order. The average value of all PTS (W-R and R-W) was defined as the preferred transition speed for the subject.

Statistical analysis

Correlation coefficients between body size and shape variables and the PTS were calculated. Stepwise multiple regression analysis was performed (retaining a maximum of 3 independent variables) to determine the variables that contribute a greater percentage of variance in the PTS, for the whole sample, and for gender subgroups separately. Independent T-tests were used to determine whether there were gender differences in the measured variables.

Results

The PTS for the entire group of subjects (n=54) was (mean ± SD) 7.30 ± 0.39 km $\cdot h^{-1}$. The PTS did not significantly differ between males (7.37 ± 0.38) and females (7.22 ± 0.39, p=0.16). Males had significantly higher values of all measured anthropometric variables, except for thigh girth. The BD/H ratio was also significantly higher in women (0.193 ± 0.006 : 0.186 ± 0.009; p=0.013), indicating a slimmer body form in males. Correlation coefficients between the PTS and various anthropometric variables are presented in Table 1.

Table 1. Correlation coefficients between anthropometric variables and PTS

Variable	Gender		
	Male	Female	Combined
	n=23	n=31	n=54
Body height	0.36	0.13	0.30*
Body weight	-0.05	-0.27	0.00
Leg length	0.36	0.07	0.27
Lower leg length	0.33	0.15	0.30*
Foot length	0.29	-0.20	0.16
Thigh girth	-0.13	-0.36*	-0.23
Calf girth	-0.28	-0.55*	-0.31*
Bicristal diameter	-0.26	-0.06	-0.07
Bitrochanteric diameter (BD)	-0.25	-0.13	-0.11
Bitrochanteric diameter/height (BD/H)	-0.61*	-0.30	-0.48*

* Correlation coefficient is significantly different than zero

The results of the stepwise multiple regression analysis for the whole sample, and for males and females, separately, are presented in Tables 2, 3, and 4, respectively.

Table 2. The results of the stepwise multiple regression analysis for the anthropometric variables predicting preferred transition speed (PTS)

R= 0.637 R^2= 0.406 Adjusted R^2= 0.370 F(3,50)=11.380 p<0.00001 SEE: 0.309

N=54	Beta	Std.Err.	B	Std.Err.	t(50)	p-level
Intercept			13.357	1.110	12.036	0.000
BD / height	-0.353	0.11	-16.504	5.322	-3.101	0.003*
Calf girth	-0.767	0.200	-0.121	0.031	-3.837	<0.001*
Weight	0.628	0.197431	0.022	0.007	3.181	0.003*

statistically significant *p<0.01

Table 3. The results of the stepwise multiple regression analysis for the anthropometric variables predicting preferred transition speed (PTS) in males

R= 0.784 R^2= 0.615 Adjusted R^2= 0.554 F(3,19)=10.120 p<0.0003 SEE: 0.253

N=23	Beta	Std.Err.	B	Std.Err.	t(19)	p-level
Intercept			10.630	1.308	8.125	0.000
BD / height	-0.645	0.151	-26.815	6.294	-4.261	<0.001*
Foot length	0.538	0.156	0.119	0.034	3.450	0.003*
Bicristal diameter	-0.261	0.161	-0.055	0.034	-1.626	0.120

statistically significant *p<0.01

Table 4. The results of the stepwise multiple regression analysis for the anthropometric variables predicting preferred transition speed (PTS) in females

R= 0.688 R^2= 0.473 Adjusted R^2= 0.415 F(3,27)=8.081 p<0.001 SEE: 0.298

N=31	Beta	Std.Err.	B	Std.Err.	t(27)	p-level
Intercept			11.140	1.171	9.509	0.000
Weight	0.729	0.276	0.039	0.015	2.636	0.014**
Calf girth	-1.247	0.277	-0.208	0.046	-4.496	<0.001*
Bicristal diameter	0.168	0.156	0.041	0.038	1.081	0.289

statistically significant, *p<0.01, **p<0.05

Discussion and conclusions

The average PTS values in this study are in agreement with the PTS values reported in literature (Hreljac, 1995; Raynor et al., 2002). Hreljac (1995) reported weak to moderate correlation coefficients between several body length variables and the PTS. In this investigation, no length variable in male as well as in female subjects was significantly correlated with the PTS, although there were generally higher correlations between body length variables and the PTS in males when compared to females (Table 1), as was found in the study of Hreljac (1995). However, to our best knowledge, no transverse body dimensions have, so far, been examined as determinants of the PTS. The results of this study demonstrate that there is an association between transverse body dimensionality and the PTS, as well as between body shape parameters (derived from both body stature and width measures) and the PTS. Also, it has been found that those relationships are gender specific. Overall, weak to moderate correlations between several body size and body form variables and the PTS were found. This could be due to the low variability in PTS and body size variables within a single species such as humans (Hreljac, 1995). In males, the pelvis width and the BD/H ratio were the best predictors of the gait transition speed, while calf girth and body weight were the best predictors of the PTS in females (Tables 1-4). This could be due to different, gender specific determinants that trigger the gait transition. Recently, it has been suggested that running rather than walking dynamics should be primarily considered as the triggers of gait transition in men (Šentija & Marković, 2008; Geyer et al., 2008). The authors report that men change gait at a speed which is related to the aerobic threshold for running (Šentija & Marković, 2008), as slow running (below the PTS) leads to exaggerated vertical motions (increased bounciness) and sense of discomfort (Geyer et al., 2008). From those studies, it can be argued that men change gait at a certain speed not because they cannot walk comfortably at faster speeds, but primarily because they cannot run smoothly at lower speeds. A slim body shape and a narrow pelvis are advantageous for running economy (Saunders et al., 2004), and, if the PTS is related to running dynamics, may therefore also contribute to higher PTS, as found in male subjects in

this study. However, it is interesting to note that no significant negative relationship between pelvis width, BD/H ratio and the PTS was found in female subjects. The relatively widely spaced femora and pelvis in women may contribute to the length of the stride, by rotation of the pelvis during walking (Rak, 1991), and to a greater mechanical advantage for the muscles that rotate the pelvis and draw the legs medially, toward the midline, thus making the female body shape more advantageous for walking. Therefore, while running dynamics could be the primary determinants of the PTS in males, walking dynamics could also play a significant role as determinants of the PTS in females. The anthropometric variable that was most highly correlated to the PTS in females was the calf girth. The significant negative correlation of the calf girth with the PTS could be explained by the influence of the leg muscle mass distribution to the inertial properties of the lower leg (Wall-Scheffler et al., 2006). A relatively more distal distribution of the leg muscle mass, resulting in a relatively greater calf girth, would contribute to a greater moment of inertia, which, in turn, would elicit a spontaneous gait transition at a relatively lower speed. A higher stride frequency for walking and running in females in comparison to males, resulting in more internal mechanical work performed at the same speed, could explain why in female subjects the calf girth is more closely related to the PTS than in male subjects.

In conclusion, based on the main results of the study, three general conclusions can be formulated to direct future research:

- transversal body dimensionality measures, as well as parameters of body shape (derived from body length and width measures) appear to be significant determinants of the gait transition speed in human locomotion,
- gender differences in body size and shape should be taken into consideration for proper interpretation of the PTS;
- the weak to moderate correlations between several body size and body form variables and the PTS found in this study indicate that the PTS is a complex phenomenon, with a number of interrelated factors rather than a single factor that determines the gait transition in men and women.

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KARATE TRAINING AND ALLERGIC DISEASES

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Abstract

The aim of this study was to establish the prevalence of subjects with allergic disorders (rhinitis, asthma and eczema) among 314 karate trainees and to evaluate the impact of these health disorders on their performance. Data about allergic nasal, asthmatic and skin symptoms, asthmatic symptoms during exercise, therapy and the diagnoses of allergic diseases were recorded and analyzed. Data about achievements on championships were collected in asthmatic patients. We found that 24.5% of subjects reported presence of allergic rhinitis, asthma and/or eczema. Allergic rhinitis were reported in 13.4%,, asthma in 7.6% and eczema in 6.7% of karate trainees. Six asthmatics won medals on national championships in disciplines kata and kumite, and one asthmatic on international kata championships. Results suggest karate as suitable sport for the conditioning of persons with allergic diseases. Kata discipline can be suggested as suitable for the performance of asthmatics on top intenational level.

Key words: *karate, allergic diseases, kata, kumite, asthma, exercise-induced asthma*

Introduction

Since 1960, a number of studies from all over the world have shown an increase in the prevalence of allergic diseases, particularly in younger age groups and urban population in the industrialized Western countries (Ring et al., 2001). Such increase in the number of persons with allergic diseases was confirmed in studies conducted in Croatia on children and adults (Banac et al., 2004; Macan et al., 2007).

The most common allergic diseases are allergic rhinitis or rhinoconjunctivitis caused by pollens (hay fever), asthma caused by dust mites or pets, and eczema with the variety of potential causes like food ingredients (egg, milk, nuts) or dust mites. All these allergic diseases are related to various limitations in physical activity. The most common is exercise-induced bronchospasm regularly present in asthmatics. There are also limitations for outdoor activities during the pollen seasons for persons with hay fever, and intolerance of swimming pool attendance for persons with allergic eczema. Exercise-induced bronchospasm is the most dramatic disorder related to physical activity, particularly present in asthmatic children, defined as an asthmatic attack with wheezing and dyspnea during, or shortly after the exercise (Macan et al., 2000). This phenomenon usually limits or ceases physical activity in children due to physician's, teacher's, coach's or parental fears for child's health. The avoidance of physical activity can result in physical and social damage of asthmatic children. Studies have shown that asthmatic children are more likely to be obese with significantly less activity and higher level of emotional difficulties than non-asthmatics (Glazebrook et al., 2006). On the other hand, there are some evidence that in persons with exercise-induced bronhospasm, aerobic conditioning diminish the risk for asthma attack by reducing the ventilatory requirement for any activity, making improved fitness of children with asthma highly desirable (Milgrom and Taussig, 1999).

In the last 15 years, karate became very popular competitive and recreative sport involving a great number of children and adolescents in many European countries including Croatia. Modern non-contact karate consists of two disciplines: kata and kumite. Kata means fights with imaginary opponents, and kumite is a synonym for karate fight. While physical loads in kata and kumite are considered similar, with involved mixed aerobic/anaerobic metabolisms and domination of lactic and alactic anaerobic metabolisms, psychological demands differ between these two disciplines. Kata performance demands concentration of the athlete to his own performance, i.e. movement sequence, postures and rhythm. Fighting against the opponent brings greater stress and demands self-control due to the unpredictability of movements and situations, as well as the exchange of blows/kicks and pain tolerance (Kuleš, 1998).

The aim of this study was to establish the prevalence of subjects with allergic disorders among karate trainees and competitors from karate clubs from Zagreb and surroundings and to evaluate the impact of these health disorders on athlete's performance.

Methods

The study had cross-sectional design and involved 314 karate trainees and /or competitors from 12 karate clubs from Zagreb and surroundings.

Data about allergic symptoms, therapy and the diagnoses of allergic diseases were recorded in the form of structured medical interview conducted by the author, physician, the member of the Medical Board of the Croatian Karate Union. All subjects were questioned about the presence of allergy-related nasal symptoms (sneezing, rhinorrhea, nasal itching and obstruction not related to common cold), asthmatic symptoms (wheezing, dyspnea, dry cough), asthmatic symptoms during exercise, and skin symptoms (itching, rush, erythema, urticaria, eczema) during last 12 month. Subjects who reported presence of at least two nasal, asthmatic or skin symptoms were considered as subjects with allergic rhinitis, asthma or eczema, respectively.

Additionally, subjects were asked if they were taking therapy for allergic disease and about the diagnosis of allergic disease established by the physician. In the group of subjects with exercise-induced asthmatic symptoms, additional data about their achievements on national and international championships were collected from the records of the official national and international competitions.

All data were handled, analyzed and presented in accordance with the ethical principles of the Helsinki Declaration, maintaining anonymity of involved subjects.

The main descriptive characteristics of the study subjects are presented in Table 1.

Table 1. Main characteristics of the studied subjects

Subjects	N	Age (years) median (range)
Men	208 (66.24%)	12 (6-28)
Women	106 (33.76%)	11 (6-24)
Total	314 (100%)	12 (6-28)

Data were analyzed separately in women and men. Statistical analysis was done by programme Statistica 5.0 for Windows with methods of descriptive statistics, and non-parametric procedure (chi-square test, Yates correction for samples less than 10) for testing differences in the prevalence of allergic symptoms related to localization of symptoms and sex. A value of $P< 0.05$ was considered statistically significant.

Results

In this study, 77/314 (24.52%) subjects, 53/208 (25.48%) men and 24/106 (22.64%) women, reported the presence of allergic rhinitis, asthma and/or eczema. Allergic rhinitis were reported in 42/314 (13.38%) subjects, asthma in 24/314 (7.64%) subjects and eczema in 21/314 (6.69%) subjects. The prevalences of reported allergic disorders in women and men are presented in Figure 1. The prevalence of allergic respiratory disorders (rhinitis and/or asthma) was significantly higher in men than in women (19.7% vs 10.4%, P=0.0354). There were no significant difference in the prevalence of asthma between men and women (3.4% vs 2.8%, P=0.932). The prevalence of eczema was higher in women than in men, but without statistical significance (10.4% vs 4.8%, P=0.062).

The prevalence of diagnosed allergic rhinitis by a physician in subjects with reported nasal symptoms was similar to the prevalence of diagnosed allergic asthma in subjects with asthmatic symptoms (71.43% vs 90%, P=0.452). However, the prevalence of medically treated nasal symptoms was significantly lower than the prevalence of medically treated asthmatic symptoms (28.57% vs 90%, P=0.003). Occasional exercise-induced asthmatic symptoms were reported in 8 out of 24 subjects with asthmatic symptoms, 7 men and 1 woman.

Six subjects (5 men, 1 woman) with diagnosed allergic asthma were competitors with national championships medals, and one among them won medals from international championships (european and world championships). Three medal winners with asthma reported occasional exercise-induced asthmatic symptoms. Among asthmatics, medals were achieved in both karate disciplines (kata, kumite) on national level, but medals from international championships were won only in kata discipline.

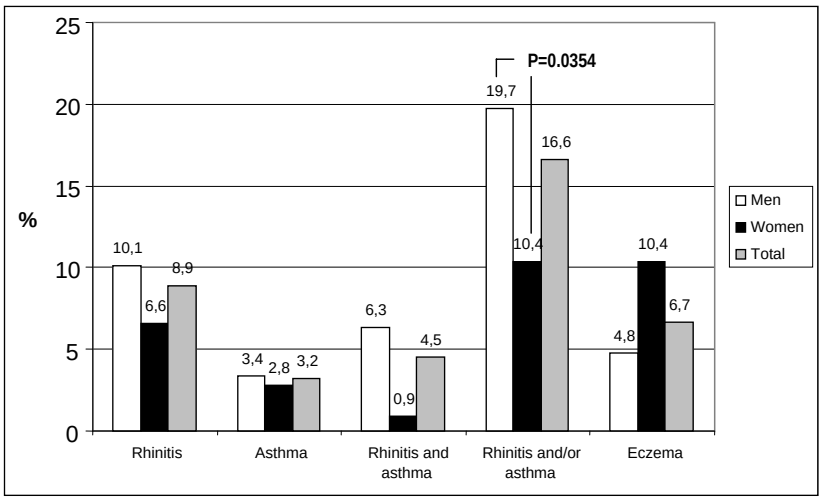

Figure 1. The prevalence of male and female subjects with allergic disorders.

Discussion and conclusions

The majority of karate trainees involved in this study were primary and high school children (the median age was 12 years). Recently, several publications about the prevalence of allergic diseases among school children (aged 10-14 years) in Croatia were published based on standardized international questionnaire (ISAAC study). These studies established the prevalence of current allergic rhinitis between 11 and 18%, current asthma between 5 and 8.5%, and current eczema between 3 and 8% (Stipić-Marković et al., 2003; Banac et al., 2004; Munivrana et al., 2007). Our results are within these ranges with 13.4% of subjects with the symptoms of rhinitis, 7.6% with asthmatic symptoms and 6.7% with skin symptoms (eczema). According to that, karate as recreative and competitive sport among schoolchildren and adolescents in Zagreb and surrounding areas involves similar proportion of subjects with allergic diseases as the general Croatian population of the same age. It seems that there is no selection or exclusion of schoolchildren and adolescents with allergic respiratory and skin diseases among karate trainees and competitors, suggesting modern non-contact karate as suitable sport discipline for the physical and psychological conditioning of children and adolescents with allergic diseases.

There are some evidence that physical conditioning have beneficial role in clinical management of asthmatics, improving pulmonary function, lessening the severity of exercise-induced bronchospasm and improving quality of life scores (Fanelli et al., 2007; Sidiropoulou et al., 2007). Benefitial impacts of sport on psychosocial status is well known, particularly in persons with chronic health disorders (Horga , 1993). Physical and psychological demands of karate sport make stimulative environment for intelectual, emotional and motor development of trainees, particularly children. Karate training increases concentration, emotional stability and contribute to better social positioning of trainees. Development of skills, winning a fight or competition, and coach's or parents' approval are important social criteria of success. Children with chronic health disorders like asthma have lower starting positions and possibilities regarding social adaptation and acceptance and therefore their inclusion in karate trainings is important and potentially benefitial.

Studies about the impact of martial arts training on the rehabilitation of asthmatic children are scarce. Beneficial impact was proposed for judo training (Kriegel,1998). The impact of karate training on physical, psychological and social rehabilitation and conditioning of asthmatic and/or allergic children has not been studied so far. The results of this study suggest that kata discipline is more suitable for asthmatics, allowing them competition and achievements on top international level. Kata performance is standardized, with predictible duration, load and rhythm. It involves shorter and continuous physical load and different psychological demands comparing to kumite. Because of that, kata performance involves less hyperventilation and stress, which can explain its convinience for athletes with allergic respiratory diseases.

Further studies are needed to evaluate the role of karate training in the conditioning of children and adults with respiratory allergic diseases, not focusing only on athmatics, but also on persons with rhinitis. Numerous studies, including this study, showed the greatest frequency of allergic rhinitis among allergic diseases, reaching 20% of general population. Rhinitis is well known risk for the development of asthma and it often coexists with asthma. A significant proportion of persons with rhinitis showed the development of exercise-induced bronchospasm. Exercise-induced rhinitis is also described, but this condition has not been fully explained so far (Bonini et al., 2006).

We can conclude that our results suggest non-contact karate as a suitable sport discipline helping psychophysical conditioning in allergic children and adolescents, while kata discipline may be recommended as a good option for asthmatics without limitations in performance and achievements even on top international level.

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NUTRITION KNOWLEDGE OF THE STUDENTS OF THE FACULTY OF KINESIOLOGY AT ZAGREB UNIVERSITY AND CROATIAN BASKETBALL COACHES

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Abstract

Nowdays the nutrition is often associated with the top sports result. It is considered to be one of essential factors for success for each single sportsman in his sports career. Every training process causes an intensified metabolic, physical and psychical exhaustion. The objective of this research is to determine the level of knowledge on nutrition, smoking habits and consumption of alcoholic beverages of the students of the Faculty of Kinesiology at Zagreb University and Croatian basketball coaches.

The respondents were divided in two samples. The first sample consisted of the students of the Faculty of Kinesiology at Zagreb University (n = 100), and the other sample were Croatian basketball coaches (n = 61). The sport nutrition knowledge and eating habits were determined through the corresponding questionnaire. The purpose of the questionnaire was to determine the knowledge level of nutrition, the knowledge of the parts of a nutrition diet which enables the sportsmen to get enough energy for their training and competition, of various food suplements, of the meals taken before, during and after competitions and of compensation of the fluid loss.

Key words: *nutrition, nutrition knowledge, students, coaches, basketball*

Introduction

Every sport activity requires great energy efforts of a sportsman. Considering the yearly training cycles and competitions in the most team sports (basketball, football, handball), it is evident that sportsmen need a lot of energy necessary to take such efforts. Most coaches pay attention only to the training process which is carried out on the sports grounds but at the same time they forget the environmental factors that can improve the sports performance. Badly-balanced diet can affect the sports performance in the same way as a poor training process. The sport nutritionist should play a significant role in a coach team. The nutritionist should support the education of the players, coaches and parents, diagnose the eating habits, intervene if necessary and take care of introducing the right eating habits, all of this for the purpose of obtaining a better result and health protection (Lacey and Pritchett, 2003). Today, there are only few clubs with a professional sport nutritionist. Bearing this in mind, we can conclude that the coaches are those who have to educate their sportsmen about the right diet. According to most researches carried out in the world, sportsmen get most information from their coaches, particularly from the coaches concerned with conditioning (Burns and associates, 2004). The objective of this research is to determine the level of knowledge on nutrition, smoking habits and consumption of alcohol with the students of the Faculty of Kinesiology at Zagreb University and with Croatian basketball coaches. The respondents were divided in two sample groups. The first sample group consisted of the students of the Faculty of Kinesiology at Zagreb University (n = 100), and the other sample group were Croatian basketball coaches (n = 61). The knowledge of the sports nutrition and the eating habits was determined through the corresponding questionnaire.

Methods

Two sample groups of respondents were used in this research. One sample group consisted of the students of the Faculty of Kinesiology at Zagreb University. Until the very start of researches, the respondents of this group had not yet acquired the curriculum of the subject Sports medicine which deals with the field of sports nutrition. Based on the mentioned research it was possible to conclude that their total knowledge was the result either of their own interest for this field or they learnt it from their coaches in the course of their sports career. The other sample group consisted of Croatian basketball coaches. And exactly these coaches are expected to have enviable knowledge in the field of the sports nutrition since in most cases they are those who have to educate their players in their clubs about the right sports nutrition. The knowledge of sports nutrition and eating habits was determined through the corresponding questionnaire. This questionnaire was formed in the way to find out the knowledge of nutrition, of the parts of the nutrition diet which

enables the sportsmen to get enough energy for the training and competition, of various food additives and the meals taken before, during and after the competition and of the importance of compensation of the loss of fluids. Before filling in the questionnaire, the respondents were informed how to fill it in, and upon their acceptance they started to fill in the questionnaire which was anonymous. The questionnaire consisted of 26 questions dealing with their knowledge of nutrition, 17 questions referred to eating habits, and 3 questions referred to consumption of alcohol and smoking of cigarettes. The obtained data were processed through the statistical packages STATISTICA FOR WINDOWS ver. 7.1 and SPSS 13. Upon the data processing, frequencies of correct and incorrect answers were presented for each single question. The relationship between the consumption of alcoholic beverages and smoking of cigarettes was determined by means of the correlation coefficient, respectively by connection between two variables.

Results and discussion

The knowledge of nutrition has been determined through 26 questions (variables) the respondents had to answer with TRUE/FALSE.

Table 1. Percentages of correct answers in individual questions regard to the knowledge about nutrition

Questions:	Answer:	KIF (% correct answers)	COACHES (% correct answers)
1. Proteins are the best and most efficient source of energy	F	51,0	62,3
2. Muscle glycogen depots can affect exercise available energy	T	83,0	90,2
3. Athletes need 3 times more proteins than sedentary persons	F	28,0	42,6
4. Athletes need more carbohydrates than sedentary persons	T	93,0	93,4
5. Thirst is not an adequate indicator of water needed during exercise	T	42,0	42,6
6. Fluids should be ingested before, during and after exercise	T	92,0	98,4
7. Skipping meals is justified when it is necessary to promote a fast weight loss	F	91,0	91,8
8. From the health nutrition perspective it is better to eat unsaturated fatty acids	T	79,0	83,6
9. Weight loss with a very restrictive diet is mostly due to water loss	T	82,0	83,6
10. Exercise while fasting could lower the blood glucose concentrations (hypoglycemia)	T	90,0	78,7
11. Calcium deficiency can lead to bone fractures and osteoporosis	T	99,0	96,7
12. Citric fruits are the only sources of vitamin C in food	F	87,0	91,8
13. To eat after a competition is only important if the athlete is hungry	F	95,0	95,1
14. Balanced diet is necessary only before the competition	F	94,0	95,1
15. The last main solid meal should be taken with a 3-4 hour interval before the competition	T	91,0	93,4
16. Hydration and carbohydrate reposition should begin as soon as possible after the competition	T	68,0	70,5
17. It is impossible to win without supplements	F	84,0	93,4
18. For sport success general diet is not important, only some specific kinds of food	F	55,0	68,9
19. Bread and potato intake should be restricted in the training cycles	F	28,0	21,3
20. Fruits and vegetables are good sources of vitamins and minerals	T	98,0	100,0
21. Excess vitamin and mineral consumption can be toxic	T	78,0	77,0
22. Cooking vegetables for long time in plenty water can remove some vitamins and minerals	T	89,0	88,5
23. High glycemic index indicates food which is easily digested and absorbed so is connected with hyperglycemia	T	58,0	72,1
24. Cholesterol exists only in animal tissue	T	56,0	55,7
25. Vitamins and minerals are sources of energy	F	60,0	50,8
26. Consuming high-glycemic, carbohydrate rich foods as soon as possible after hard training or competition speeds glycogen replenishment	T	66,0	62,3

As to the knowledge of the field of nutrition, on the basis of the obtained results, it can be concluded that the students of the Faculty of Kinesiology and Croatian basketball coaches know quite a lot about nutrition. Out of the possible 4186 correct answers, the students and the coaches answered 3157 questions correctly, i.e. 75,41% which can be considered as satisfactory. However, considering the answers to single questions, it is obvious that both students and coaches have problems concerning the knowledge of the basic rules that regulate a proper diet. So, for example, even 49% of the students and 37,7% of the coaches think that proteins make the main source of energy which is absolutely not true. In the same way, 72% of students and 57,4% of coaches believe that sportsmen need 3 times more protein than nonsportsmen which can be denied by comparing the quantities of protein necessary for the sports that require endurance for which sportsmen need about 1,2 – 1,4 g of protein per kilogram of weight at the most and the necessary protein quantities

of nonsportsmen who need about 0,8 grams of protein per kilogram of weight. Based on the obtained results it can be concluded that neither coaches nor students have the necessary knowledge of proteins and precisely they are those who consume (students) or give advice to their sportsmen (coaches) about the way of using amino acids. There is another disturbing fact which shows that even 58% of students and 57,4% of coaches believe that thirst is the adequate indicator of the lack of liquid which is not true because at the entry of liquids caused by the natural mechanism of thirst, only two thirds of the liquid lost through sweating are compensated and the right indicator of dehydration is the quantity and colour of the urine. The question that relates to taking of liquids during a sports activity has been correctly answered by the most students and coaches (92% and 98,4%), i.e., the liquid should be taken before, during and after the sports activity. Most coaches and students do not know enough about the composition of single foodstuffs. So 78,7% of coaches and 72% of students believe that during the training process the entry of bread and potatoes should be limited since they are some of the main sources of carbohydrates. 93% of the students and 93,4% of the coaches have correctly answered the question whether the sportsmen need more carbohydrates than the persons who do not train and their answers clearly show that the real problem is not the lack of knowledge of the basic energy sources but it refers to not knowing the composition of foodstuffs. As to the questions relating to vitamins and minerals, both students and coaches know this field quite well. However, there is just one fact that is pointed out and it indicates that 40% of students and 49,2% of coaches believe that vitamins and minerals are energy sources. (Table 1.).

Table 2. Percentages of individual answers in questions regard to the smoke habits and consumption of alcoholic drinks and determining differences between two samples through t-test for independent samples

	KIF (%) YES/NO	COACHES (%) YES/NO	t-value	df	p	F-ratio variances	p-variances
Do you smoke cigarettes?	**20,0/80,0**	21,31/78,6	1,70	159	0,09	1,55	0,05
Do you consume alcoholic drinks?	**86,0/14,0**	75,4/24,59	- 0,19	159	0,84	1,05	0,80
Do you consume quite a lot of alcoholic drinks at various celebrations in the club?	**44,0/56,0**	**9,84/90,16**	**4,54**	**159**	**0,00**	**2,40**	**0,00**

Table 3. Overview of relations between smoking cigarettes and consumption habits of alcoholic drinks

Variables:	CIGARETTES	ALCOHOLIC DRINKS	CELEBRATIONS IN THE CLUB
CIGARETTES Correlation coefficient	1,00	**0,19***	-0,00
Sig. (2-tailed)	.	0,01	0,91
ALCOHOLIC DRINKS Correlation coefficient	**0,19***	1,00	**0,31****
Sig. (2-tailed)	0,01	.	0,00
CELEBRATIONS IN THE CLUB Correlation coefficient	-0,00	**0,31****	1,00
Sig. (2-tailed)	0,91	0,00	.

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

Based on the obtained results referring to the habits of smoking and consumption of alcoholic beverages it can be concluded that the students of the Faculty of Kinesiology and Croatian basketball coaches have nearly the same habits. About 20% of the students and coaches are used to smoking while even nearly 80% of the students and the coaches consume alcohol. Smoking is unfortunately still widely accepted in Croatia and though the campaign against smoking is going on in many countries the real results are still not apparent, and the number of deaths caused by trachea, bronchial and lung cancer is still very high (Prabhat and Chaloupka, 2000; Samet and Yoon, 2001). The encouraging data is that most of the coaches smokers are smoking between 5 and 10 cigarettes per day.

The only variable where the difference between these two groups of respondents is also statistically significant, is the consumption of alcohol at the club parties. Even 44% of the students have answered that they consume quite a lot of alcohol at various celebrations in the club which can be absolutely considered as a disturbing fact in relation to about 10% of the coaches who have answered this question positively (Table 2). This high percentage in students probably can be related to their age.

In the same way there was an attempt to determine the connection among these three variables. On the basis of the correlation coefficients and the correlation significance level ($p<0,05$) it is concluded that in most cases the persons who smoke also consume alcohol (Table 3). This is in accordance with previous findings in different studies (Aarnio, 2003.).

Conclusions

With respect to the knowledge in the field of nutrition, and on the basis of the obtained results, it has been concluded that the students of the Faculty of Kinesiology and Croatian basketball coaches know quite a lot about nutrition. Out of the possible 4186 correct answers the students and the coaches have correctly answered 3157 questions, 75,4% respectively, which can be considered as satisfactory. However, on the basis of the nutrition knowledge analysis of single questions the conclusion is that neither the students nor the coaches have a satisfactory level of knowledge. In particular, it refers to proteins, energy composition of foodstuffs, compensation of liquids after a sport activity, energy sources, and others.

Based on the results obtained during determining the habits of consuming alcohol and smoking, it has been concluded that the students of the Faculty of Kinesiology and Croatian basketball coaches have nearly the same habits. About 20% of the students and the coaches are used to smoking cigarettes, while even 80% of the students and the coaches consume alcoholic beverages. The only difference between the students and the coaches is the quantity of alcohol consumed at club celebrations. It has also been found out that both the students and the coaches who smoke in most cases consume alcohol as well.

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THE PREDICTIVE POWER OF BALANCE BOARD: TESTS FOR "ON-THE-SKIS" BALANCE PERFORMANCE

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Abstract

Well developed proprioceptive abilities may be the essential aspects of injury prevention and rehabilitation in many sports including alpine skiing. In our study we hypothesised that balance may be the factor that influences performance in skiers and the aim was to determine which of the three laboratory balance tests correlated the most with situational "on the snow" balance ability of the skiers. The study design encompassed 3 simple laboratory balance tests (lateral and front-back tilts tests on the balance board, and hanging board balance test) and 2 "on the snow" tests (inner ski jump test and one leg carving test) that required advanced skiing skills. The subjects were 27 candidates for a national alpine skiing instructor. Multiple regression analysis singled out the lateral tilts balance as an important prediction factor for balance abilities on the skies. The subjects that performed well on lateral tilts board test got on average 3,3±1,2 points on inner ski jump test while the others who had poor lateral tilts board performance got only 2,2±0,9 average points on the same ski test (p=0.018).

Key words: *predictive power, balance board tests*

Introduction

Proprioception may be defined as a concept that includes balance and postural control with visual and vestibular contributions, joint kinesthesia, position sense, and muscle reaction time (Ergen & Ulkar 2008). Well developed proprioceptive abilities may be the essential aspects of injury prevention and rehabilitation in many sports and otherwise (Fitzgerald et al. 2000, Taube et al. 2007, Geritsen et al. 1996).

It is known that good agility, certain level of technical skills, and overall fitness are important in injury prevention among the recreative athletes who easily become injured, especially if older (Kallinen & Markku 1995). According to Johnson (1995) the balance in alpine skiing is dynamic and tenuous and loss of balance may lead to the accumulation of forces that create severe bending moments at the knee, resulting in injury. The injuries in alpine skiing may happen in a specific moment when a skier tries to gain back the lost balance (Tudor et. al, 2003). Bouter and al. 1989 established that 24% of alpine skiing injuries happened because of the lost balance.The two factors that could decrease the risk of aforementioned injuries are better neurophysiological functions (balance) and the development of "smarter" bindings. From the viewpoint of the sports physicians, the athletes with better proprioceptive and balance abilities may perform better and suffer lower rate of injuries (White & Johnson, 1993). There are only a few studies conducted and published measuring the influence of proprioceptive training on skiing performance (Kioumourtzoglou 2004, Malliou et al. 2005). The group of Malliou (2004) proved that that the experimental group that underwent indoor balance training on a balance board, wearing ski boots, for 20 min every second day during two weeks of ski school influenced the performance on two downhill ski tests of agility, slalom and snow-ploughing techniques.

Despite the fact that evidence about the influence of balance and proprioception on alpine skiing performance and skiing injuries is very limited, the training of neurophysiological functions (balance, coordination and reaction time) became an obligatory part of alpine skiers conditioning programme. Probably through empirical observations, many of the alpine skiing teams introduced the balance board tests into their training and testing regime (Ellis & Sparovec 2006). In our opinion, there is still a the missing link which is a lack of controlled studies investigating the relationship between laboratory balance tests, field balance tests and the overall skiing performance. In our study we hypothesised that balance may be the factor that influences performance in recreational and in competitive skiers and the aim was to determine which of the three laboratory balance tests correlates the most with situational "on the snow" balance ability of the skier.

Methods

Subjects

The study design encompassed 3 simple laboratory balance tests ("on the board") and 2 field balance tests ("on the snow") that required advanced skiing skills. For that reason the subjects were recruited among the candidates for national skiing instructors. The sample comprised 27 ski instructor candidates (17 male and 10 female) participating in a formation course organized by Croatian Ski Instructors and Trainers Association. Some of the descriptive parameters of the sample are presented in Table 1. All of the candidates passed an admittance test for ski-instructors course two months prior to the beginning of the study.

Table 1. Average age, number of skiing years and average number of skiing days per year

	Mean	Std.Dev.	Minimum	Maximum
Age	25,34	7,22	17,00	44,00
Seasons skied in the past	14,57	6,58	4,00	33,00
Number of skiing days/season	20,95	25,13	5,00	130,00

In order to test the relations between on the board and on the skies balance performance three laboratory and two field tests were used:

Balance board tests

Lateral tilts (LAT TILT):

The subject stands on plywood balance board with feet positioned parallel to the fulcrum (pivot) of the board (Figure 1). The subjects were given a minute to practice before starting the test. The timing begins when the subject is ready and releases his/her hands from the support and stops when either of the later sides of the board touches the ground or the subject hops or otherwise loses the balance position. The best of three attempts is recorded.

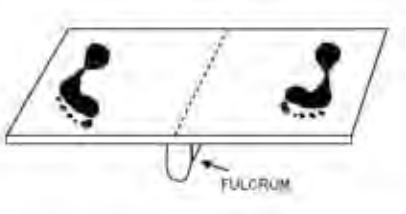

Figure 1. Lateral tilts test

Front-Back tilts (F-B TILT)

The test is performed in the same manner as the lateral tilts test but the subject stands on plywood balance board with feet positioned vertical to the position of the fulcrum (pivot) of the board (Figure 2).

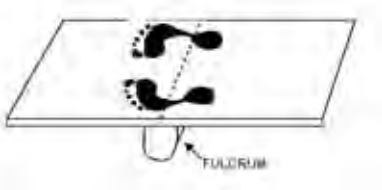

Figure 2. Front-back tilts test

Hanging board balance test

The hanging board is usually used to improve balance and proprioceptive skills in training or rehabilitation. This is a rectangular platform hanging on a metal frame, 10cm above the ground. When an unaccustomed person stands on the board it may start to oscillate heavily, eventually leading to the loss of balance. The timing begins when the subject steps on the board and stops when a free leg touches the ground or the person hops or otherwise loses their balance position. The best of three attempts is recorded.

On the "skies" field tests

The two "on the skies" tests were evaluated by three experienced independent judges, all members of the Croatian Ski Instructors and Trainers Association (two being also the National Ski Demonstrators and one a member of the National Ski Teacher Licensing Committee). The criteria were brought before the beginning of the study. In order to establish the criteria, the three judges performed a pilot testing and evaluation on 10 subjects which were not included in this study.

Inner ski jump test

The test consisted of 8 subsequent curves performed in a way that after every turn the subject skied on the upper ski while the lower leg was lifted up in abduction. At the turn the skier shifts the body weight by jumping on the inner ski (which soon becomes an upper ski again). Depending on the height of the airborne phase, quality and balance during the landing and ability to balance throughout all turns, the performance was evaluated by grades ranging from 5 (excellent) to 1 (poor).

One leg carving turns test (ONE LEG CARV)

During the test the skier performed 20 carving curves on only one, dominant, leg while the other leg was lifted up in abduction. Depending on the ability to lean, tilt, keep the balance and perform rhythmic turns the performance the performance was evaluated by grades ranging from 5 (excellent) to 1 (poor).

Results and discussion

First, the correlations between the judges in both on the ski elements were calculated. The judges showed high correlations in both test with correlation coefficients between 0,76 (the lowest) and 0,94 (the highest) depending on the pair of judges and the element that was evaluated.

Tables 2a and 2b. The correlations between the judges in both "on the skies" tests

INNER SKI JUMP TEST			
JUDGE	1	2	3
1	1,00	0,90*	0,84*
2	0,90*	1,00	0,76*
3	0,84*	0,76*	1,00

ONE LEG CARVING CURVES			
JUDGE	1	2	3
1	1,00	0,94*	0,86*
2	0,94*	1,00	0,84*
3	0,86*	0,84*	1,00

Marked correlations are significant at p <0 ,05

As the above presented correlations were all significant and satisfactory it enabled us to continue with the analysis of the obtained data. In the beginning we were interested in possible correlations between the "*on the snow*" and "*on the board tests*". The results are presented in Table 3.

Table 3. Correlations (r) between the "on the snow" and "on the board tests"

	F-B TILTS	LAT TILTS	HANGING BALANCE	INNER SKI JUMP	ONE LEG CARV
F-B TILTS	1,00	0,51*	-0,05	0,34	0,38*
LAT TILTS	0,51	1,00	0,07	0,61*	0,35
HANGING BALANCE	-0,05	0,07	1,00	0,09	-0,09
INNER SKI JUMP	0,34	0,61*	0,09	1,00	0,68*
ONE LEG CARV	0,38*	0,35	-0,09	0,68*	1,00

Marked correlations are significant at p <0 ,05

The highest correlation found was between the two tests on the snow which was expected. What interested us the most were the correlations between the "on the snow" and "on the board" tests. The lateral tilts test (LAT TILTS) was found to be correlated with INNER SKI JUMP while the front-back balance test (F_B TILTS) showed a weak, but still significant correlation with ONE LEG CARV. On the contrary HANGING BALANCE test did not prove to be in any correlation with either *one of on the snow tests.* Even though this platform may be useful in rehabilitation of athletes in this case it may not be used as a test corresponding to skiing performance.

In order to test the prediction power of "on the board" tests on inner ski jump test we performed the multiple regression analysis. The model was found to be significant and the variable with the highest and statistically significant prediction power was the lateral tilts test on the board ($p<0.0001$) while other two test showed no predictive significance (Table 4).

Table 4. The results of the multiple regression analysis for on Inner ski jump test

Regression Summary for Dependent Variable: Inner ski jump R= ,66532971 R2= ,44266362 Adjusted R2= ,36996758 F(3,23)=6,0892						
	Beta	Std.Err.	B	Std.Err.	t(23)	p-level
Intercept			1,93535	0,2835	6,8267	0,000001
HANGING BALANCE	0,017	0,1568	0,0015	0,0096	0,1087	0,9141
F-B TILTS	-0,205	0,1566	-0,0012	0,0009	-1,3140	0,2012
LAT TILTS	0,618	0,1563	0,1064	0,0269	3,9567	0,0007

The model was tested once more through the multiple regression analysis for *One leg carving test.* The only "on the board" test that was found to be a significant predictor for *the One leg carving test* was again the lateral tilts test (Table 5) but with lower prediction power ($p<0,05$) then for the *inner ski jump test.*

Table 5. The results of the multiple regression analysis for One leg carving test

Regression Summary for Dependent Variable: ONE LEG CARV R= ,44162090 R2= ,19502902 Adjusted R2= ,09003280 F(3,23)=1,8575						
	Beta	Std.Err.	B	Std.Err.	t(23)	p-level
Intercept			2,45735	0,33076	7,42936	0,00000
HANGING BALANCE	-0,13192	0,18847	-0,00783	0,01118	-0,69994	0,49099
F-B TILTS	-0,11591	0,18822	-0,00069	0,00111	-0,61582	0,54406
LAT TILTS	0,41242	0,18791	0,06887	0,03138	2,19471	0,03855

Obviously, the lateral tilts (LAT TILTS) balance test can be an important factor for alpine skiing performance and especially balance abilities on the skies. That is why in the next step we divided our sample into two groups, based on the results on lateral tilts test (LAT TILTS). The Group 1 comprised the subjects with poor performance on this test (lower than the mean value) while the Group 2 comprised the subjects that performed better (mean value and higher). Than the differences between the groups in *Inner ski jump test* were tested by Student t-test for independent samples. Even though the relations between the later tilts test and Inner ski test were proven previously the results of the t-test were more than surprising. The Group 2 subjects, who had shown much better board balance, also performed much better on the snow. They got on the average 3,3±1,2 points in *Inner ski jump* test while the Group 1 got only 2,2±0,9 average points on the same ski test (Figure 3, $p=0.018$).

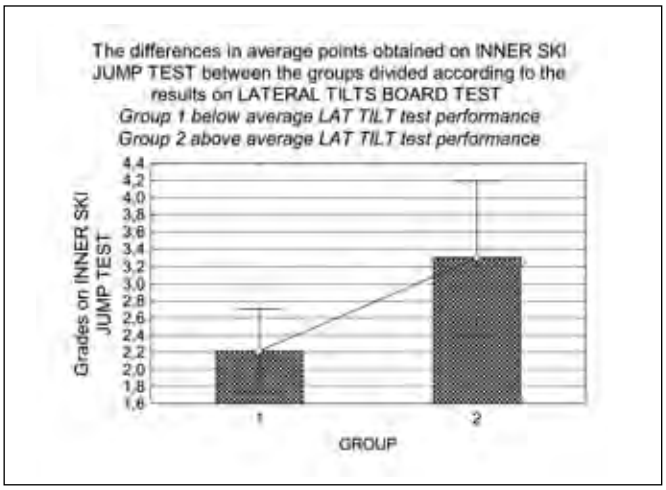

Figure 3. The differences in average points obtained on Inner ski jump test between the groups divided according to the results on lateral tilts test

Conclusions

"On the board" balance test may be the useful indicator for "on the snow" balance performance. The application of balance training program could improve body control and proprioception in skiers, reduce the risk of injuries and improve performance. Nevertheless, it is important to understand that only specific balance training (and tests) is correlated to alpine skiing performance and those are the ones involving the neuromuscular control of lateral tilts.

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CORRELATIONS BETWEEN PARENTS' PERCEPTIONS OF DIABETIC CHILDREN'S HEALTH AND THE CHILDREN'S ACTUAL HEALTH-RELATED QUALITY OF LIFE, AS MEASURED BY A CHQ-PF50 QUESTIONNAIRE

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Abstract

The aim of the study was to determine whether parents` perception of their children illness (their emotional distress) is related to the actual health status of the child. The PAID (Personal Areas in Diabetes) scale was used in order to evaluate the emotional distress in parents of diabetic children, while the actual health of the children was measured by CHQ-PF50 questionnaire (Children Health Questionnaire- Parents Form 50 items). One month before the summer camp for diabetic children the two questionnaires were administered to the parents. The total number of answered questionnaires was 27. The average score obtained on PAID questionnaire was 26,02±14,82. There was no relation between the actual health of the children and the parents´ emotional distress originating from perception of their child's health. The regression analysis was also not significant and none of the actual health parameters obtained by CHQ-PF 50 was found to be a significant predictor of parental perception of their child's illness. As it is known that children whose parents perceive them to be in poor health use more of the ambulatory care and participate less in sports activities, these findings may be important for the practitioners treating children with diabetes.

Key words: *diabetic children's, CHQ-PF50 questionnaire*

Introduction

Parents of children with Type 1 diabetes mellitus (T1DM) are very important factor for the self-esteem of the children, yet this success may come from their understanding the illness itself. The more parents know about their child's disease, the more they will know about how much can be expected from their child. Little research has examined how do the parents perceive their children health status and if their personal experience of the illness is in concordance with the real severity of the situation. Health status of a child is not always in concordance with the level of self-esteem and the self coping with illness. Parents also tend to experience the health problems of their children differently and not always according to the level of the illness.

The vast majority of studies investigating the childhood diabetes have had focused on children's coping with the illness and their health outcomes. The pediatricians always suggest that the level of child's health will be influenced by behavior of the all family members a scarce number of studies analyzing the parents` view of their children's health were published.

The participation of children in sport activities is often influenced by the position their parents have towards their illness and it is also not always in concordance with the real situation. That is why many children do not participate in sport activities even though their illness should not be a limitation. According to Valerio et al. (2007) the children and adolescents with T1DM appeared to spend less time in physical activity than their non-diabetic peers. The correlation between participation in sport of diabetic children and parents` educational level was also found.

The aim of the study was to determine whether parents` perception of their children illness (their emotional distress) is related to the actual health status of the child. The PAID (Personal Areas in Diabetes) scale was used in order to evaluate the emotional distress in parents of diabetic children while the actual health of the children was measured by CHQ-PF50 questionnaire.

Methods

Subjects

One month before the summer camp for diabetic children two questionnaires were administered to the parents. All of their children suffered from diabetes mellitus Type 1 and were on insulin therapy (one treated with insulin pump, while the others were on standard combined insulin injections therapy). Along with the questionnaires the parents obtained

the instruction how to fill in the survey and were asked not to administer the questionnaire to the children. Of the two-parent families, only one parent was asked to participate from each family and in most cases, it was the mother of the child. The total number of answered questionnaires was 27.

Methods

The first used questionnaire was administered in order to evaluate the parents` perception of their children's health and the emotional distress caused by that. The second questionnaire evaluated children's health status;

PAID questionnaire

The PAID is a questionnaire that measures emotional distress of diabetic patients that was developed by the Joslin Diabetes Center, Boston. It is a relatively new measure of emotional functioning in diabetes. It consists of twenty covering a range of emotional problems frequently reported in type 1 and type 2 diabetes. The answers to items are graded with 0 (not a problem) to 4 (presents a serious problem). The final score is between the 0 and 100 and it is obtained by multiplying the sum of all scores by 1.25. The internal reliability of the test is high (a=0.90) and test-retest reliability is also considerate (r=0.83). The obtained score is a measure of depression, internal distress and coping with illness. Nevertheless no relation was found between the score and duration of illness, education, gender or ethnicity (Polonsky 1995, Welch 1997). Usually the questionnaire is answered by the patient himself but in this case we were interested in parents` perception of their child illness, so the parents were instructed to fill in the questionnaire.

CHQ-PF50 questionnaire

As the measure of physical and psychosocial health the Child Health Questionnaire CHQ-PF50 was used. The CHQ is a paper and pencil questionnaire comprised of sets of questions (known as item sets or scales) that have been specifically developed for children and adolescents five years of age and older. The CHQ assesses a child's physical, emotional, and social well-being from the perspective of their parent/guardian or, in some instances, the child directly. The letters PF mean that this is a version that is answered by parent. This is the questionnaire that assesses the health in several domains: the child/adolescent's general health, change in health, physical functioning, bodily pain/discomfort, limitations in school work and activities with friends due to physical problems or emotional/behavioral difficulties, behavior, mental health, and self-esteem All questions are answered on 4 point ordinal scale. First, overall means for the individual CHQ scales and items can be derived using a simple summated rating approach. This method yields a profile for each of the health concepts. Salmon &Wake 2000 indicated that summary scores may actually be more useful in children with severe illness than in general population.

Statistical analysis

The statistical Package for Social Sciences SPSS (ver. 13.0, SPSS Inc., Chicago, IL) was used for the statistical analysis. Data are presented as mean and standard deviation (SD). The Pearson product-moment correlation was used to determine the relation between selected variables (CHQ and Paid). Regression analysis (model Enter) was used to calculate the relationship between CHQ factors and paid questionnaire. $P<0.05$ was considered significant.

Results and discussion

The average score obtained on PAID questionnaire was 26,02±14,82. As the highest possible score on this test is 100 and as in some similar studies on children the scores were higher (in the study of Wagner in 2005 it was around 40), this value was not found to be alarming and it was a bit surprising. Likewise, in previous studies the patients treated with insulin usually had higher scores than patients on *per os* therapy. In the study of Delahanty et al. (2007) those values were 26 vs. 17 respectively, which mean that the parents in this study perceive their children's health relatively good despite their diabetes.

Table 1. Descriptive statistics for each of the CHQ-PF 50 health concept and PAID

	Mean	Std. Deviation	Minimum	Maximum
Global Health	75,93	22,91	30	100
Physical Functioning	96,30	8,30	72,23	100
Emocional Social Limitations	92,59	13,78	44,44	100
Physical Social Limitation	93,21	15,51	33,33	100
Bodily Pain or Discomfort	84,44	15,77	50	100
Behavior	76,63	12,75	45	100
Global Behavior Item	85,19	19,39	30	100
Mental Health	76,67	12,56	45	95
Self Esteem	83,02	14,43	37,5	100
General Health Perceptions	57,56	10,27	41,67	83,33
Change in Health	55,56	16,01	25	100
Parental Impact – Emotional	72,84	20,36	33,33	100
Parental Impact – Time	90,53	12,59	55,56	100
Family Activities Ability	81,64	18,43	33,33	100
Family Cohesion	84,81	17,29	30	100
PAID_1	26,02	14,82	10	62,5

To determine the relations between the actual and perceived health the correlation coefficients between the results obtained on PAID questionnaire and factors representing health status measured by CHQ-PF 50 were calculated (Table 2).

Table 2. The correlation coefficients between the PAID questionnaire score and factors representing health status measured by CHQ-PF 50 were calculated (Table 2)

HEALTH RELATED FACTORS MEASURED BY CHQ-PF50	PAID
Global Health	-0,1472
Physical Functioning	0,0828
Emocional Social Limitations	0,0071
Physical Social Limitation	-0,0154
Bodily Pain or Discomfort	-0,0962
Behavior	0,2949
Global Behavior Item	0,1109
Mental Health	0,0295
Self Esteem	0,1401
General Health Perceptions	0,3554
Change in Health	-0,0269
Parental Impact – Emotional	0,0813
Parental Impact – Time	0,0051
Family Activities Ability	0,0501
Family Cohesion	-0,0758
PAID_	1

None of the correlation coefficients was found to be statistically significant (Table 2) so it pointed to no relation between the actual health of the children and the parents´ emotional distress originating from perception of their child's health. Than we tried to link CHQ-PF 50 data to the PAID score and used linear regression models to assess the associations of actual health with the health of the children as perceived by their parents (Table 3).

Table 3. The results of the regression analysis (model Enter) used to calculate the relationship between CHQ factors and PAID score

Model Summary					F	Sig.
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate		
1	0,7963	0,6341	0,1351	13,7854	1,270675	0,349593

As seen in Table 3, the regression model was not significant so it meant that none of the factors representing health status of the child was found to be a significant predictor of parents´ perception of their child health. It seems that the level of emotional distress that the parents experience because of their child illness is not proportional to the children's actual health-related quality of life, as measured by a CHQ-PF 50 questionnaire.

Conclusions

The perception of the health is probably influenced by many factors, including emotional, cultural, educational, social etc. The scores representing the emotional distress of the parents were in no significant relation with actual health measured by worldwide accepted CHQ-PF 50 questionnaire. Parental perception about their child's health was not at all associated with their child's actual health. There is no possibility to predict the parents´ perception of the child's health (and the emotional distress caused by it) on grounds of actual health of the child. As it is known that children whose parents perceive them to be in poor health use more of the ambulatory care and participate less in sports activities, these findings may be important for the practitioners treating children with diabetes.

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HABITUAL PHYSICAL ACTIVITY FOR BASKETBALL COACHES IN CROATIA, NORWAY, SLOVENIA, AND THE UNITED STATES

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Abstract

This study was a preliminary investigation into the health habits of basketball coaches in Croatia, Norway, Slovenia, and the United States. The study employed the Baecke Questionnaire of Habitual Physical Activity to establish levels of physical activity on coaches. Coaches were measured on three indices: work activity load, sport activity load and leisure-time activity load. The study found limited differences between groups on the three activity dimensions, but as a combined group a significant difference was established among coaches on the sport activity dimension. This study was preliminary to a larger investigation that will study the relationship between the health and physical activity of coaches to job anxiety and stress.

Key words: *health, physical activity, basketball, coaches*

Introduction

Sports in general, as well as other professions that are in close relation with sport are usually presumed to be in connection with life quality especially regarding health. Most of the laics would conclude that people involved professionally in sport lead a healthy way of life, take care about their dietary habits and avoid most of the habits that would endanger the health. Sports coaches would be a typical example of a professional who should be well aware of the basis of healthy living and particularly of habitual physical activity and its relationship with health. Though, this has never been scientifically proved and there is a great lack of published papers dealing with this issue.

World health organisation has already established the main factors influencing health those being socio-economic factors, way of life and physical environment (WHO, 2002). The risk factors in relation with the way of life are nutrition, physical inactivity, smoking, alcohol consumption and use of drugs. Coaching is definitely a profession that has a high amount of stress involved.

There are many scientific evidences linking physical activity to numerous health improvements and substantial benefits that can be gained. Regular physical activity greatly reduces the risk of dying from coronary heart disease. It reduces the risk of developing diabetes, hypertension, and even colon cancer. Physical activity fosters strong muscles, healthy bones and joints and may favourably affect body fat distribution and prevent obesity. In older adults it helps maintain function and greater quality of life.

The purpose of this study was to measure and establish levels of habitual physical activity for basketball coaches in Croatia, Norway, Slovenia, and the United States using the *Baecke Questionnaire of Habitual Physical Activity* (1). A second objective of the study was to determine if there were significant differences between the groups of coaches (Croatia, Norway, Slovenia and the US) on the three habitual activity dimensions or indices established by the *Baecke Questionnaire*. The three distinct dimensions of habitual physical activity include: physical activity at work measured by the work index (WI), sport physical activity measured by the sport index (SI), and leisure-time physical activity measured by the leisure index (LI).

The present study suggests that that habitual physical activity can be determined when the three above dimensions are measured and assessed. The assessment then can be used to determine if there are significant differences between the four groups of coaches on any dimension, and if all three dimension behave the same on coaches as a whole.

Subjects and Methods

The sample comprised 216 male and female basketball coaches. The subjects were tested with the *Baecke Questionnaire* to assess three levels of habitual physical activity. In Croatia, Norway, and Slovenia questionnaires were distributed at national coaches' association meeting. In the U.S. 80 male coaches were randomly invited to participate, 46 returned

surveys. It must be mentioned here that along with the *Baecke Questionnaire*, coaches were also asked to complete a *Health Status Questionnaire*, and a coaches' inventory to measure job anxiety and stress.

The *Baecke Questionnaire* was composed of 16 items that determined the three dimensions of each subject's status for habitual physical activity. First, each subjects physical workload during employment, second, the subjects physical workload during sport, and third, the subjects physical workload during leisure-time. Three basic indices are calculated from the *Baecke Questionnaire*: work index (WI), sport index (SI), and leisure index (LI). The lowest possible score of indices was 1.0, representing the lowest physical activity, whereas, 5.0 was the highest possible value signifying the highest level of physical activity.

The significance of the calculated differences for each physical dimension (WI, SI, & LI) between groups was checked by use of t-test. To test the differences between the variables work index, sport index and leisure index, MANOVA was used.

Results

The results are presented in tables. **Table 1** shows the mean age of coaches from the four groups and the frequency by gender from each respective group. It must be mentioned here that no female coaches from the U.S. were asked to participate. This was an oversight by the author who thought that only male coaches were being studied. In **Table 2**, the indices scores for WI, SI, and LI are illustrated for each respective coaching group.

Table 1. Mean ages and frequency of gender by group

VARIABLE	USA	CROATIA	SLOVENIA	NORWAY
AGE	42	39	32	38
GENDER (MALE/ FEMALE)	M=46 F=0	M=54 F=7	M=91 F=7	M=5 F=6

Table 2. Differences in work, sport, and leisure-time index (mean±SD) according to group (scale from 1 to 5, higher value signifying a higher physical activity load)

Croatia	N	mean±SD
WI	56	2.95±0.47
SI	57	2.99±0.77
LI	50	3.03±0.68
Slovenia	**N**	**mean±SD**
WI	85	2.91±0.45
SI	78	3.39±0.65
LI	88	3.14±0.61
Norway	**N**	**mean±SD**
WI	11	2.73±0.44
SI	11	3.27±0.83
LI	9	3.19±0.50
USA	**N**	**mean±SD**
WI	45	2.88±0.32
SI	45	3.10±0.76
LI	45	2.86±0.69

The second objective of the study was to determine if there were significant differences between groups as measured by t-test scores at the .05 level of significance. Table 3 illustrates that in only three cases there were significant differences between subject groups on individual activity dimensions. Slovenia (3.394±0.65) was significantly different on the sport index (SI) from Croatia (2.995±0.77), Slovenia (3.394±0.64) also for sport index (SI) from USA (3.10±0.76), and Slovenia (3.236±0.64) form USA (2.855±0.64) on the leisure index (LI).

Table 3. t-test, test for significant differences between subject group for variables WI, SI, and LI Statistically significant p-scores are bolded

	Croatia	Slovenia	
Activity Dimension	**mean±SD**	**mean±Sd**	**p < .05**
WI	2.948±0.47	2.905±0.45	0.585
SI	2.995±0.77	3.394±0.65	**0.001**
LI	3.025±.068	3.136±0.61	0.325
	Croatia	**Norway**	
Activity Dimension	**mean±SD**	**mean±SD**	**p < .05**
WI	2.948±0.47	2.727±0.44	0.152
SI	2.995±0.77	3.272±0.83	0.285
LI	3.025±0.68	3.194±0.49	0.480
	Croatia	**USA**	
Activity Dimension	**mean±SD**	**mean±SD**	**p < .05**
WI	2.948±0.47	2.877±0.32	0.389
SI	2.995±0.77	3.100±0.76	0.496
LI	3.025±0.68	2.855±0.64	0.215
	Slovenia	**Norway**	
Activity Dimension	**mean±SD**	**mean±SD**	**p < .05**
WI	2.905±0.44	2.727±0.44	0.214
SI	3.394±0.64	3.272±0.83	0.575
LI	3.136±0.61	3.194±0.49	0.783
	Slovenia	**USA**	
Activity Dimension	**mean±SD**	**mean±SD**	**p < .05**
WI	2.905±0.45	2.877±0.32	0.709
SI	3.394±0.65	3.100±0.76	**0.024**
LI	3.136±0.61	2.855±0.64	**0.014**
	Norway	**USA**	
Activity Dimension	**mean±SD**	**mean±SD**	**p < .05**
WI	2.727±0.44	2.877±0.32	0.202
SI	3.272±0.83	3.100±0.76	0.510
LI	3.149±0.40	2.855±0.64	0.138

To test whether there are differences between the means of the identified groups of subjects on the combination of independent variables (WI, SI, & LI), Wilks' lambda was used in a multivariate analysis of variance (MANOVA). **Table 4** indicates that the sport index (SI) was the only variable which showed a statistically significant difference for the four identified subject groups.

Table 4. MANOVA, test of the independent variables; work index, sport index, and leisure index

N=147	Wilks lambda	Partial Lambda	F-remove (2,142)	p-level	Toler.	1-Toler. (R-sqr.)
WI	0,903644	0,990126	0,531858	0,661066	0,984662	0,015338
SI	0,950139	0,941674	3,303413	**0,021835**	0,951644	0,048356
LI	0,924100	0,968208	1,751258	0,158712	0,939366	0,060634

Discussion

This study measured the habitual physical activity levels of basketball coaches in Croatia, Norway, Slovenia, and the United States and determined if there were significant differences between groups in terms of the three indices established by the *Baecke Questionnaire.*

Compared to adult urban population basketball coaches have greater indices values in all dimensions – work, leisure and sport. Only coaches from Norway had similar work index as adult males in Croatia. Probably we could find the reason for this in the fact that coaches being fitter accomplish their working tasks easier.

The study showed little variance between groups on the three indices, as in only three cases did a variable rise to the level of a significant statistical difference at the .05 level. For the four identified sub- groups, the sport index was shown to have the greatest variance of the three indices. This finding is understandable considering the different mean ages of the groups studied, the variety of sport activities participated in, and the influence of the four potentially different sport cultures. For example, in the U.S. the mean age of coaches was 42 years of age. In the forth decade of life, U.S. coaches may be turning to less strenuous forms of sport such as golf as their primary sport activity. For most coaches, golf is only played for five to six months of the year as few coaches have time to play golf during the basketball season. Another cultural influence that may account for the low score U.S. coaches established on the leisure index, is the distance to their work facility. Generally in the U.S., most coaches live beyond walking or cycling distances to their jobs. Coaches' get little or no exercise while commuting to work. However, they may get some exercise by mowing their lawns which most coaches in our opinion would not consider leisure. Culture, then may influence the sport and leisure-time activity of coaches and therefore may account for some of the variance on respective indices as a whole or on indices from one group to another.

Conclusion

In conclusion, the data suggest that basketball coaches have similar habitual activity levels, with the largest difference for all coaches as a group exhibited in the sport index (SI). It would have been useful and interesting to compare coaching activity levels by gender, but insufficient data were collected in the study to compare the physical activity of coaches by gender. Again, this study was part of a larger study and will in the future be beneficial in the comparison of coaches activity levels to an analysis of work related stress and anxiety.

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THE EFFECT OF KNEE EXTENSORS FATIGUE ON POSTURAL STABILITY AMONG YOUNG MEN

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Abstract

The aim of the study was the assessment of the effect of knee extensors fatigue caused by isomoetric effort on the level of postural stability in standing on one foot. Also the speed of recovery of postural stability level to pre-effort values was assessed.

Fourteen young physically active men – physical education students were examined (age, $\bar{x}$ = 21.9±0.6 years). The effort was preceded by a warm-up (approx. 5 min.) and measurement of postural stability (pre). After the physical effort postural stability was measured four times (post0, post1, post2, post3). The participants rested for 2 minutes in a sitting position between measurements. For the measurement of postural stability the AccuSway platform was used (AMTI, Balance Trainer software). The following parameters of the centre of pressure sways (COP) were analysed: a) V_{Avg} – mean velocity, b) MR – mean radius, c) Area 95% – sway area limited with an ellipse of the 95th centile, d) X_{Range} – range of maximum median-lateral sways (M-L), e) Y_{Range} – range of maximum anterior-posterior sways (A-P). In order to cause fatigue of knee extensors the UPR-02 A/S multifunctional chair made by SUMER was used. After establishing the maximum voluntary contraction (MVC) the participant performed maximum pressures on the lever of the dynamometer with a computer-imposed rate of contractions (2 second contraction and 2 second break). The test was stopped when on three consecutive repetitions the participant achieved values below 50% MVC.

The physical effort and fatigue caused by it resulted in a significant change in the values of most tested parameters (difference between pre and post0) except for X_{Range}. Not only V_{Avg} ($p \leq 0.01$) increased, but also parameters related to the spatial distribution of sways – Area95%, MR and Y_{Range} ($p \leq 0.01$) did. This may be significant in the context of limits of body stability (e.g. Błaszczyk, Hansen, Lowe 1993). With an increased sway area of COP the space between this area and limits of stability is reduced which may cause increased risk of losing the balance and falling, in particular in case of elderly persons.

It was noted that MR and Y_{Range} are the quickest to reach the values close to pre-effort (within 5:10-5:40 minutes from the completion of the procedure causing fatigue). In case of Area95% and V_{Avg} the process took 7:40-8:10 minutes from the completion of the procedure causing fatigue. The observed changes in the studied parameters under the influence of fatigue are short-lived and disappear in 5 to 8 minutes after the effort which confirms the results of other authors (e.g. Adlerton, Moritz and Moe-Nilssen 2003). MR and Y_{Range} were the quickest to return to the state before the effort, so the effects of fatigue were the quickest to disappear, which is a consequence of a significantly smaller initial effect caused by the fatigue procedure.

Key words: *knee extensors fatigue, postural stability*

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TRAINING INDUCED OXIDATIVE DAMAGE IN PROFESSIONAL SOCCER PLAYERS

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Abstract

We studied the effect of training exercise of professional soccer players (a simulated soccer match) on the levels of DNA damage in peripheral blood lymphocytes, especially 7,8-dihydro-8-oxo-2'-deoxyguanosine (8-oxodG), using the modified alkaline comet assay before and after the training. After the match, the values of tail length and tail intensity were significantly increased ($p<0.05$ for both indicators), indicating substantial DNA damage due to the exercise induced oxidative stress.

Key words: *7,8-dihydro-8-oxo-2'-deoxyguanosine (8-oxodG), physical exercise, alkaline comet assay, reactive oxygen species (ROS)*

Introduction

Acute bouts of aerobic exercise of high intensity are associated with increased oxidative activity and enhanced production of oxygen-derived free radicals which permeate the nuclei and induce DNA cell damage in lymphocytes (Peters et al. 2006). Reactive oxygen species (ROS) and reactive nitrogen species (RNS) such as hydrogen peroxide (H_2O_2) , superoxide ($O_2^{\bullet -}$), hyperchlorous acid (HOCl), and nitric oxide ($NO^{\bullet}$) play important roles in body immune response, redox regulation of gene transcription, cell signaling, enzimology and aging (Vollard et al. 2005). Recently, the increased lymphocyte level of 7,8-dihydro-8-oxo-2'-deoxyguanosine (8-oxodG) - a degenerative product of the DNA base guanine – was shown to be a reliable indicator of exercise generated oxidative stress which may last up to several days thereafter (Hartman et al., 1994). The oxidation of DNA is important since the oxidative modifications of DNA bases, particularly the hydroxylation of guanine, are mutagenic (Poulsen et al. 1999).

The aim of this work was to study the levels of lymphocyte 8-oxodG before and after a training soccer game in professional soccer players, where bouts of intense activity are unpredictably exchanged with the less intensive physical efforts. All the other studies related to exercise induced DNA damage were conducted during endurance training where the pace of the exercise is predominantly even, or by gradual, stepwise increase and reduction of the exercise intensity (Vollard et al. 2005).

Methods

Subjects. This study was conducted according to the principles of the Declaration of Helsinki and approved by the Local Ethical Committee. Nine apparently healthy adult men (all non smokers and no alcohol consumers) of a professional soccer team participated in the study (code name, age, letter symbol): StSl, 22 (A), PrIg, 18 (B), SmIv, 29 (C), ViDo, 18 (D), PaMi, 27 (E), BaVa, 26 (F), PrMa 21 (G), VuDa 35 (H), and ViAn, 25 (I). They gave their full consent to participate in the study.

Physical exercise training. Training was conducted at 100% competitive intensity (sparring match on a regular soccer playing field), consisting of two 45 min time sessions separated by 15 min rest, and followed by shooting practice for another 15 min.

Modified alkaline comet assay. The level of oxidative DNA damage in the peripheral lymphocyte was assessed by the 7,8-dihydro-8-oxo-2'-deoxyguanosine (8-oxodG) (Smith et al. 2006), and the tail length (μm) and tail intensity (% DNA) were calculated (Faust et al. 2004).

Statistical analysis. The respective difference in the tail length (μm) and tail intensity (% DNA) before and after the training exercise were assessed by the t-test at the $p<0.05$ level (Glantz, 2005).

Results

The effect of the physical training of the professional soccer club players was assessed by the 7,8-dihydro-8-oxo-2'-deoxyguanosine (8-oxodG) for tail length (μm) and tail intensity (%DNA) (Fig. 1 and Fig. 2). There is a remarkable effect of the increased oxidative damage to DNA due to the physical exercise. Both the tail length and tail intensity were higher after the training in every single subject ($p<0.05$ for both indicators). Incidentally, subject A who had the lowest initial 8-oxodG had the highest tail length after the training, whereas the subject I who had the highest initial 8-oxodG tail length had the lowest percentage increase after the training (Fig.1). The visual exploration of the changes in the tail intensity (Fig.2) also showed that the lower the initial 8-oxodG, the higher the final 8-ox-odG after the training. This pattern of response is indicative of some potential ceiling saturation value for DNA oxidative damage.

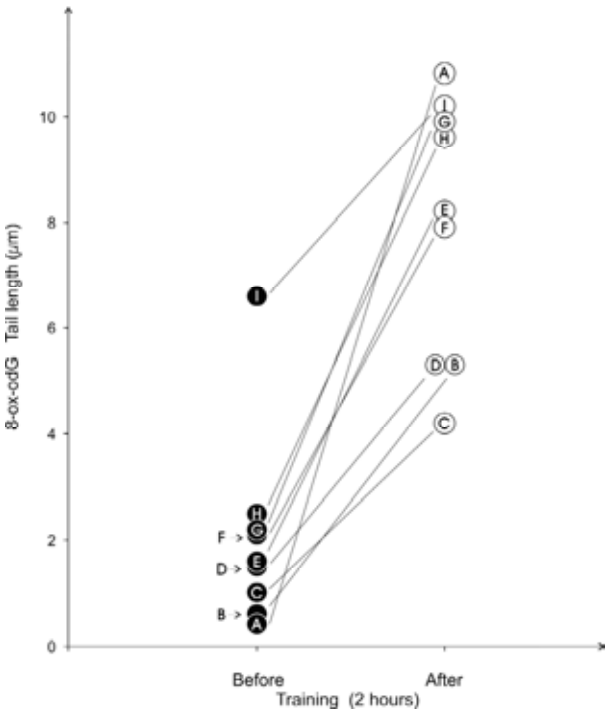

Figure 1. Tail length (μm). 8-ox-odG - 8-oxo-7,8dihydroxy-2'-deoxyguanosine, before (●) and after the training (○). Letters within the circle represent the subjects code (see Subjects and methods for the details).

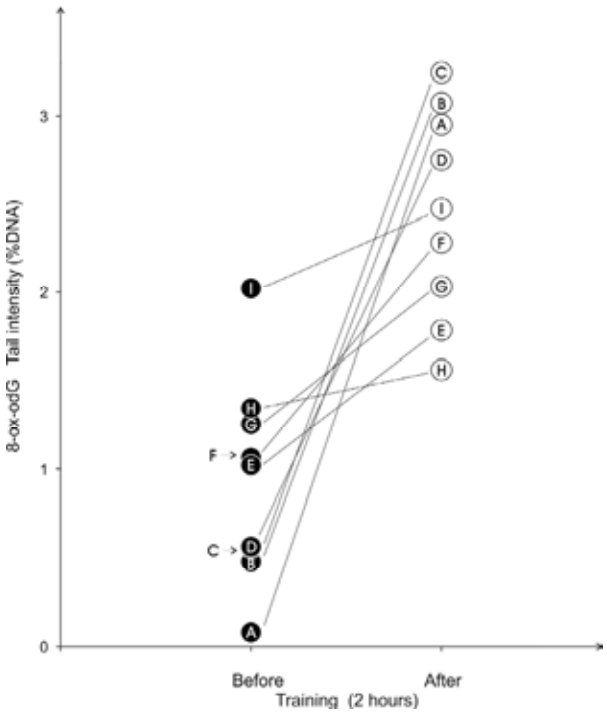

Figure 2. Tail intensity (% DNA). 8-ox-odG - 8-oxo-7,8dihydroxy-2'-deoxyguanosine, before (●) and after the training (○). Letters within the circle represent the subjects code (see Subjects and methods for the details).

Discussion and conclusions

Both comet parameters, i.e., tail length and tail intensity were significantly increased after the training exercise in every tested professional soccer player. Thus, the exercise induced increase of oxidation activity, and hence increased production of oxygen-derived free radicals permeating the nuclei, lead to DNA cell damage. There was a considerable individual variability in the observed DNA damage before and after the training exercise. It is reasonable to assume that some of the players have increased initial values of the DNA damage due to some other physical effort over the 3 days preceding the training (Hartman et al. 1994). The level of the individual physical condition may also play a role, since trained persons show less oxidative DNA damage as compared to the untrained (Peters et. al. 2006, Pitalluga et al.. 2006).

The observed impression on how the magnitude of the 8-oxodG response to the training exercise is inversely related to the initial level of the DNA damage requires further elucidation. It is known that exercise induced DNA damage can be reduced by dosed administration of tocopherol, selenium, vitamin C, and beta carotene, given either separately or in combination (Sen, 2001). Indeed, we recently demonstrated how the sister chromatid exchange (another indicator of the free radical oxidative damage), depends upon the trace element nutritional status, i.e., the poorer the trace element nutritional status the greater the susceptibility to the damage (Ivičić et al. 2007).

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THE RELATIONSHIP BETWEEN HEART RATE DEFLECTION POINT AND THE VENTILATORY ANAEROBIC THRESHOLD IN RUNNERS WHITH DIFFERENT AEROBIC CAPACITY

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Abstract

The purpose of this study was to examine the relationship between the heart rate deflection point (HR_{DP}) and the gas exchange anaerobic threshold (AnT) and to determine whether changes in heart rate to workload linearity can be used to accurately estimate anaerobic threshold in runners. Forty-eight male runners competing in different running disciplines performed a graded maximal exercise test on a motor-driven treadmill. The anaerobic threshold was assessed by a nonlinear increase in carbon dioxide output to oxygen consumption ratio (V-slope method). The HR_{DP} was determined using the method of deflection of linearity by visual inspection. There was no statistically significant difference between the heart rate at the AnT (176.5±9.9 bpm) and HR_{DP} (177.5±9.9 bpm, $p>0.05$), as well as between running speed (v) at the AnT (15.0±2.2 km/h) and HR_{DP} (15.0±2.0 km/h). We conclude that the intensity at the HR_{DP}, based on HR response during graded exercise in runners, can be recommended as a valid tool for non-invasive detection of the intensity at the AnT.

Key words: *Anaerobic threshold, heart rate deflection point, runners*

Introduction

The 'anaerobic threshold', also termed respiratory compensation point, is defined as the exercise intensity, or speed of locomotion, where the processes of glycogen oxidation and lactate removal reach their ceilings and above which blood [La^-] ad [H^+] rise inexorably and cannot be stabilized, with a disproportionate increase in VCO_2 and V_E in relation to VO_2, and decrease in arterial pH and CO_2 pressure (15, 16). Arterial blood lactate and/or gas exchange measurements are conventionally used for determination of this metabolic threshold. The AnT has been shown to be highly correlated to performance in aerobic events and is valuable in determination of optimal training loads and fitness level in competitive athletes. The determination of the anaerobic threshold has traditionally required laboratory exercise and blood sampling procedures for the assessment of the maximal exercise intensity above which blood [La^-] rise inexorably and cannot be stabilized (maximal lactate steady state, MLSS), or sophisticated gas analysis systems if the anaerobic threshold is defined by non-invasive gas exchange methods. Laboratory assessment of the AnT by gas exchange measurement represents an accurate but expensive procedure, and is thus out of reach for many athletes and sport coaches. Therefore, there is a need in sports diagnostics for simple and inexpensive, but nevertheless valid and accurate tests to assess the AnT. An alternative method to indentify the AnT using HR alone was originally suggested by Conconi et al. (1982). They described a non-invasive field test for AnT determination, hypothesizing that anaerobic energy production would 'spare' aerobic demand and result in a reduced rate of increase in VO_2 (and therefore in a reduced increase, or deflection of heart rate) above the anaerobic threshold in relation to running speed. This test, which was to become known in sports science and clinical exercise laboratories as the 'Conconi test', was based upon the loss of linearity in the relationship between heart rate and running velocity during an incremental exercise protocol. The relevant parameters at this point of deflection are the running speed (v_{DP}) and the heart rate, i.e., the heart rate deflection point (HR_{DP}) (Fig.1). HR_{DP}, as a marker of exercise intensity related to the AnT, is used to evaluate aerobic endurance, prescribe and monitor exercise intensity of healthy subjects and patients (Conconi et al., 1982; Bodner and Rhodes, 2000; Bunc et al., 1995). It is performed either as a field or as a laboratory test, with numerous modifications for different modes of exercise (field running, treadmill running, cycling, swimming, etc.). Conconi et al. (1982) and other researchers (Bunc et al., 1995; Hofmann et al., 1994) report a high correlation between v_{DP} and the lactate threshold (LT) and AnT, and recommend its use to evaluate endurance capacity and to assess training programs. Since the original work (Conconi et al., 1982), several modifications of the test have been proposed (Ribeiro et al., 1985; Zacharogiannis and Farrally, 1993; Hofmann et al., 1994; Bunc et al., 1995; Pokan et al., 1995). The relationship between HR_{DP} and AnT is the subject of research in the last 2 decades; recently, a number of studies have independently assessed the validity of the Conconi test, but producing contradictory results. Some studies have demonstrated disparity between the exercise intensities corresponding to a deviation in heart rate from linearity (HR_{DP}) and to the ventilatory or lactate anaerobic threshold (Tokmakidis and Leger, 1992; Zacharogiannis and Farrally, 1993), whereas others have confirmed the validity of the method (Hofmann et al., 1994; Bunc et al., 1995). However, the blood lactate or gas exchange criteria used to define the anaerobic threshold have differed between studies, as different authors use the same term (anaerobic threshold) to describe different metabolic thresholds, or use different methods in their comparisons (Hofmann et al., 1994; Bunc et al., 1995; Pokan et al., 1995).

In our laboratory, when evaluating aerobic capacity with gas exchange data collection, we perform a standard treadmill test with fixed stage duration, and a protocol that allows simultaneous determination of both, Conconi and gas exchange thresholds. The aim of this study was to investigate the relationship between the parameters at the gas exchange anaerobic threshold and at the heart rate deflection point, derived from the same incremental treadmill test, in trained runners competing in different running disciplines.

Methods

Forty-eight Croatian runners of national rank participated in the study (10 sprinters, 15 400m runners, 10 middle distance runners and 13 long distance runners) (Table 1).

Table 1. Physical characteristics

Variables	mean±SD
Age (years)	21.7±5.1
Weight (kg)	181.1±5.7
Height (cm)	71.9±6.9

The measurement procedures and potential risks were verbally explained to each subject prior to obtaining a written informed consent according to the Helsinki Declaration. The study was approved by the institutional Ethics Committee. Subjects were admitted in the study if they had a minimum training experience of 3 yrs, with 10 training hours per week and were currently active in national or international competitions.

All subjects performed an incremental maximal exercise test to volitional fatigue on a motor-driven treadmill (Run race, Technogym, Italy). The test started with running at 7 km/h and with 1 km/h speed increments every minute, at a constant inclination of 1.5%. A „breath-by-breath" gas analysis system (Quark b^2, Cosmed, Italy) was used for respiratory gas exchange recording. Heart rate was monitored using a Polar Vantage NV (Polar ElectroOi, Finland) heart rate monitor. HR, metabolic and ventilatory parameters were averaged at 30 second intervals.

The anaerobic threshold was estimated by the V-slope method, using a second disproportionate increase of the volume of carbon dioxide expired in relation to the volume of oxygen consumption (respiratory compensation point) (Beaver et al., 1986). Heart rate and running speed at AnT were interpolated from test data. Using the same test data, the heart rate vs. time was plotted and evaluated by visual inspection for detecting the HR breakpoint. The subjects whose HR_{DP} could not be indentified, were excluded from further analysis.

Paired t-test for dependent samples was used to evaluate the statistical significance of differences between the ventilatory AnT and the HR_{DP} method. The Pearson product moment correlation coefficients were used to determine the relationship between AnT and HR_{DP} parameters. The significance level was set at $p < 0.05$.

Results and discussion

The mean peak values of the treadmill incremental test are presented in Table 2. The time necessary to perform the test was relatively short (approximately 10 to 20 minutes), which means that it can be incorporated within or as part of a training session.

Table 2. Peak values of the treadmill test

Variables	mean±SD
VO_{2max} (ml/kg/min)	62.0±6.0
HR_{max} (beat/min)	194.4±8.7
RQ_{max}	1.18±0.04
v_{max}	19.99±2.05

Abbreviations: VO_{2max}: maximal oxygen uptake, HR_{max}: maximal heart rate, RQ_{max}: maximal respiratory quotient, v_{max}: maximal running speed

Table 2 presents the mean values of parameters measured at the gas exchange threshold and HR_{DP}. No significant differences were noted between mean, VO_2, VO_2%, HR, %HR_{max}, at AnT and HR_{DP}.

Table 3. VO_2, heart rate and running speed at AnT and HR_{DP} and corresponding correlation coefficients (r)

Variables	VT	HR_{DP}*	r
VO_2 (ml/kg/min)	53.5±5.8	53.1±5.7	0.77*
HR (beat/min)	176.5±9.9	177.5±9.9	0.83*
v (km/h)	15.0±2.2	15.0±2.0	0.85*

Values are means ± SD; *correlation coefficient significantly different from zero;
Abbreviations: VO_2: oxygen uptake, HR: heart rate, v: running speed, VT: ventilatory threshold, HR_{DP}: heart rate deflection point

In our study, the HR deflection and the gas exchange anaerobic thresholds were evident in all 48 subjects. Some others studies have documented the same (100%) success discerning the HR_{DP} (Conconi et al., 1982; Pokan et al., 1995) but others reported lower values (46 – 94%) of successfulness in HR_{DP} detection (Hofmann at al., 1997; Ribeiro et al., 1985; Kuipers et al., 1988; Bodner et al., 2000), suggesting that the HR_{DP} may not be reproducible across dissimilar populations. A deficiency of HR_{DP} detection, in the literature has been attributed to differences among the training or fitness status (Ribeiro et al., 1985; Francis et al., 1989). The HR/speed curve and the VCO_2/VO_2 relationship, used to determine HR_{DP} and AnT in one subject, are shown in Fig.1 and Fig.2.

The HR achieved at AnT and HR_{DP} (176.5±9.9 and 177.5±9.9 bpm, respectively, p=0.61), equaled 90.7% and 91.3% of maximal heart rate, respectively, similarly to other studies reporting values in the range of 88 to 94% of HR_{max} (Bodner et al., 2000). Identical average values for heart rate at the Conconi and gas exchange thresholds (177.0±6.0 and 176.0±6.0 bpm) were measured in the study of Bunc et al. (1988) on 28 trained runners. The HR values at the two thresholds in this study were highly correlated (r=0.83; p<0.01), and in the range of values (r=0.81-0.96) previously reported in other studies (Grant et al., 2002; Weltman et al., 1990).

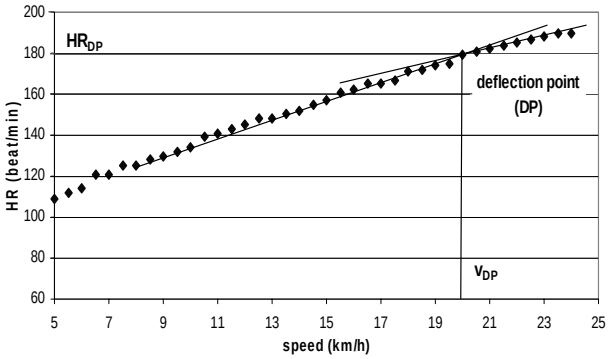

Figure 1. Determination of HRDP from the HR/speed relati onship

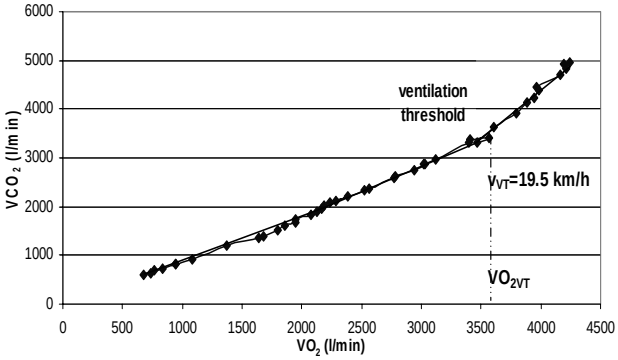

Figure 2. Determination of AnT from the VCO_2/VO_2 relationship (V-slope method)

Conconi et al. (1982) originally reported that the running speed at HR_{DP} and speed at the anaerobic threshold were significantly related (r=0.99; n=10). The authors also reported significant correlations between either AnT or HR_{DP} running speed and the average running speed at the 5000m race (r=0.93) and marathon (r=0.95). Contrary to their results, Tokmakidis and Leger (1992) observed low correlation coefficients (r=0.50) between speeds at HR_{DP} and the lactate threshold. In our study, the mean running speeds at HR_{DP} and AnT were almost identical (Table 3), and highly correlated (r=0.85; p<0.01), confirming the original results of Conconi et al. (1982), as well as several other studies (Zacharogiannis et al., 1993; Bunc et al., 1995). The very small, unsignificant mean difference and high correlations between the Conconi and gas exchange anaerobic thresholds confirm the validity of the workload at HR_{DP} as a measure of intensity at the anaerobic threshold.

Conclusions

The simplicity and low-cost favors the use of noninvasive methods such as the HR_{DP} method in fitness status and sports performance evaluation, especially where the laboratory equipment for AnT determination (lactate and gas analyzers) is not available. Our data suggest that the intensity (i.e., running speed) at the HR_{DP} coincides with the intensity at the gas exchange anaerobic threshold during graded exercise in runners, and therefore can be recommended, in most cases, for the detection of the anaerobic threshold.

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Biomechanics and Motor Control

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FORCE COORDINATION IN MANIPULATION TASKS: EFFECTS OF GRASPING TECHNIQUE

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Abstract

Both an elaborate coordination of the hand grip force (GF; normal component of the force acting at the digits-object contact area) and load force (LF; tangential component), and the role of cutaneous afferents in GF-LF coordination have been well documented in a variety of manipulation tasks. Our recent studies revealed that GF-LF coordination deteriorates when LF is consecutively exerted in two opposite direction (bidirectional tasks; e.g., when vigorously shaking objects or using tools). The aim of the study was to explore the possible role of afferent information from the skin mechanoreceptors in the observed phenomenon, through the comparison of various grasping techniques (involving skin areas of different sensitivity), as well as through the skin cooling. Subjects (N=14) exerted sinusoidal LF pattern in vertical direction against an externally fixed device in one (unidirectional) and two opposite directions (bidirectional task). The device was grasped either by applying a natural precision and palm-palm grasps, or by holding it by fists and wrists. The precision grasp was also tested prior to and after cooling of the tips of the digits with ethyl chloride. In line with our previous findings, the results revealed that switching from uni- to bidirectional tasks was associated with a marked decrease in the indices of GF-LF coordination. However, neither the change in grasping technique (presumably involving areas of skin of different sensitivity) nor cooling (reducing skin sensitivity *per se*) affected GF-LF coordination. Therefore, we conclude that the afferent sensory information from cutaneous receptors could not play an important role force coordination associated with continuous manipulation tasks.

Key words: *hand function, grip, load, neural control, cooling, skin mechanoreceptors*

Introduction

Holding and manipulating objects are important motor activities of daily living. Two distinct force components act upon a manipulated object. The load force (LF) that acts in parallel to the digits-object contact surface(s) is exerted by both the proximal and distal upper limb muscles either to counteract the object's weight and inertia or to produce a reaction force from external support when preserving a posture. The grip force (GF) is exerted by both the intrinsic and extrinsic hand muscles and acts perpendicularly to the longitudinal axis of the object. GF needs not only to be sufficiently high to prevent slippage caused by LF, but also to be low enough to avoid crushing the object or preclude fine coordination of the ongoing manipulation task. During the digits-object interaction, a high level of coordination of GF and LF accounts for the simultaneous modulation of GF to the changing LF, which is responsible for keeping a stable and low safety margin (GF/LF ratio relative minimal required for preventing slippage) (Flanagan, Tresilian, & Wing, 1993; Zatsiorsky, Gao, & Latash, 2005). The afferent sensory activity is believed to play an important role in discreet manipulation tasks (e.g.; lifting a glass of milk) during initial adjustment of GF to the friction coefficient that provides relatively low GF/LF ratio (Johansson & Westling, 1984, , 1987). However, the role of the same sensory activity in the force coordination in continuous tasks still remains unknown.

We recently developed a novel method for testing the GF-LF coordination in uni- and bimanual manipulation tasks under various mechanical conditions (Jaric, Collins, Marwaha, & Russell, 2006; Jaric, Knight, Collins, & Marwaha, 2005). Among other findings, we observed an abrupt deterioration in GF-LF coordination whenever the subjects switched from uni- (LF exerted only in one direction) to bidirectional tasks (LF changes directions, such as in shaking objects, or using tools) (de Freitas, Krishnan, & Jaric, 2007; de Freitas, Markovic, Krishnan, & Jaric, 2008; Jaric, Russell, Collins, & Marwaha, 2005). In the present study, we assessed the role the skin mechanoreceptors in the force coordination of continuous manipulation tasks through the comparison of the uni- and bidirectional tasks performed under various experimental conditions. We hypothesized that the change in sensitivity of skin mechanoreceptors (accomplished either by changing skin areas used for manipulation, or by cooling) would affect the difference in force coordination observed between the uni- and bidirectional tasks.

Methods

Fourteen healthy volunteers participated in the study. They exerted a continuous sinusoidal F_Z (vertical component of LF) against the experimental device that recorded both GF and LF (see Fig. 1 for details) at prescribed frequencies paced by a metronome. The tasks required exerting either unidirectional (direction either vertically up or down, pace 1.33 Hz) or bidirectional (consecutively up and down at 0.66 and 1.33 Hz). In the Experiment 1, the participants repeated the tasks by applying four distinctive grasping techniques (see Fig. 1 for details). Note that the precision and palm-palm grasp used the highly sensitive skin areas for the contact with the device. However, the remaining two grasping techniques (i.e., the wrist-wrist and fist-fist) used the skin area that are not regularly used for object manipulations and also with low sensitivity of skin mechanoreceptors. In the Experiment 2, only the precision grip was tested. However, the participants repeated the tasks prior to and after cooling the tips of the fingers and the thumbs with ethyl chloride which significantly reduced the skin sensitivity (as assessed by a standard neurological test).

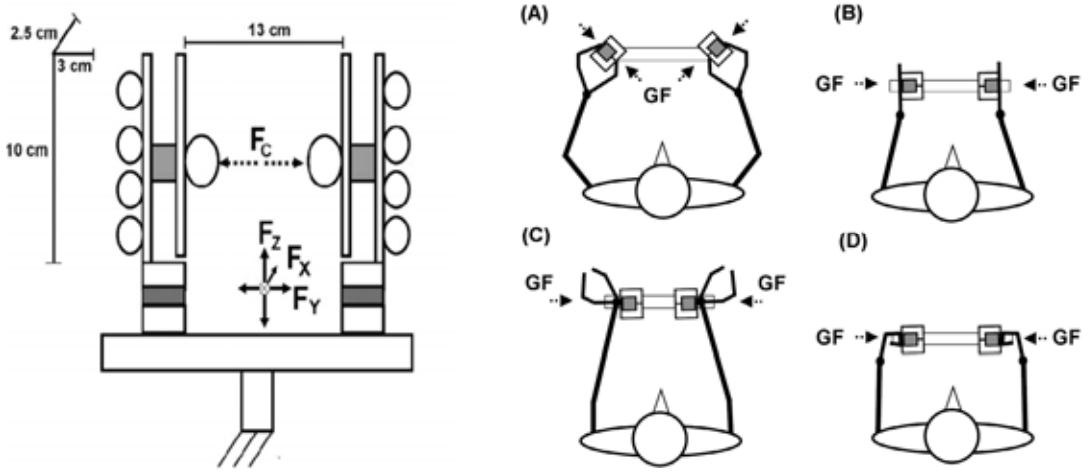

Figure 1. Illustration of the experimental device (left hand side), together with the force transducers (shaded rectangles), recorded forces and tips of the digits applying precision grip. The right hand side illustrates four grasping techniques (A - precision, B- palm-palm, C - wrist-wrist, D - fist-fist).

Results

The patterns of the force profiles obtained from various tasks were in line with our previous findings (Fig. 2). In particular, while the unidirectional tasks showed highly coordinated changes of GF and LF, the GF profiles of the bidirectional tasks were weakly related with the changes of LF and also depicting a relatively high GF/LF ratio.

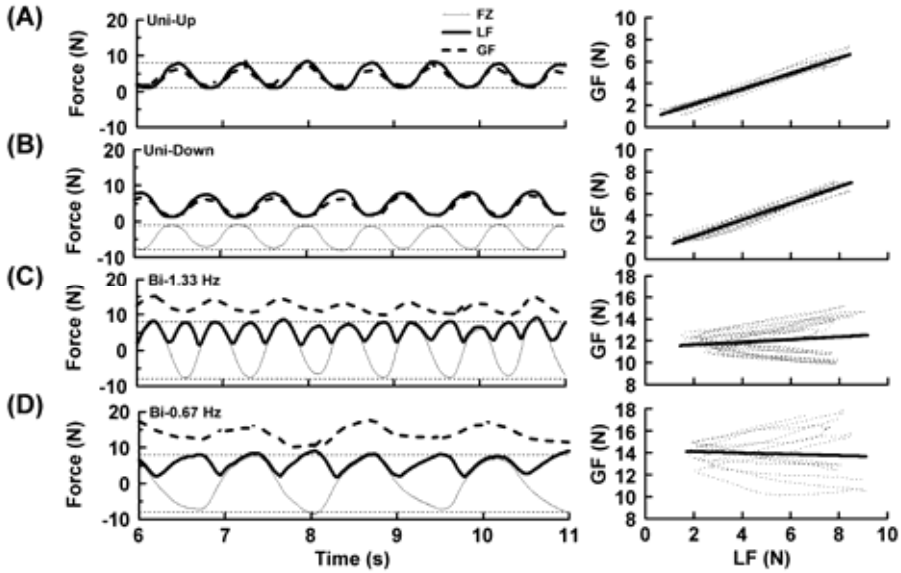

Figure 2. Typical force recordings obtained from four tasks performed by a representative subject (see left hand graphs). Note that the thin line represents the F_Z, the thick solid line shows the net tangential LF (the vectorial sum of the vertical and horizontal component) that tends to cause slippage, and the thick dashed line represents GF that tends to prevent slippage. The right hand graphs show the same data presented on GF-LF diagrams illustrating the force coordination.

When averaged across the subject (see Fig. 3), the data revealed the expected effect of direction. In particular, unidirectional tasks demonstrated a higher correlation and lower safety margin in than the bidirectional tasks. However, no effect of the grasping technique was found. The only exception was a relatively high safety margin of the palm-palm grasp which could be related to the exceptionally high friction coefficient of the palm skin.

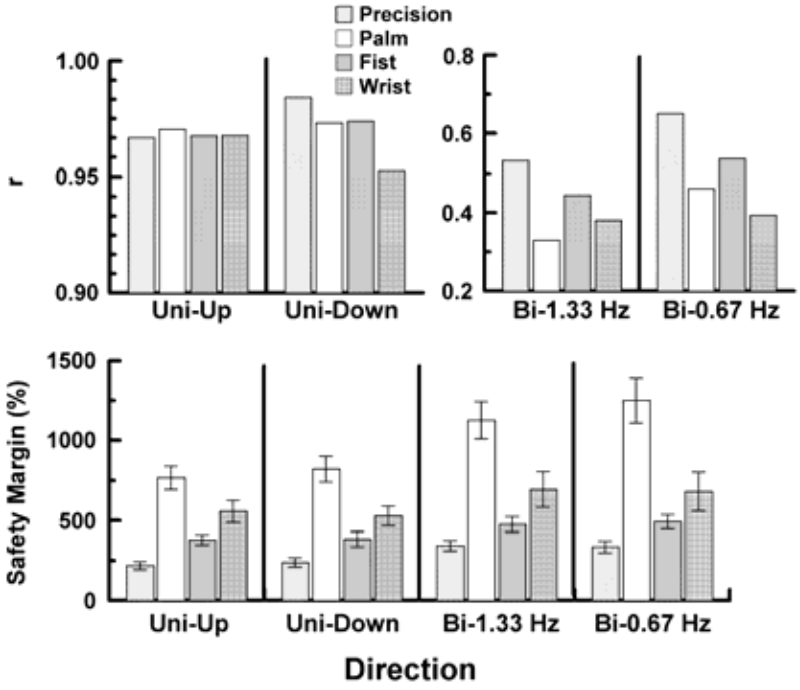

Figure 3. Median correlation coefficients (r; upper panels) and safety margin (i.e., how much was GF higher than necessary to prevent slippage; lower panel). The data represent average across the subjects with SE error bars.

Finally, as assessed by a standard neurological test, the cooling of the tips of the digits caused a reduction in the sensitivity of the skin mechanoreceptors. However, the cooling failed to affect any of the indices of force coordination.

Discussion

Based on the results obtained from rapid and transient manipulation actions (Flanagan & Wing, 1995; Johansson & Westling, 1984, , 1987), we hypothesized that the afferent activity of skin mechanoreceptors could play an important role in elaborate force coordination associated with the most of daily manipulation tasks. Therefore, we manipulated the sensitivity of the skin receptors either by using different hand skin areas to grasp the device (Experiment 1) or by cooling (Experiment 2) to evaluate the standard indices of GF-LF coordination. The experimental tasks included those usually showing both a high (i.e., unidirectional) and low force coordination (bidirectional). However, both of the manipulated experimental factors failed to affect the studied GF-LF coordination. Therefore, the afferent sensory activity of skin mechanoreceptors may not play important role in the studied force coordination and, consequently, in the success of daily manipulative tasks in general.

Since the importance of skin receptors in adjusting GF to changes in LF has been well documented in previous studies of manipulative actions (Johansson & Westling, 1984; Nowak, Glasauer, Meyer, Mait, & Hermsdorfer, 2002), the obtained finding could be considered as quite unexpected. However, one could speculate on the possible role of the tasks studied. Namely, previous studies were based on rapid adjustments of GF to the friction forces in the initial phases of the manipulative actions (Johansson, Hager, & Riso, 1992; Johansson, Riso, Hager, & Backstrom, 1992). Our study, however, evaluated a continuous manipulation that excluded initial task phases. Therefore, it remains possible that the documented role of skin mechanoreceptors could be of importance only in the initial phases of the task when the detected 'micro-slippages' and skin bending help the CNS to decide upon the needed GF (Johansson & Birznieks, 2004). The later phases could be predominantly based on central mechanisms that provide highly coordinated changes of GF and LF without an important role of afferent sensory information. The finding that the GF-LF coordination is generally based on feed-forward control mechanisms (Flanagan & Wing, 1995; Johansson & Westling, 1988) seems to speak in favor of this interpretation.

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BILATERAL DEFICIT OR FACILITATION – NEUROPHYSIOLOGICAL APPROACH

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Abstract

Although the human neuromuscular system is capable of performing motor tasks of great complexity, there are several reports in the literature describing the inability of human subjects to generate maximal force when contra-lateral muscle pairs work simultaneously.

The results of our study suggest that there is interaction between the two homologous motor cortex causing deficit in isometric force generation when two homologous muscle group of the two limbs are activated simultaneously. The fMRI records showed clearly that the activity of the motor areas of the muscles decreases during bilateral force exertion which is in good agreement with the reduced torque production. However, it seems that during eccentric contraction the torque rather increased than deceased. We may conclude that muscle stretch might cause facilitation during the interaction of the two hemispheres. This assumption is supported by the result of the second approach of our experiment. Namely, when one of the muscles was stretched, the isometric torque increased significantly above the bilateral isometric torque level in the contra-lateral muscle. In summary, our results suggest that the bilateral deficit or facilitation can partly attributed to the reduction or elevation of the neural drive.

Key words: *bilateral deficit or facilitation, neurophyisological approach*

Review of the relevant literature

Although the human neuromuscular system is capable of performing motor tasks of great complexity, there are several reports in the literature describing the inability of human subjects to generate maximal force when contra-lateral muscle pairs work simultaneously.

The maximum voluntary force produced by an individuals with the muscles of one limb is less when these muscles are active simultaneously with the homologous muscles in the contra-lateral limb than when they are active alone. Forces produced during maximum voluntary contractions can be 3–25% smaller during simultaneous bilateral exertions than during independent unilateral exertions of homologous limbs (Archontides and Fazey 1993).

This phenomenon is called bilateral deficit (BLSD) or bilateral strength (force) deficit. This phenomenon was first described by Henry and Smith (1961). Since the first report numerous researchers have investigated the BLD in isometric and isokinetic leg or arm tasks.

Although most of the investigators have confirmed the BLD existence (Vanderwoort et al. 1984; Van Dieen et al. 2003), some investigators were unable to find a bilateral force deficit (Jakobi and Cafarelli 1988), and a few have even reported a bilateral facilitation (Howard and Enoka 1991). To explain these different findings, some of which were obtained in apparently similar tasks executed by apparently similar subjects, various factors have been proposed, such as the level of training of the subjects and their familiarity with the task.

Different investigators using similar protocols in nearidentical samples have found a BLD in some cases (Howard and Enoka. 1991) but not in others (Coyle et al. 1981; Vandervoort et al. 1983). At one time or another, it has been suggested that factors such as training (Howard et al 1991; Oda and Moritani 1995; Rothmuller and Cafarelli 1995; Schantz et al. 1989; Secher 1975), age (Hakkinen et al. 19985, 1996), motor disorders (Secher et al. 1988), fatigue (Kroll 1965; Vandervoort et al. 1984, 1987), fiber type (Coyle et al. 1981; Koh, et al. 1993; Secher et al. 1978; Vandervoort et al. 1984), and right-left dominance (Henry and Smith 1961; Herbert and Gandevia 1996; Oda and Moritani 1994, 1995a,b; Ohtsuki 1983; Weir 1995) have a role in this phenomenon.

Also, one and two legged jump was studied in relation with bilateral deficit (BLD). It has been experienced that in standing vertical jumps the subjects are able to jump higher when the jump is carried out with two legs compared to one-leg jump. In several studies (Challis 1998; Van Soest et al. 1985; Vint and Hinrichs 1996; Bobbert et al. 2006), it has been reported that, in a two-leg jump, humans achieve less than twice the jump height they are able to reach in a one-leg jump.

Despite the numerous studies on BLD that have appeared in the literature since 1961, no clear explanation for this phenomenon has emerged. It appears that BLD occurs more frequently in the upper body (Henry and Smith 1961; Kroll

1965; Oda and Moritani 1994, 1995a,b; Ohtsuki 1981a,b,1983) and less frequently in contra-lateral muscle pairs that have undergone bilateral resistance training (Howard and Enoka. 1991; Rothmuller and Cafarelli 1995; Secher 1975). There is no BLD when non-homonymous muscles contract simultaneously, for example, during simultaneous flexion of one arm and extension of the other (Herbert and Gandevia 1996; Howard and Enoka. 1991; Kawakami et al. 1995; Ohtsuki 1991). Perhaps the most perplexing finding has been the observation of BLD that have not been accompanied by proportional deficits in activation as measured with surface electromyography (EMG) (Howard and Enoka. 1991; Kawakami et al. 1995; Schantz et al. 1989), although this might be due, in part, to the potential insensitivity of the method.

Some of the researchers suggested that the reason of the bilateral deficit is the decreased neural drive (Howard and Enoka 1991; Vanderwoort et al. 1984; Van Dieen et al. 2003). However, Jacobi and Carafelly (1998) reported that neuromuscular drive and force production was not altered during bilateral contractions. Also, Bobbert et al. (2006) suggested that the reason of the bilateral deficit in jumping is primarily caused by the force-velocity relationship rather than by a reduction of neural drive.

The question arises if not the decreased neural drive is the reason for the bilateral deficit, what else can be? Also, if there is bilateral facilitation, how the force during bilateral exertion can be greater?

Studying the problem

We hypothesized that despite the suggestion of some researchers the bilateral deficit and facilitation originates from the central nervous system, i.e., from the motor cortex. Since the bilateral deficit was investigated under voluntary contraction using isometric or concentric contractions, it seems logic that the bilateral deficit or facilitation is due to the interaction between the two hemispheres. Namely, during bilateral force exertion there is inhibition between the homologous motor areas or the contra-lateral facilitation disappears during unilateral force exertion.

To test our hypothesis we designed the following research protocols.

1. Maximum uni- and bilateral isometric knee extension at a joint angle of 40 or 90, and eccentric contraction with 30 degrees of range of motion applying 30 or 300 degree/s constant velocity.
2. Bilateral isometric knee extension followed by a stretch of one of the knees extensors (left or right) using 30 degree angular displacement.
3. Functional magnetic resonance image (fMRI) of the brain during voluntary maximum isometric uni- and bilateral isometric contraction (Figure 1).

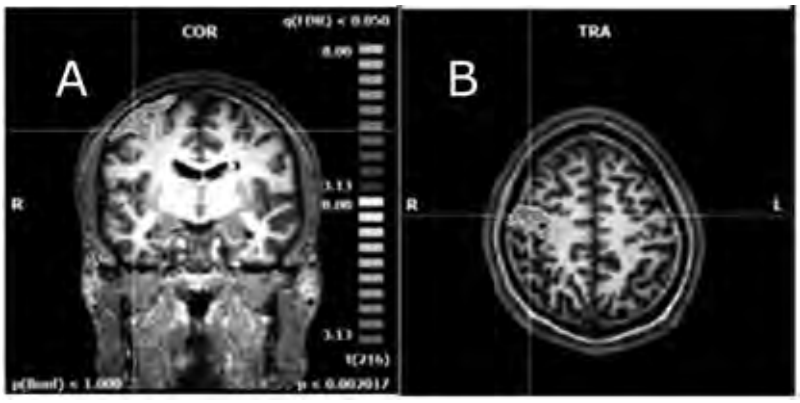

Figure 1. Functional MR image of the brain in frontal (A) and transversal (B) plane. The images show the activity of the motor cortex of the right hemisphere when the left elbow extensors exerted maximum isometric force.

Brief introduction of the result of our study

1. Under isometric knee extension the bilateral torque production was significantly reduced with 11.3 %. During eccentric contraction the torque production was greater during bilateral contraction with 8.1 % as compared to unilateral contraction. However, the difference is not significant.
2. Stretching one of the knee extensors while the other leg maintained the isometric contraction, the isometric torque increased in the non-stretched knee extensor significantly with 17.4 % comparing the maximum isometric torque during bilateral contraction.
3. The fMRI study indicated that during unilateral isometric elbow flexion the motor area of the contracting muscle is active and this activity is the highest at the beginning of the contraction, then it decreases almost gradually till

the end of contraction. The motor area of the non-contracting muscle also displays activity at the beginning of the contra-lateral knee extension, but it is significantly less than that of the active muscle. During bilateral contraction the activity of the motor areas in both hemispheres are significantly less than during unilateral contraction (Figure 2).

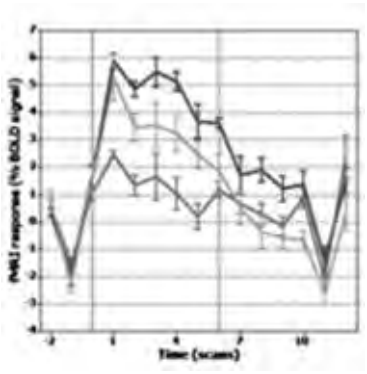

Figure 2. The activity of the motor area of the elbow flexors in the left and right hemisphere during unilateral left and bilateral (left and right) isometric contraction of the elbow flexors. The upper curve shows the activity of right hemisphere during 10 s left elbow isometric contraction. The lower curve represents the activity of left hemisphere during left elbow force exertion. The middle curve indicates the activity of right hemisphere during bilateral isometric contraction.

Conclusion

The results of our study suggest that there is interaction between the two homologous motor cortex causing deficit in isometric force generation when two homologous muscle group of the two limbs are activated simultaneously. The fMRI records showed clearly that the activity of the motor areas of the muscles decreases during bilateral force exertion which is in good agreement with the reduced torque production. However, it seems that during eccentric contraction the torque rather increased than deceased. We may conclude that muscle stretch might cause facilitation during the interaction of the two hemispheres. This assumption is supported by the result of the second approach of our experiment. Namely, when one of the muscles was stretched, the isometric torque increased significantly above the bilateral isometric torque level in the contra-lateral muscle. In summary, our results suggest that the bilateral deficit or facilitation can partly attributed to the reduction or elevation of the neural drive.

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THE FITTS' LAW AND THE ANTICIPATORY POSTURAL ADJUSTMENT

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Abstract

The aim of the work was to understand the neuro-physiological nature of the control for the speed accuracy trade of in human movement. Twelve expert dancers pointed their foot at a target under the Fitts' paradigm considering six movement amplitudes and five target widths. The results showed that movement time scaled with target width, as predicted by Fitts' law, but not with target distances. The Anticipatory Postural Adjustments revealed that the onset of muscles activity was linearity correlated with the index of difficulties only for the shortest distances. By taking both results together they showed that Fitts' law is applied when the movement time is short and the control under a feed forward manner.

Key words: *fitts' law, speed-accuracy trade off, postural control, anticipatory postural adjustment, action –perception, stepping*

Introduction

Most of the daily human activities are characterized by velocity and precision while reaching or carrying on a limb at a target. For example while hiking or walking on an uneven ground, subjects need to quickly move with accuracy to avoid tripping and fall. The most well-known formulation that takes into account movement speed and movement precision was introduced first by Paul Fitts (1954), who proposed that movement time is linearly related with target size and target distance such as:

$$MT = a + b \log_2(2D/W), \quad (1)$$

where MT is the time applied to reach a target, *a* and *b* are empirical constants, and $\log_2(2D/W)$ is the index of difficulty (ID). This relationship predicts that as long as D/W is constant, MT should remain unchanged. Many studies demonstrated the validity of the law in a wide variety of tasks (for a review see Plamondon & Alimi, 1997). Recently though few works demonstrated violations of the law. The common aspect among these works is that in all experiments subjects were requested to displace big masses, as moving the whole body to a target or as grasping and moving to a target heavy objects, (Danion et al., 1999; Cesari & Newell, 2002; Duarte & Freitas, 2005; Duarte & Latash, 2007). The idea is that as the masses involved increase, the time to displace them increases as well but not in a linear fashion. One other possible hypothesis that can explain the Fitts'law violation, is still related to movement time and to the type of control applied. As distances to travel increase as the movement time increases such as for a long movement time a feedback control is available on the contrary for a short movement time a feed forward control is applied. One way to test these hypotheses is to measure the Anticipatory Postural Adjustments (APA) on the muscles that counteract the predicted mechanical effects of the planned action as a means of pre-planned generation of forces and moments of force (Bouisset & Zattara, 1987; Massion, 1992; Aruin, 2002). In summary, the aim of the study is to develop a deeper understanding of the nature and the type of control applied during a speed accuracy trade off task. Moreover, as the ongoing for the control involves different aspects of the performance such as planning and execution, our aim was to analyze the behaviour of the Anticipatory Postural Adjustments (APAs) under Fitts' Law paradigm. The assessment for a specific APAs modulation given the different Index of Difficulties (IDs) could be an indication for a specific underlined neuro-physiological mechanism that accounts for a trade-off between speed and accuracy in the human movement domain. The task we used was similar to those that have formed the experimental foundation by Fitts (1954) by performing an aiming movement with a foot at different targets width and distances (Duarte & Latash, 2007).

Methods

Twelve expert female dancers took part in the experiment. The mean age was 23 ± 5 years, their mean height was 1.65 ± 0.07 m, and their mean body mass was 52.7 ± 5.7 kg. All participants signed the informed consent form according to the procedures approved by the University of Verona. During the experiment, the subject stood on a force platform with their feet parallel distanced by 10 cm and with the arms crossed over the chest. Kinematics of lower limbs were

recorded using seven cameras of motion capture system (VICON, Mx 13) at a sampling frequency of 250 Hz. Markers were placed on the following bony landmarks: first metatarsal head (big toe), lateral malleolus, femoral epicondyle, and anterior superior iliac spine. Eight self-adhesive electrodes for surface electro-myograms (ZeroWire, AURION) were recorded on both side of the lower leg muscles: tibialis anterior (TA), soleus (SOL), rectus femoris (RF), biceps femoris (BF). The sampling frequency of EMG signals was 1000Hz. The kinematics and EMG data were aligned together at t_0.

Subjects were instructed to point with the tip of the toe at a target (with width W) placed on the floor in front of them at certain distance, (D). The task was to perform a single discrete movement. The instruction given was: "be as fast and as accurate as possible in your pointing movement". After the pointing movement, subjects were instructed to keep the final position for about 2s. Six target distances (D = 10, 20, 40, 60, and 100cm) and five target widths (W = 2, 4, 6, 8, and 10 cm) were used resulting in 30 different target conditions with indices of difficulty, ID, varying from 1.00 to 6.64. Within each condition the subject performed 20 trials. The conditions were presented in a pseudo-random order, while the trials within a condition were blocked. The subjects performed 3-4 practise trials before starting each condition, for each trial they were free to initiate the step at any moment within 4 s after an auditory signal, moreover, they were allowed to rest between conditions, such as fatigue was never an issue.

Data analyses were performed using Matlab 7.0 software(Mathworks Inc.). The kinematic data were digitally low-pass filtered at 15 Hz using a sixth order, zero-lag Butterworth filter. The data were analysed only in the sagittal plane. The time when the movement started considering the marker at the lateral malleolus and (t_0) was defined as the instant when the tangential velocity of that maker reached 2 % of its maximum value for each trial. The time when the movement ended (t_f) was defined as the time when the tangential velocity of the marker of big toe of the pointing foot reached 2 % of its maximum value. Movement time was always calculated as the time between t_0 and t_f. The movement amplitude was calculated as the distance between the position of lateral malleolus marker (t_0) and the final position of big toe marker (t_f) in the anterior posterior direction. Movement variability was estimated using the effective target width (W_E), which was computed as four times the standard deviation of movement amplitude across the 20 trials within a condition.

The EMG raw data was rectified and filtered with a 10-500 Hz band-pass, second order, Butterworth filter. The variables considered were the onset of EMG signal before focal movement and the amplitude of EMG between from onset to the initial of movement (t_0).

To detect the EMG onset, data were filtered with a 12 Hz low-pass, fifth order, Butterworth filter. Individual trials were aligned by the first deflection of an EMG signal above 2 standard deviation from its baseline level. The baseline level was defined as the mean EMG activity during the first 300 ms of data recording. The onset of each muscle was calculated as the difference between the t_0 of lateral malleolus marker and the time at the onset value for each muscle. For statistical analysis was used a SPSS software, the statistical significance was set at $P < 0.05$.

Results

Figure 1 shows the movement time averaged across subjects versus the index of difficulty (ID). The longest movement times were achieved with the highest IDs. It clear that MT scaled with both distance (*D*) to the target and target width (*W*). The correlations coefficients were significant at all distances (all $r > 0.90$, all *P*-values < 0.01). If all data are considered (all combinations of *D* and *W*), one can observe a non-linear relationship between MT and ID. There was an increase in the slope and the intercept of the regression lines with an increase in D. The Figure 2 shows the linear fits of intercepts (a) ($r > 0.96$, *P*-values < 0.01) and slopes (b) ($r > 0.96$, *P*-values < 0.01) of the regression lines.

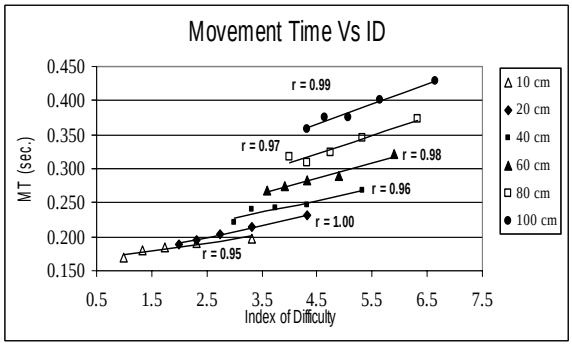

Figure 1. Movement time (MT) versus index of difficulty (ID) across subjects

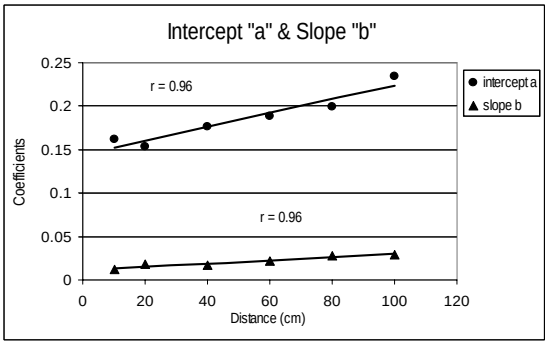

Figure 2. a and b coefficients of the regression lines for each target distance versus target distance

The dependent variables of APA measured, onset and amplitude, revealed a robust relationship with the ID just only short distances. In particular the Figure 3 and 4 shown the onset of both TA was linearly directed with the ID in 10 ($r > 0.97$, P-values < 0.01) and 20 ($r > 0.99$, P-values < 0.01) cm respectively), indeed for long distance no linear relationship was found.

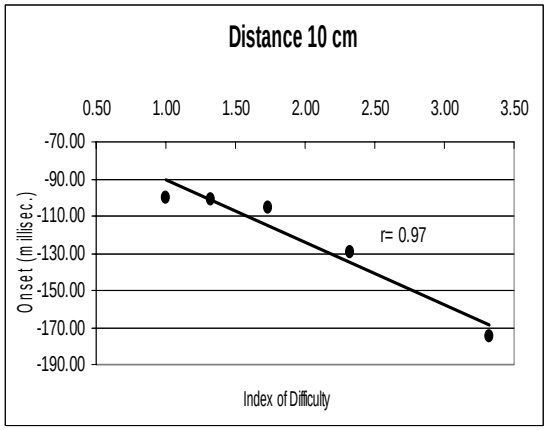

Figure 3. Tibialis Anteriors onset versus index of difficulty across subjects in 10 cm distance

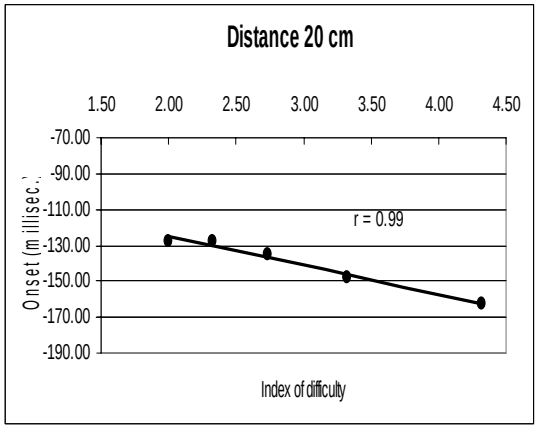

Figure 4. Tibialis Anteriors onset versus index of difficulty across subjects in 20 cm distance

Conclusion

Our data confirmed the results found by Duarte & Latash (2007) that when the entire body is used to accomplish a speed-accuracy trade –off task, Fitts' law does not hold and movement time (MT) is not linearly related with the increases of the Index of Difficulty. Our hypothesis was that Fitts' law holds just for movements that are constrained to be planned in advance such as the one with a very short MT, so short that none feedback adjustment is possible. We used the Anticipatory Postural Adjustments as a measure for indicating the planning influence of the performance the idea was that if APA were modulated with respect to the ID, then this was a strong indicator for the motion-pre-planning, otherwise, if APA were not modulated to the ID then a feedback was acting in adjusting the ongoing of the action. Our results showed that just for the shortest distances, APA onset were modulated with the ID, by reinforcing the idea that Fitt's law holds for movements basically pre-planned in advance.

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DYNAMIC, KINEMATIC AND EMG PARAMETERS OF SQUAT JUMP AND DROP JUMP

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Abstract

In many sports, vertical and drop jumps are an important exercise resource in an athlete's power training.This study aimed to establish the main dynamic and kinematic parameters that generate the efficiency of squat jump and and drop jump, and establish the EMG activation of leg and back muscles. In the experimental procedures, two elite athletes triple jumpers took part. M. gastrocnemius medialis is one of the most important muscles in the production of mechanical energy in the kinetic chain. This is a two-joint muscle and can transfer energy between its segments. One-joint muscles generate the initial mechanical energy for vertical jumps, whereas two-joint muscles control the intermuscular coordination and the final vertical impulse. In a drop jump from 25 cm the ankle joint sustains the highest loading, followed by the knee joint and the hip joint. Based on this information the training process can be far more accurately programmed and controlled in terms of power.

Key words: *biomechanics, dynamic, kinematic, EMG, vertical jump*

Introduction

The movement structures that occur in specific sport situations are associated with different inputs of eccentric and concentric muscle contractions. The aim of training is often to modify the eccentric muscle contraction in view of its neurological characteristics. A good understanding of the role of eccentric muscle contraction in sport activities facilitates adaptation through the application of apposite training resources. The eccentric-concentric cycle consists of muscle stretching due to an external force and muscle shortening in the second phase, i.e. a stretch-shortening cycle (Komi & Gollhofer, 1997). In the eccentric phase, a limited quantity of elastic energy accumulates in the muscle-tendon complex to be used in the second phase. This portion of elastic energy that is accumulated in the muscle is only available for a specific time. The available time depends on the life span of the cross-bridges and lasts from 15 to 120 milliseconds (Enoka, 2003). As regards the production of force, it is essential that the muscle develops more force and consumes less chemical energy during an eccentric contraction compared to a concentric contraction (Komi & Gollhofer, 1997; Enoka, 2003). The efficiency of an eccentric-concentric contraction also depends on the time of the transition. The longer the time, the less efficient is the contraction. In addition to the extent and velocity of the change in the muscle's length and the duration of the transition, the efficiency of an eccentric-concentric contraction largely depends on pre-activation. The latter defines the first contact of the foot with the ground. Pre-activation prepares the muscles for stretching and is manifested in the number of attached cross-bridges and the change in the excitability of ά-motor nerves. Both factors affect the short-range stiffness of the muscle. Greater muscle stiffness causes a marked extension of the ligaments and the tendon which, in turn, reduces the consumption of chemical energy in the muscle. The reduced consumption of chemical energy is particularly important in those motor situations where specific movements must be made at a high velocity (e.g. the action of the ankle joint in a sprint, the take-off action in long jump, high jump and triple jump).

In functional and anatomical terms, the main role in a vertical jump is played by the two-joint thigh muscles hamstrings. This muscle group includes: m. semimembranosus, m. semitendinosus and m. biceps femoris. In specific sport situations these muscles are responsible for the primary extension of the hip joint in a closed kinetic chain and for flexion of the knee joint. The length of the two-joint thigh muscle is highly variable, depending largely on the position of the knee and hip joints. Its efficiency is best manifested in conditions of the high angular velocity of the joints of lower extremities. For that reason, the thigh muscles play an important role in fast explosive moves of acyclic and cyclic types. In many sports, vertical and drop jumps are an important exercise resource in an athlete's power training. They enhance the eccentric-concentric muscle contraction of the lower extremities. At the same time, they are an indispensable measurement instrument in take-off power diagnostics. As regards their movement structure, vertical and drop jumps are similar to real motor situations in sports practice. Different test batteries are used to diagnose the explosive power of the lower extremities, either of a laboratory or a situational-field type. Bosco (1992) developed a classical protocol to monitor take-off power based on vertical jumps. Take-off power in concentric conditions of neuromuscular activity is measured by a squat vertical jump. Take-off power in conditions where the active muscles first extend (eccentric contraction) and then shorten (concentric contraction) is measured by drop jumps.

This study aimed to:

1. establish the main dynamic and kinematic parameters that generate the efficiency of squat jump and and drop jump;
2. establish the EMG activation of m. erector spinae. m. gluteus maximus, m. rectus femoris, m. biceps femoris, m. vastus lateralis, m. vastus medialis, m. tibialis anterior and m. gastrocnemius medialis in squat jump and drop jump.

Methods

In the experimental procedures, two elite athletes – triple jumpers – took part - M.Š.: age 29 years, height 173.5 cm, body mass 59.0 kg; and M. G.: age 21 years, height 181.4 cm, body mass 60.0 kg. The vertical jump measurement protocol was carried out in the Biomechanical Laboratory of the Peharec Polyclinic for Physical Medicine and Rehabilitation in Pula, Croatia. Each jump was performed three times. A system consisting of nine CCD SMART-e 600 video cameras (BTS Bioengineering, Padua) with a 50 Hz frequency and 768 x 576 pixel resolution was used for a 3-D kinematic analysis of vertical jumps. Kinematic parameters were processed by the BTS SMART Suite programme. A dynamic model featuring a system of 17 markers sensitive to infra-red light was defined (head, shoulders, forearm, upper arm, trunk, hips, thigh, shank, foot). The kinematic analysis revealed the following parameters of vertical and drop jump: take-off height, flight phase time, take-off phase time, eccentric phase time, concentric phase time, take-off velocity, angle in the ankle, knee and hip joints.

The dynamic parameters of vertical and drop jump were established by using two independent force plates (Kistler, Type 9286A). The sampling frequency was 1,000 Hz. The analysis was based on the following dynamic parameters: peak ground reaction force, force impulse and amount of work per 1 kg of body mass (concentric work J/kg). The ground reaction force was measured uni- and bilaterally. A 16-channel electromyography (BTS Pocket EMG, Myolab) was used to analyse electromyographic (muscle) activity (EMG). It consisted of two units: a mobile unit (HP Ipaq 4700) captured all EMG signals and transmitted them to the stationary unit using wireless technology (Wi-Fi). The EMG activation of seven muscles on the left and seven muscles on the right leg (m. gluteus maximus, m. rectus femoris, m. vastus medialis, m. vastus lateralis, m. tibialis, m. biceps femoris, m. gastrocnemius medialis) as well as one trunk extensor muscle (m. erector spinae) was monitored. Superficial electromyographic muscle activity was detected by means of bipolar surface electrodes Ag-AgCl (Ambu Blue Sensor SE – 00-S/50, Denmark), which were fastened to the specific location of a motor unit of each muscle, following thorough skin preparation. The electrodes were fastened by a qualified person. In the continuation of the experiment the recorded signals were filtered and smoothed. First, a Hamming high-pass filter was used at a 30 Hz frequency to eliminate the artefacts. Then, the signal was integrated with the RMS algorithm with a time base of 20 ms. A Hamming low-pass filter was used for further smoothing at a 10 Hz frequency. The statistical analysis of the results was processed with the SPSS statistical software (SPSS 15.0 for Windows, Chicago, IL).

Results and discussion

According to the standard test protocol (Bosco, 1992) a vertical jump is initiated from a stationary upright posture, with the knee angle measuring about 90°.This enables the elimination of the effect of elastic energy in the muscles and tendons and the effect of reflex mechanisms which boost muscle activation. The jump was performed with arms kept akimbo. The test measured the concentric component of speed strength. The measurement procedure was based on two separate Kistler force plates, Type 9286A. The jump height depends on the extensor muscles of the ankle, knee and hip joints. Based on the ground reaction force, measured by force plates, and the 3-D kinematic analysis (a system consisting of nine SMART video cameras) the following kinematic and dynamic parameters were investigated (Table 1).

Table 1. Dynamic and kinematic parameters of a squat jump

SQUAT JUMP	UNIT	A	B
Jump height	cm	45.8±0.5	37.7±0.6
Concentric time	ms	314±6	326±17
Concentric work	J/kg	6.5±0.2	5.4±0.4
Jump efficiency	cm/J	7.0±0.3	7.1±1.2
Peak power	W/kg	48.7±1.1	41.7±0.3
Flight time	ms	572±4	504±4
Take-off velocity	$m.s^{-1}$	2.37±0.3	2.30±0.3
Peak force	N	846±1.4	744±1.2
Generated concentric impulse	Ns	172± 3	154±6
Hip flexion	deg	84±2	71±2
Knee flexion	deg	89±2	90±4
Ankle flexion	deg	30±1	38±1

Table 1 reveal dynamic and kinematic parameters that generate the jump height. The key parameter is the take-off velocity which depends on the impulse force in the concentric phase, the peak ground reaction force (peak force) and power (W) per 1 kg of body mass. In all vertical jumps, a limiting factor is the time available for the execution of an explosive movement. The force generation time in the concentric phase ranges from 314 ± 6 to 326 ± 17 milliseconds. Some authors (Gollhofer & Kyrolainen, 1991; Bobbert et al., 1987) have demonstrated that squat vertical jumps largely depend on the contractile characteristics of muscles and considerably less on reflex mechanisms and pre-activation. The optimal knee angle ranges from 89° to 90° and the hip angle from 71° to 84°. These angles are important as the take-off action in the initial phase is associated with the action of the hip and trunk joint extensors. The final take-off velocity mainly depends on the knee and ankle joint extensors. Study subject A had an angular velocity of 514 °/s in their hip joint, 771 °/s in their knee joint and 878 °/s in their ankle joint. These angular velocities are slightly higher than those recorded in the research by Bobbert et al. (1987). Last but not least, it was established that, in terms of bilateralism, subject A had a deficit in the production of force with their right leg. The force impulse produced by their right leg was 14 Ns less than that produced with their left leg.

In a vertical jump with a dominant concentric component of explosive power (squat jump) (Figure 1), the take-off action is triggered by m. erector spinae and m. gluteus maximus, followed by m. vastus lateralis and medialis and completed by m. gastrocnemius medialis. The peak activation was established in m. gluteus maximus and m. gastrocnemius medialis (Figure 2). In a squat jump, the muscle activation follows the proximal-distal principle. The initial velocity of a vertical jump is generated by the trunk and hip joint extensors, followed by the knee extensors and, at the very end, plantar flexors. Throughout the take-off action, a relatively low activation is seen in m. rectus femoris. The results of subject A showed strong asymmetry in the activation of m. gluteus maximus and m. biceps, with left leg recording lower values. Subject B had poorer intermuscular co-ordination between two-joint and one-joint muscles. A low level of activation was recorded in m. gluteus maximus, m. vastus medialis and m. vastus lateralis, whereas a high level was seen in m. erector spinae, m. rectus femoris and m. gastrocnemius.

Drop jumps are an extremely efficient means to improve how the ankle muscles function in eccentric-concentric conditions. At the same time, they are used in take-off power diagnostics. The degree of loading in drop jumps is defined by the jump depth, the athlete's body mass, contact time and vertical jump height. The jumps are performed from a height of 20 cm to 80 cm. Jumps from a height of 80 cm or more constitute a risk of injury which is why they are usually warned against in training practice. These jumps put the bulk of loading on the plantar flexors and the knee and hip extensors. The landing must be performed in such a way as to prevent the heel from touching the ground. The bumping of the heel against the ground causes a rise in the ground reaction force of more than 100%. If braking in the eccentric phase cannot be performed by the ankle joint extensors, the task is taken over by the knee and hip extensors. However, in this case, the time of the transition from the eccentric to the concentric phase is substantially longer, thus negatively affecting the efficiency of the jump.

Figure 1. Squat jump.

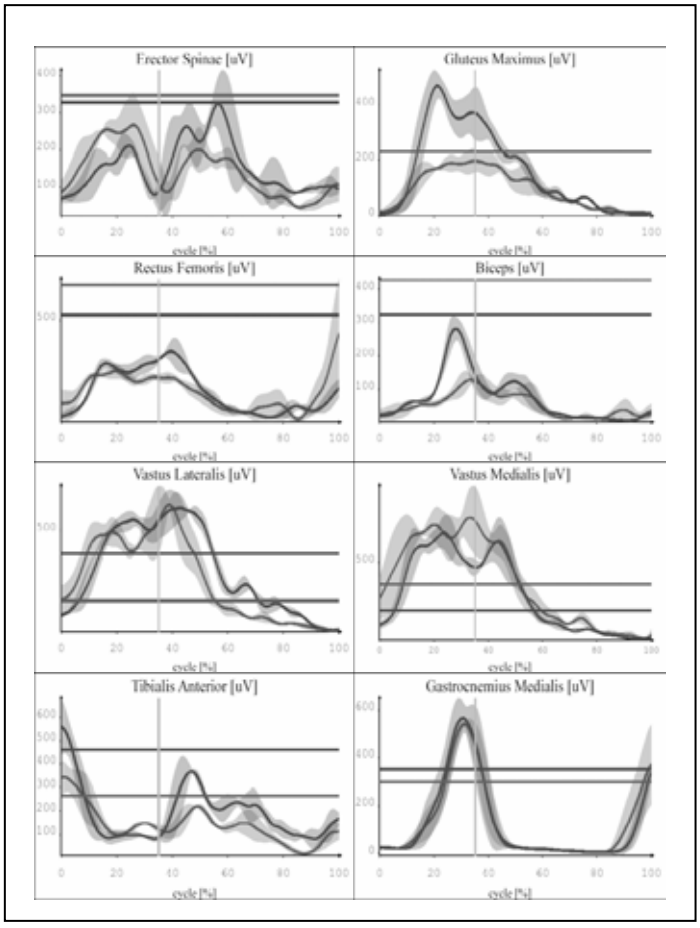

Figure 2. EMG activation of muscles in a squat jump.

A drop jump consists of the following phases: leaving the bench set at a specific height, flight, preparation for landing, ground contact, braking, eccentric-concentric contraction and vertical acceleration. Not only is the height of the bench important, but so too is the peak height of the body's centre of gravity during the flight phase. The pre-activation phase starts 100 milliseconds before the ground contact (Gollhofer and Kyrolainen, 1991; Dolenec, 1999). The function of the muscle pre-activation is to prepare the muscle for stretching. This pre-activation is secured by the concurrent activation of m. gastrocnemius and m. tibialis anterior. The short-range stiffness of m. gastrocnemius thus facilitates the accumulation of a higher quantity of elastic energy in the tendon and a smaller extension of the muscle (Dolenec, 1999). The purpose of drop jumps is to shorten the time of shock absorption which generates an optimum transition from the eccentric to the concentric contraction. The analysis of drop jump 25 cm was based on the following parameters (Table 2).

Table 2. Dynamic and kinematic parameters of a drop jump from a height of 25 cm

DROP JUMP –25 cm	UNIT	A	B
Jump height	cm	47.3±0.8	38.6 ±0.8
Ground contact time	ms	165±5	174±3
Eccentric time	ms	73±2	80±2
Concentric time	ms	92 ± 2	94±1
Concentric work	J/kg	5.1±0.2	4.3±0.1
Jump efficiency	cm/J	9.3±0.3	9.0±0.3
Peak power	W/kg	92.4±6.7	76.6±1.2
Flight time	ms	580±3	503±6
Take-off velocity	$m.s^{-1}$	2.78±0.1	2.65±0.4
Peak force	N	3654±108	3689±180
Eccentric impulse	Ns	161±4	151±3
Concentric impulse	Ns	164±1	141±2
Hip flexion	deg	26±1	29±1
Knee flexion	deg	56±2	61±2
Ankle flexion	deg	13±1	25±1

Contact time is one of the crucial parameters of drop jumps as it defines the efficiency of the transition from the eccentric to the concentric contraction. The contact time of the study subjects who performed a drop jump from a height of 25 cm ranged from 165 to 174 milliseconds. The ratio between the time of the eccentric and concentric phases of subject A was 44.2% : 55.8%, whereas that for subject B was 45.9% : 54.1%. Subject A expressed greater efficiency in braking after landing from a 47.3 centimetre-high jump. Some authors (Gollhofer & Kyrolainen, 1991) have shown that the pre-activation of plantar flexors is the most important mechanism in shortening the contact time in eccentric-concentric motor tasks.

Basically, the central motor programme improves and – through control of musculature activation – increases the short-range stiffness of the muscle-tendon complex of the lower extremities upon contact with the ground. This programme is responsible for synchronisation of the ankle joint flexors and extensors. The optimum pre-activation of agonists and antagonists prior to contacting the ground reduces the amplitudes of movement and shortens the eccentric phase. Consequently, a larger muscle force is generated, along with a lower consumption of metabolic muscle energy. The shortening of the ground contact time in a drop jump is mainly the result of the pre-activation of m. gastrocnemius, m. soleus and m. tibialis anterior (Gollhofer & Kyrolainen, 1991). The efficiency of the performance of drop jumps in subject A (this athlete is an elite triple jumper) compared to that in subject B is primarily reflected in the following parameters: a shorter contact time, a shorter eccentric phase, peak power (W/kg of body mass), a higher take-off velocity, a higher force impulse in the eccentric and particularly the concentric phase as well as a lower amplitude of movement in the knee and ankle joints. Short-range muscle stiffness is additionally manifested in the ankle joint since the amplitude of the movement of subject A was only 13°, whereas that of subject B was 25°. The peak ground reaction force, measured by two force plates (Kistler, Type 9286A), was 3654 ± 108 N in the case of subject A and 3689 ± 180 N in the case of subject B (drop jump from 25 cm). The peak ground reaction force and the peak force impulse were recorded in the eccentric phase.

The electromyographic method discloses important information on movement strategies in drop jump (Figure 3 and 4). During the pre-activation and eccentric phases, it is possible to establish the peak activation of m. erector spinae, m. rectus femoris, m. tibialis anterior and m. gastrocnemius medialis. In the efficient pre-activation of muscles during their preparation for stretching, the concurrent activation of m. gastrocnemius and m. tibialis anterior plays a particularly important role. The former muscle is an agonist and the latter an antagonist (Gollhofer & Kyrolainen, 1991). At the moment of contacting the ground, the highest EMG activation was recorded in m. rectus femoris, m. gastrocnemius medialis and

m. tibialis anterior. The conclusion of the take-off action (concentric phase) depends on the EMG activation of m. gluteus maximus, m. vastus lateralis and medialis and m. gastrocnemius. The concentric phase lasts for 92 ± 2 milliseconds and the impulse measures 164 ± 1 Ns. M. gastrocnemius medialis is one of the most important muscles in the production of mechanical energy in the kinetic chain. This is a two-joint muscle and can transfer energy between its segments.

Zajac (1993) established that one-joint muscles generate the initial mechanical energy for vertical jumps, whereas two-joint muscles control the intermuscular co-ordination and the final vertical impulse. In a drop jump from 25 cm the ankle joint sustains the highest loading, followed by the knee joint and the hip joint.

In sports practice and theory, the optimal performance of a drop jump has not yet been figured out. What is arguable is the optimal jump depth. There are three criteria concerning this point. The first is the jump height, the second the contact time while the third is the volume of the produced force. All of them stem from the requirements of specific motor situations in sport. In a sprint or a triple jump, the basic requirement is to develop great force within a very short contact time of 80 to 100 milliseconds. Therefore, in terms of kinematic and dynamic structure, athletic training must consist of drop jumps that maximally correspond to the movement structure of the relevant athletic discipline.

Figure 3. Drop Jump – 25 cm

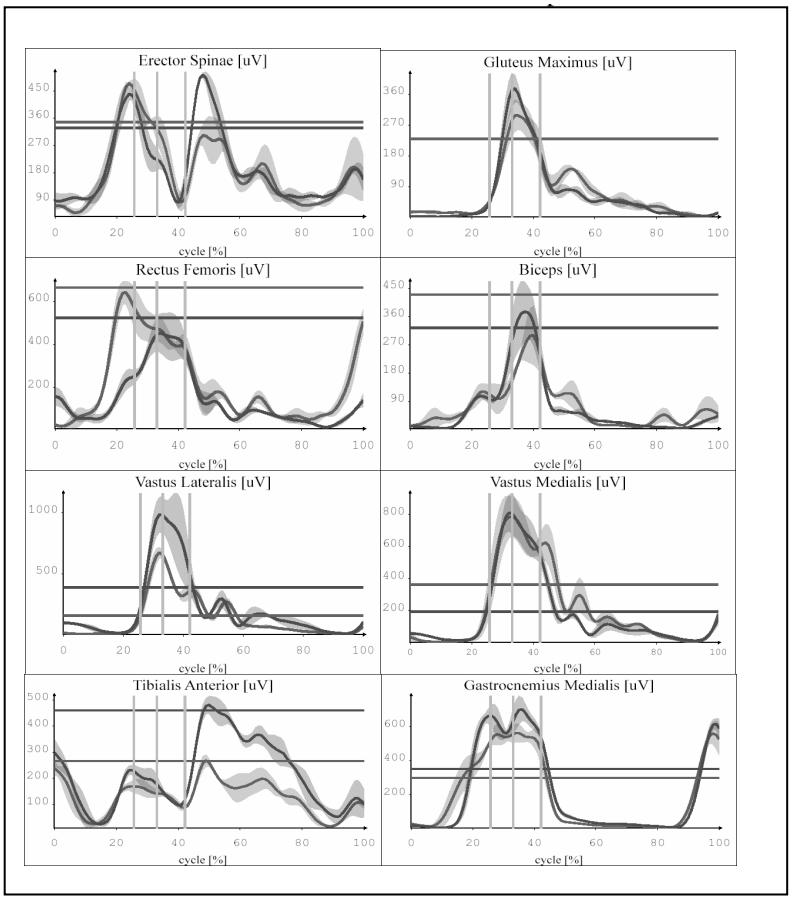

Figure 4. EMG activation of muscles in the drop jump

Conclusion

The biomechanical diagnostics of the explosive power of lower extremities is an extremely important element of monitoring modern athletes' training processes. The results of measuring different types of vertical and drop jumps provide us with fundamental information on the status and functioning of the neuromuscular system. Based on this information the training process can be far more accurately programmed and controlled in terms of power. Certain state-of-the-art technologies and measurement procedures for diagnosing explosive power have been presented, primarily as regards monitoring the dynamic and kinematic parameters of vertical and drop jumps.

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THE DIFFERENCES IN TOE-TO-TOE DISTANCE IN FIRST SINGLE SUPPORT PHASE OF ROTATIONAL SHOT PUT BEETWEN ELITE AND SUB-ELITE PERFORMERS

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Abstract

The aim of this study was to identify the differences between the arithmetic means of toe-to-toe distance in first single support phase of rotational shot put of the sub elite throwers and the toe-to-toe distance in first single support phase of rotational shot put of the elite throwers. The sample of examinees on basis on which this study was conducted constitute of trials of top shot putters realized on international official competition. The differences between arithmetic means and the descriptive parameters make it possible to conclude that toe-to-toe distance in first single support phase of rotational shot put of the elite throwers are less than toe-to-toe distance in first single support phase of rotational shot put of the sub elite throwers. The conclusions of this project are significant because they validate some of the previous theories on shot putting and reflect those that were not valuable. These conclusion do however provide valuable information for coaches and elite shot putters and should be used as a guideline for technical development.

Key words: *shot put, biomechanics, kinematics parameters*

Introduction

Optimal values of release parameters (release velocity, angle and height) are related to individual athletes' qualities (first by capacity of explosive power and length of the body) but also related to applying of appropriate shot-putting technique. The most important factor in shot putting is the release velocity. The release velocity depends on the magnitude and direction of the force applied to the shot, the distance over which the force is applied, and the duration of the action. The magnitude and direction of the force applied to the shot, the distance over which the force is applied, and the duration of the action are the outcome of the movements (and speeds) of several body segments – legs, trunk and arms. Each body segment takes part in two movements: turning around the proximal joint axis and movement together with the joint. The right hand velocity (similar to release velocity of the shot) equals the vector sum of the velocity of the shoulder joint and the arm. Serial organization and the transfer of the angular momentum along the kinetic chain involve the recruitment of particular body segments (what) into the movement at the correct time (when). Thus, this arises the following question: how should the individual movements be coordinated (what and when) to make the speed of the hand and the shot maximal. Same of the experts claim that the wide sweep of the free leg will help to maximize the rotary momentum of the rotational thrower as the rear foot touches down near the center of the ring and will assist in developing greater positive separation between the shoulders and hips during the power position. A long sweeping free leg refers to the non-support leg on a rotational thrower as he is making the turn and subsequent flight phase to enter the center of the circle. A wide sweep of the free leg will help to maximize the rotary momentum of the rotational thrower as he enters the flight phase and will assist in developing greater positive separation between the shoulders and hips at rear-foot touchdown. The correct execution of the free leg should be characterized by a great toe-to-toe distance (Figure 1), a wide radius about the free-leg hip axis, and a sweep that is low enough to the throwing surface to not disturb balance but high enough to optimize the effective radius of the leg. But, this movement pattern has yet to be confirmed experimetaly.

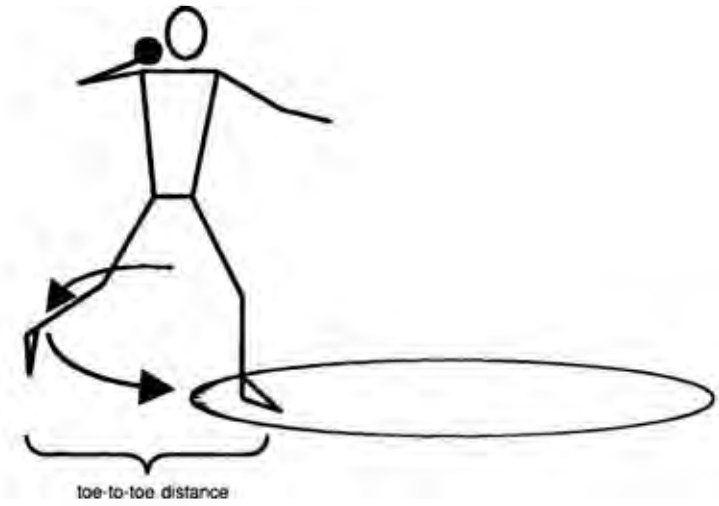

Figure 1. Toe-to-toe distance in first single support phase of rotational shot put (Young, 2003).

Accordingly, the aim of this study was to identify the differences between the arithmetic means of toe-to-toe distance in first single support phase of rotational shot put of the sub elite throwers and the toe-to-toe distance in first single support phase of rotational shot put of the elite throwers. The determination of these differences would actually help determine the moving standard of rotational shot put. Further, this would significantly help expand our knowledge about what thrower should do to be more effective. The basic hypothesis that was tested in this study was that significant differences existed between the toe-to-toe distance in first single support phase of rotational shot put of the sub elite throwers and the toe-to-toe distance in first single support phase of rotational shot put of the elite throwers.

Methods

The variable in this study is toe-to-toe distance in first single support phase of rotational shot put. The sample of examinees on basis on which this study was conducted constitute of trials of top shot putters realized on international official competition. According to purpose of experiment the information resource collected on two sub samples. The first sub sample which constitutes by the trails of the sub elite shot put performers (above 16 m, less than 17 m) fixed by set of 10 trails. The second sub sample which constitutes by the trails of the elite shot put performers (above 19 m, less than 20,44 m) fixed by set of 10 trails too. The performance has been recorded by two video cameras (mini DV, NV-GS200) operating at 50 frames per second positioned to provide 3D analyses. The collected video images were digitized using APAS (Ariel Performance Analyses System). The coordinates of 18 points, defining the 14-segmental model of human body, plus 1 point for describing the implement, were manually processed for each frame of the movement. Reference scaling frame was placed in the throwing circle before the training and the positions recorded for calibration purposes. The eight reference edges were used to define a global reference frame for data reduction. Transformation into 3D space was made by DLT (Direct Linear Transformation) method. The obtained 3-D coordinates of the digitized body and the shot parts were then filtered using Cubic Spline smoothing method. The collected data were processed by the program package Statistica. The variables included in the analysis were described (arithmetic means, standard deviations) by applying the module Descriptive statistics. The analysis was conducted on the basis of these data of the statistical significance of differences between arithmetic means of toe-to-toe distance in first single support phase of rotational shot put of the sub elite throwers and the toe-to-toe distance in first single support phase of rotational shot put of the elite throwers. For this purpose the method and the program for the analysis of differences between arithmetic means were used with the help of the module 't-test for independent samples'.

Results and discussion

Before the identification of differences defined by the aim of this study, descriptive statistical parameters of toe-to-toe distance in first single support phase of rotational shot put of the sub elite (group 1) and elite throwers (group 2) were determined. These parameters are presented in table 1.

Table 1. Descriptive statistical parameters of toe-to-toe distance in first single support phase of rotational shot put (LF - toe-to-toe distance in first single support phase of rotational shot put (cm), AS1 - arithmetic mean of the sub elite performers, AS2 - arithmetic mean of the elite performers, SD1 - standard deviation of the sub elite performers, SD2 - standard deviation of the elite performers).

	AS1	AS2	SD1	SD2
LF	130,0960	116,6760	12,87050	17,85713

The values of toe-to-toe distance in first single support phase of rotational shot put of the sub elite performers are enhanced than the values of toe-to-toe distance in first single support phase of rotational shot put of the elite performers. After determining the descriptive parameters, the statistical procedures were applied for the identification of differences between arithmetic means of the toe-to-toe distance in first single support phase of rotational shot put of the sub elite throwers and the toe-to-toe distance in first single support phase of rotational shot put of the elite throwers. This analysis will provide the answer to the main hypothesis in this study about the differences between the two series of kinematics' values in shot putting technique. The results of this part of the analysis are presented in table 2.

Table 2. Differences between arithmetic means of toe-to-toe distance in first single support phase of rotational shot put of the sub elite throwers and the toe-to-toe distance in first single support phase of rotational shot put of the elite throwers (t - t-test, df – degrees of freedom and p – significance of differences).

	t	df	p
LF	1,927940	18	0,069791

The tables of differences between arithmetic means and the descriptive parameters make it possible to conclude that toe-to-toe distance in first single support phase of rotational shot put of the elite throwers are less than toe-to-toe distance in first single support phase of rotational shot put of the sub elite throwers. All the obtained values are statistically significant at the level of 99%. The obtained t-values of differences between arithmetic means with eighteen degrees of freedom point to absence of the statistically significant differences between the values of toe-to-toe distance in first single support phase of rotational shot put of samples, that is, it was confirmed with big certainty that the samples had not been derived from two very different populations as regards the feature analysed. According to this, the difference is accidental, and it may be said, the differentiation between the populations of throwers was under the influence of certain factors. The main question is which factors affected the fact that the better throwers achieve enhanced values of release velocity. The reasons may be found among the other kinematics factors.

Conclusion

The aim of this study was to identify the differences between the arithmetic means of toe-to-toe distance in first single support phase of rotational shot put of the sub elite throwers and the toe-to-toe distance in first single support phase of rotational shot put of the elite throwers. The statistically significant difference between the arithmetic means of toe-to-toe distance in first single support phase of rotational shot put of the sub elite throwers and the toe-to-toe distance in first single support phase of rotational shot put of the elite throwers is the proof that the better throwers did not achieve enhanced values of toe-to-toe distance in first single support phase. Taking into account numerous factors that affect the release velocity one cannot be sure whether it was the kinematics or the biomechanic-related factors that affected such dynamics of the sports quality. In accord with this it would be interesting to start a new study that would answer the question which factors affected the fact that the better throwers achieve enhanced values of release velocity. The conclusions of this project are significant because they validate some of the previous theories on shot putting and reflect those that were not valuable. These conclusion do however provide valuable information for coaches and elite shot putters and should be used as a guideline for technical development.

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THE RELATIONSHIP BETWEEN SKIER'S LATERAL BODY GEOMETRY IN SLALOM TURNS AND DIFFERENT INCLINATION OF THE SLOPE

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Abstract

For skier it is very important to perform his or her turn technique with the same quality on different conditions of slopes. The aim of this research was to determine if there is a difference in lateral body geometry of a skier during slalom turns on steep, mild steep and flat part of the course. The sample was made of 18 slalom turns, recorded from three runs, executed by one promising Croatian junior female skier, age 15. The variables included in this analysis are selected by the way as the coaches perceive the skier during the turns: hip angulation, inclination, outside knee angulation and outside lower leg angulation. The difference between turns on different inclination of the slope was acquired by t-test analysis. From obtained results it can be concluded that there is a significant difference in subject's lateral body geometry in slalom turns performed on steep, mild steep and flat part of the course.

Key words: *Alpine skiing, slalom, body geometry, slope inclination, t-test*

Introduction

Alpine skiing is combined from five different technical disciplines: downhill, super giant slalom, combination, giant slalom and slalom. According to propositions defined by FIS (Federation Internationale de Ski), each of those disciplines is different in length of the course, vertical drop, inclination, number of gates, and distance between the gates. It also means that each of those disciplines is demanding different physical, technical and tactical preparation. Thus, from motor point of view, the skier has to be ready on various savor and different duration of muscular activities (Reid et al., 2007), while from the technical and tactical point of view a skier has to adjust his technique on different conditions of the course such as: inclination, length, configuration, quality of snow (Waibel, Huber and Spitzenpfeil, 2007). In this research a technique of the slalom turns, executed on steep, mild steep and flat part of the course will be analyzed.

Slalom is discipline where the course has to be set on slopes with vertical drop from 140 to 200 meters and the gradient of approximately 33% to 45%. The number of gates has to be from 55 to 75 for men and from 45 to 65 for ladies (+-3). The minimum width of the gates is 4 meters and a maximum is 6 meters. On the base of all this it can be assumed that for slalom race a skier has to be prepared on 1 minute of vigorous muscular activities, with constant and fast changing of direction. Besides that, a skier also has to be ready to adjust his technique of a turn on frequent transition from steep to flat parts of the course and opposite (Supej, Nemec and Kugovnik, 2005). Throughout the whole course every single turn must be performed as fast as possible (Gurshman).

The aim of this study was to determine if there is a difference in the skier turn technique, represented by lateral body geometry, while executing slalom turns on steep, mild steep and flat part of the course.

Methods

The subject of this study was one promising Croatian junior female skier, age 15. For the need of this study, 18 slalom turns, recorded from 3 runs, were analyzed. In each of those 3 runs, 2 slalom turns (left/right) are recorded on steep part of the course; 2 on mild steep part and 2 on the flat part of the course. Every pair of turns (left and right slalom gates), was placed symmetrically from the fall line. The video camera (25 Hz) was located down the fall line of the course, in projection that symmetrical separate right and left turns of a skier. The collection of video data was made during training on of the World Cup slalom course, Sljeme/Medvednica, in January 2008.

The variables included in this analysis are selected by the way as the coaches perceive the skier during the turns: hip angulation-HA, inclination-IN, outside knee angulation-OKA and outside lower leg angulation-OLLA (Supej, Kugovnik and Ivanek M, 2006). These variables are describing the lateral body geometry of a subject at the beginning of a slalom turn, so all of the parameters were registered at the moment when subject's tip of the outside ski was aligned with the turn pole. Namely, according to the relevant literature (Gurshman), since the final success of edging (which is highly related to the speed of the turn) depends on combination of ankle, knee and hip angulations and inclination, those are the angles that coaches primarily observe when they are standing on the bottom of the course, down with the fall line of the slope.

The collected video material was processed by advanced video analysis (2D) software (*Dart Trainer*). The obtained data were analyzed by *Statistic for Windows 7.0.* Basic descriptive parameters (mean, standard deviation, variance, minimum, maximum and range) and correlation coefficients were calculated. The difference between right and left slalom turns on different inclination of the course was analyzed by t-test analyses for independent sample.

Results

In Tables 1, 2 and 3, results of descriptive statistics for three different groups of six slalom turns, three right turns and three left turns, performed on steep, mild steep and flat part of the course, are presented. From obtained results it can be perceived that there are certain differences of mean values between each group. The largest range and variation of results are noticeable in variable *outside knee angulation* (OKA), for turns on steep and mild steep part, when for turns on flat part of the course the largest variation is registered in variable hip angulation (HA).

Table 1. Descriptive statistic of the slalom turns on steep part of the course

Descriptive Statistics (RL1All)							
	Valid N	**Mean**	**Minimum**	**Maximum**	**Range**	**Variance**	**Standard Deviation**
HA	6	150.8500	150.2333	151.4667	1.23333	0.4563	0.67552
IN	6	120.7167	118.5333	122.9000	4.36667	5.7203	2.39172
OKA	6	175.2500	164.0333	186.4667	22.43333	150.9763	12.28724
OLLA	6	131.4833	124.4000	138.5667	14.16667	60.2083	7.75940

Table 2. Descriptive statistic of the slalom turns on mild steep part of the course

Descriptive Statistics (RL2All)							
	Valid N	**Mean**	**Minimum**	**Maximum**	**Range**	**Variance**	**Standard Deviation**
HA	6	151.7833	146.0667	157.5000	11.43333	39.2163	6.26229
IN	6	126.7667	126.3667	127.1667	0.80000	0.1920	0.43818
OKA	6	175.1667	162.7667	187.5667	24.80000	184.5120	13.58352
OLLA	6	132.3167	125.7667	138.8667	13.10000	51.4830	7.17517

Table 3. Descriptive statistic of the slalom turns on flat part of the course

Descriptive Statistics (RL3All)							
	Valid N	**Mean**	**Minimum**	**Maximum**	**Range**	**Variance**	**Standard Deviation**
HA	6	139.3000	128.6000	150.0000	21.40000	137.3880	11.72126
IN	6	127.3500	126.4333	128.2667	1.83333	1.0083	1.00416
OKA	6	166.6500	164.7333	168.5667	3.83333	4.4083	2.09960
OLLA	6	142.6000	139.9000	145.3000	5.40000	8.7480	2.95770

From the results of correlation analyzes, that are showed in Table 4, it can be concluded that there is a significant relationship between some variables which describe the lateral body geometry of a subject during execution of a slalom turn. Namely, the variable *Inclination* (IN) is significantly correlated with variables *Outside knee angulation* (OKA) and *Outside lower leg angulation* (OLLA), which are also significantly correlated between them. According to that, it can be concluded that if a skier during the turn has larger inclination, the outside knee angulation will be greater and the outside lower leg angulation will decrease. It means that during the turn, when the subject provides greater inclination the outside knee is in technical better position and the ski is executing a clear edging.

Table 4. Correlation between all eighteen executions of a slalom turn

Correlations Marked correlations are significant at p < .05000 N=18				
	HA	**IN**	**OKA**	**OLLA**
HA	1.00	-0.14	-0.10	-0.35
IN	-0.14	1.00	**-0.50**	**0.58**
OKA	-0.10	**-0.50**	1.00	**-0.89**
OLLA	-0.35	**0.58**	**-0.89**	1.00

In Table 5the results of t-test analysis between slalom turns executed on steep and mild steep part of the slope are presented. From obtained results it can be noticed that there is significant difference between those two groups of turns in variable *Inclination* (IN). Obviously, according to the registered row data of angle values, the subject of this study performed a greater inclination in slalom turns on mild steep part of the course. As previously mentioned, from the technical point of view, it can be concluded that on mild part of the course she had a better positions of the body.

Table 5. The results of t-test analysis between slalom turns on steep and mild steep part of the slope

	Mean	Mean	t-value	df	p	Valid N	Std.Dev.	Std.Dev.	F-ratio	p
HA	0.33	0.43	-0.42	10.00	0.68	6.00	0.05	0.59	119.73	0.00
IN	**-1.17**	**0.50**	**-6.11**	**10.00**	**0.00**	**6.00**	**0.66**	**0.12**	**28.75**	**0.00**
OKA	0.24	0.24	0.02	10.00	0.99	6.00	1.05	1.16	1.22	0.83
OLLA	-0.47	-0.37	-0.19	10.00	0.85	6.00	0.92	0.84	1.18	0.86

T-test analysis of slalom turns on mild steep and flat part of the course (Table 6.) showed significant differences in variables *Hip angulation* (HA) and *Outside lower leg angulation* (OLLA). After analyzing the registered angle values it can be said that the subject during slalom execution on flat part of the slope achieves smaller hip angulation and smaller outside lower leg angulation.

Table 6. The results of t-test analyses between slalom turns on mild steep and flat part of the slope

	Mean	Mean	t-value	df	p	Valid N	Std.Dev.	Std.Dev.	F-ratio	p
HA	**0.43**	**-0.76**	**2.32**	**10.00**	**0.04**	**6.00**	**0.59**	**1.11**	**3.54**	**0.19**
IN	0.50	0.66	-1.30	10.00	0.22	6.00	0.12	0.27	4.96	0.10
OKA	0.24	-0.48	1.48	10.00	0.17	6.00	1.16	0.19	36.95	0.00
OLLA	**-0.37**	**0.84**	**-3.26**	**10.00**	**0.01**	**6.00**	**0.84**	**0.35**	**5.72**	**0.08**

Table 7. The results of t-test analyses between slalom turns on steep and flat part of the slope

	Mean	Mean	t-value	df	p	Valid N	Std.Dev.	Std.Dev.	F-ratio	p
HA	**0.33**	**-0.76**	**2.40**	**10.00**	**0.04**	**6.00**	**0.05**	**1.11**	**423.26**	**0.00**
IN	**-1.17**	**0.66**	**-6.29**	**10.00**	**0.00**	**6.00**	**0.66**	**0.27**	**5.79**	**0.08**
OKA	0.24	-0.48	1.66	10.00	0.13	6.00	1.05	0.19	30.17	0.00
OLLA	**-0.47**	**0.84**	**-3.28**	**10.00**	**0.01**	**6.00**	**0.92**	**0.35**	**6.76**	**0.06**

The last t-test analysis is made for groups of slalom turns on steep and flat part of the slope (Table 7.). From obtain results it is evident that those two groups of slalom turns are significant different in variables *Hip angulation* (HA), *Inclination* (IN) and *Outside lower leg angulation* (OLLA). According to that and after analyzing the measured angle values in those variables it is possible to say that the subject had a better lateral body geometry of a slalom turn execution on flat part of the slope. There she performs greater inclination and greater hip and smaller outside lower leg angulation, which is all important for enhanced edging during the turn.

Discussion and conclusion

From results obtained in this research it can be concluded that there is a significant difference in skier's lateral body geometry during execution of slalom turns on different inclination of the slope. According to the analysis of the turns on three dissimilar types of inclination - steep, mild steep and flat part of the slope, a subject performed technically the most cleanly slalom turns on the flat part of the slope. Namely, on flat part of the slope she moves her body forward and inward in the direction of the center of the future turn. This was accompanied with extension of outside leg with minimal or no knee angulation which aloud her to put the skis far a way from the centre of the mass. The consequence of that is more direct path of CM throughout the analyzed gates. Also, on flat part of the course a subject had a greater hip and smaller outside lower leg angulation. That allows her better edging and thus more efficient execution of the slalom turn. It can be concluded that the subject of this study has to adjust her technique on different configurations and changed conditions of the slope. Technique of the turns, registered on the less steep part of the slope, manifested through the recorded angle values, must also be applied on the more steep parts of the slope.

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BIOMECHANICAL DIAGNOSTICS OF KNEE JOINT CONDITION IN SPORT

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Abstract

This study involved 20 subjects divided in 3 groups (10 healthy subjects, 10 subjects with an ACL deficit). Kinematic and kinetic data were obtained through one-legged vertical jump, a motion which is very common in sport activities such as football. This motion comprises of concentric and eccentric component, meaning a preparation and performing the maximal take-off and finishing or stabilization in the knee joint, i.e. the landing, which is dominated by the work of one leg, the other one having no possible influence. The statistically significant difference between "healthy" and "ACL def." groups is the angle of flexion and extension during take off. This means that the proprioceptive system follows what happens in the knee joint and in the case of a danger, sometimes even unnecessarily, it reduces the range of motions in the joint trying to decrease the load and the risk. This study could provide an insight into the functional status of the knee joint during training and rehabilitation process.

Key words: *biomechanical diagnostics, knee joint, sports*

Introduction

The basic difference between a healthy and an injured knee is its stability. The stability of the knee joint is affected by the following: the shape of condyles, menisci, joint capsule and the surrounding muscles. If one or several elements are dysfunctional or injured, the stability of the knee joint is disturbed. Ligaments are the major stabilizers of the knee joint. The biomechanical complexity of the anterior cruciate ligament (ACL) is contained in providing of static and dynamic stability and proprioceptive biofeedback in the knee joint. ACL prevents the tibia from being pushed too far anterior relative to the femur. It also takes up 75% of the anterior force to the knee when fully extended, plus additional 10% of the load (over 90°) when knee is flexed. As a stabilizer, ACL has four major roles: it resists the anterior translation of the tibia, it prevents the hyperextension in the joint, at valgus (outside-in) force it is a secondary stabilizer reinforcing the medial collateral ligament (MCL) and controlling the rotation of the tibia at 0-30° femur extension, the latter representing the most important function of the ACL. The ACL defect causes this "screw-home" mechanism to fail. Screw-home mechanism relates to an external rotation of the tibia when the knee is extended; tibia glides anteriorly on femur; prolonged anterior glide on the medial side produces external tibial rotation, the "*screw-home*" mechanism. As a result, a tibial subluxation on the femur occurs. This function, ranging from 0-30°, is very important for side step and pivoting. Furthermore, the joint mechanism loosens which leads to the tibial subluxation on the femur and traction of the ligaments of the joint capsule. As a result, increased forces on menisci and joint cartilage occur. The possible occurrence of new and much heavier injuries of the structures in the joint, as well as the traction of the secondary stabilizers of the joint capsule, i.e. ligaments, increases with the late diagnosis and the beginning of the rehabilitation treatment. The studies show a statistical probability of 40% for an ACL rupture in persons with the primary diagnosis of the medial meniscus lesion. With those who have a lateral meniscus lesion, the probability is even higher and amounts 60%. Statistically, the highest probability for an ACL rupture, as much as 95%, is in persons with both menisci damaged. Except the above mentioned lesions, there has been noted through the monitoring the persons with the ACL deficit, a statistically significant occurrence of osteoarthritis. This study aims to analyse motions in the knee joint at given and controlled movements and loads, as well as to give a biomechanical assessment of the joint function with an ACL deficit. The obtained data could be used to optimize the rehabilitation program by choosing a proper reconstruction technique and appropriate physical therapy, thus bringing back a knee joint function faster and with better quality.

Methods

This study involved 20 subjects (10 healthy subjects and 10 subjects with an ACL deficit). The subjects were divided in 3 groups. The first experimental group comprised injured athletes (football players) doing the assigned tests using their injured leg, i.e. with the ACL deficit. The second experimental group comprised injured athletes (football players) doing the assigned tests using their healthy leg. The third, control group or a model group, comprised freshmen students (football players) from the Faculty of Kinesiology in Zagreb. All subjects had well developed motor abilities, approximately the

same anthropometric characteristics and were close to the same age. Kinematic and kinetic data were obtained through one-legged vertical jump, a motion which is very common in sport activities such as football. This motion comprises of concentric and eccentric component, meaning a preparation and performing the maximal take-off and finishing or stabilization in the knee joint, i.e. the landing, which is dominated by the work of one leg, the other one having no possible influence. The same motion pattern can be seen during the sudden direction change when leading the ball on the field. One leg is primarily in charge of performing the activity and shifting the body position in space, while other leg controls the ball independently. Kinematic data of knee joint angulations at valgus and varus, internal and external rotation and flexion and extension, together with the ground reaction forces in direction forward-backward, right-left and vertical, were obtained for the duration of 4 seconds (100% of the cycle). The middle of the cycle (51%) is regaining the contact with the ground at landing. By the use of ELITE BTS system with 8 cameras and a "Kistler" platform for measuring ground force reaction, 60 x 40 cm, kinematic and kinetic data were registered and processed. Due to a large amount of data, the method of data mining was used for finding and picking out the most relevant information. Data mining is the process of sorting through large amounts of data and picking out relevant information. It is usually used by business intelligence organizations, and financial analysts, but is increasingly being used in the sciences to extract information from the enormous data sets generated by modern experimental and observational methods. It has been described as "the nontrivial extraction of implicit, previously unknown, and potentially useful information from data" and "the science of extracting useful information from large data sets or databases." Finally, by the use of correlation analysis and standard deviation we will try to determine the resemblance of the single data between groups and the resemblance of the data within groups.

Results and discussion

Graph 1 shows an example of average value of vertical ground reaction force of the model group or the control group. Graph 1b shows an average standard deviation of a single phase of vertical jump for the same group. The examples for the remaining two groups are shown in the same manner. Since the control group has been well trained and homogenous, the differences between this one and the other two groups were expected, just as it is shown in the graphs. The differences appear in the form of a signal, i.e. a motion pattern, and the numeric values in a single phase of the vertical jump. An expected difference is noticed between the model group and the ACL deficient group. These groups represent the signals of completely healthy and well functional or trained knee joint (Graphs 1a and b), in contrast to an ACL deficient knee joint in the acute phase of injury (Graphs 3a and b), ACL being one of the most important components for normal functioning, especially under sports loads. Less expected results were noticed in relatively high correlation or high correlation coefficient between the groups "healthy" and "ACL def.", especially kinematical variables valgus-varus and rotation angle, as well as kinetic "fore-aft." and medial-lateral force (Table 1, 2, 3, 4 and 5).

Some authors give as a justified or unjustified reason that a negative functional adaptation of the healthy leg occurs, and after a thorough inspection, and we agree. The negative functional adaptation or functional and biomechanical diminishing of a healthy joint happens when the level of physical activity drops down due to an injury of the opposite knee joint and also when the functional load level of the healthy knee joint doesn't go over the level of an injured knee joint. In these situations and without a visible reason, the functional status of the healthy knee joint could drop beneath the average level. The only statistically significant difference between "healthy" and "ACL def." groups is the angle of flexion and extension during take off. This means that the proprioceptive system follows what happens in the knee joint and in the case of a danger, sometimes even unnecessarily, it reduces the range of motions in the joint trying to decrease the load and the risk. This way, during the take-off phase the angle of flexion decreases whereas during the jump phase the angle of extension decreases (Table 2 and 3).

Table 1. Correlation coefficients and comparison of kinetic signals of the ground reaction force between the healthy, the ACL deficient group and the model group. Signal correlation relates to the take-off phase.

Fore-aft. force	Medial-lateral force	Vertical force	Group
0,45	0,40	0,27	healthy
0,48	0,37	0,34	ACL def.

Table 2. Correlation coefficients and comparison of cinematic signals of the knee joint angle between the healthy, the ACL deficient group and the model group. Signal correlation relates to the take-off phase.

Valgus-varus	Rotation	Flexion - extension	Group
-0,02	0,09	0,68	healthy
0,32	-0,20	0,46	ACL def.

Table 3. Correlation coefficients and comparison of cinematic signals of the knee joint angle between the healthy, the ACL deficient group and the model group. Signal correlation relates to the jump phase.

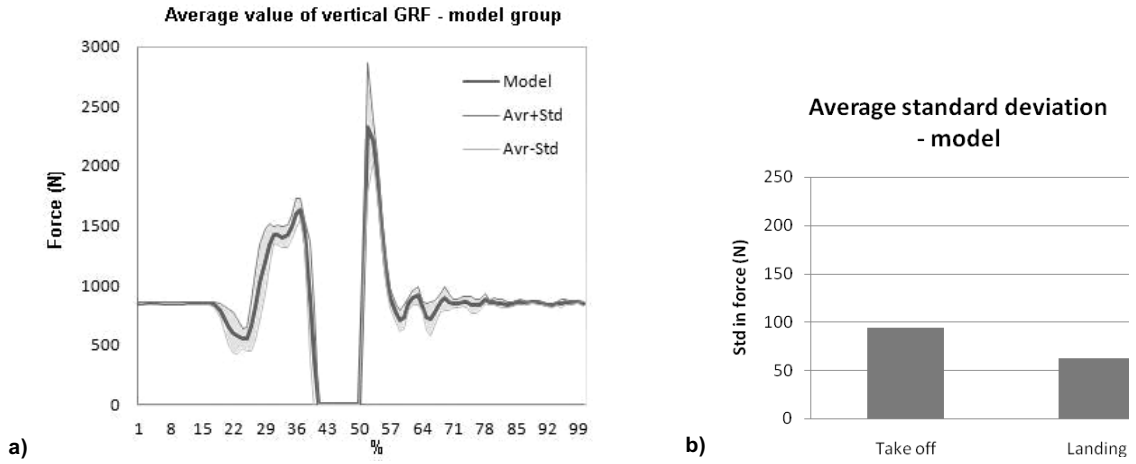
Valgus-varus	Rotation	Flexion - extension	Group
0,56	-0,84	0,88	healthy
0,48	-0,72	0,17	ACL def.

Table 4. Correlation coefficients and comparison of kinetic signals of the ground reaction force between the healthy, the ACL deficient group and the model group. Signal correlation relates to the landing phase.

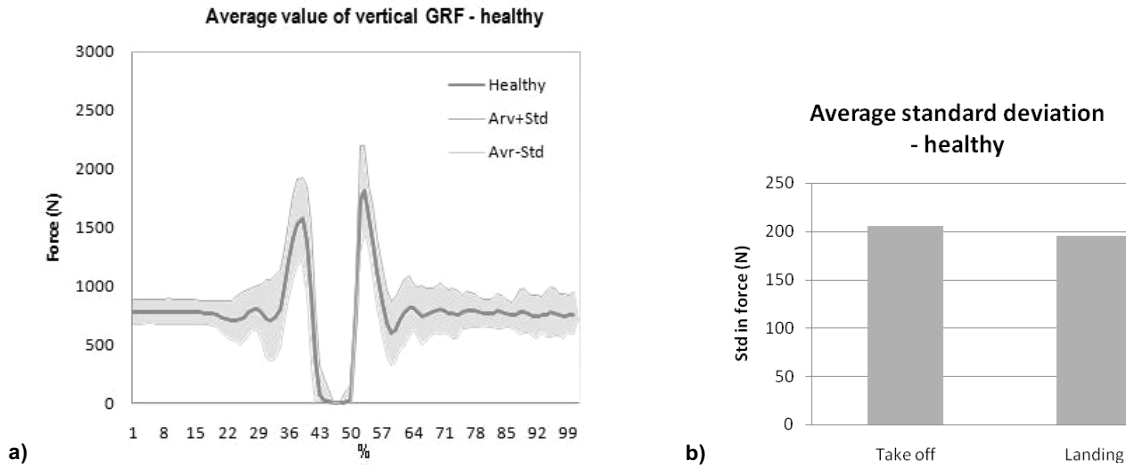
Fore-aft. force	Medial-lateral force	Vertical force	Group
0,45	-0,19	0,98	healthy
0,61	0,10	0,91	ACL def.

Table 5. Correlation coefficients and comparison of cinematic signals of the knee joint angle between the healthy, the ACL deficient group and the model group. Signal correlation relates to the landing phase.

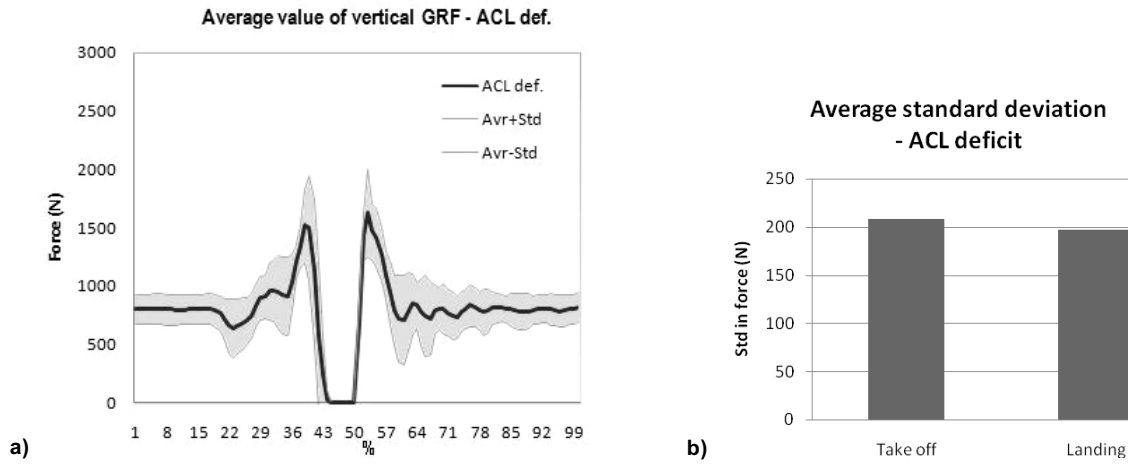
Valgus-varus	Rotation	Flexion - extension	Group
0,36	0,56	0,98	healthy
0,83	0,63	0,95	ACL def.



Graph 1. Average value and standard deviation of vertical force of vertical jump in model group (a) and average standard deviation of a single phase of vertical jump (b).



Graph 2. Average value and standard deviation of vertical force of vertical jump – healthy (a) and average standard deviation of a single phase of vertical jump (b).



Graph 3. Average value and standard deviation of vertical force of vertical jump – ACL deficit(a) and average standard deviation of a single phase of vertical jump (b).

Conclusion

This study could provide an insight into the functional status of the knee joint during training and rehabilitation process. To optimize the above mentioned processes, additional ones should be engaged.

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INFLUENCE OF THE MAXIMUM STRENGTH OF DYNAMIC KNEE STABILIZERS ON THE FIELD OF MOVABLE BALANCE

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Abstract

The identifying of the strength of dynamic knee stabilizers on the field of motoric balance was performed on the sample of 130 examinees aged 18 to 20. The sample of examinees consisted of the students from the first year of the Faculty of Sport and Physical Education (Sarajevo University). The main aim of the research was to identify the influence of the strength of dynamic knee stabilizers on the common criterion balance. This research showed that predictive system of variables has middle statistically important multiple correlations on the criterion variable balance, while there are no statistically important partially regressive coefficients on the criterion variable on the field of motoric balance.

Key words: *regression analyse, biodex, balance*

Introduction

Knee is a modified moving joint through which the 12 muscles pass, making it stable and functional (Worell, Perrin and Denegar, 1989). Knee extension is performed primarily by contracting the quadriceps femoris muscle which consists of rectus femoris and vastii medialis, intermedius and lateralis. Rectum femoris is a two-joint muscle that goes over the hip and knee. Its leading role is in the knee extension that can grow their size by hip extension, even though supination tends to put rectus femoris into useless, elongated position (Kazazović and others).

Knee flexion is performed by the group of the knee tendon muscles, which consists of the muscle biceps femoris and semitendinosus. All of these muscles go over the hip joint except the short top part of the biceps. The muscle gastrocnemius helps the tendon group of muscles during the knee flexion. The muscle plantaris also goes on the posterior side of the knee but its little trasnversal section (CUT) makes its contribution to the knee flexion unimportant. Knee stabilizers present the groups of the muscles that are vital for the knee joint.

Balance with the eyes opened is defined as the ability to maintain the balancing position receiving the information from the field of vision about the position of the body relative to reference point.

Searching the field of balance is the least explored field, so this research tries to concentrate on it. Field of balance was the subject of some of the researches of the uninjured people in the field of balance (Rozzi and others, 1999; Kollmitzer, 2000; Blackburn and others, 2000; Eils and Roesnbaum, 2001; Bruhn and others, 2004; Vrcić and others, 2007), in the field of front and back part of upper leg (Ziegler and others, 2002; Brown and others 1994; Klopfer and others, 1988; Ghena and others 1991) as well as in the researches of sportspeople (Tabaković, 2003).

The aim of this research is to identify the influence of the strength of knee stabilizer on the field of motoric balance on the sample of the freshmen (Faculty of Sport and Physical Education, University of Sarajevo) aged 18 to 20.

The change of motoric capabilities is determined by genetic potential, biological growth and development, so it is possible to influence the improvement of the potential of the motoric capabilities by well structured training technologies.

The influence of the strength of dynamic knee stabilizers on the certain field of motoric balance is not so well-known. To identify this would be very important for the physiological science, especially for practical work. That is the reason this research concentrates on the predictive system on the common criterion BALANCE.

Methodology

The sample of examinees consisted of the freshmen from the first year of the Faculty of Sport and Physical Education, Sarajevo, aged 18 to 20. This sample was selected according to the special results they had on the tests of motoric capabilities. The number of examinees was 130.

For identifying the state for estimation of knee stabilizer muscle performance, the Biodex isocinetic test was used. Isocinetic testing of bone structure represents an important diagnostic method because it is adjusted to the individual in order to measure biomechanic parameters. Isocinetic dynamometer is used to measure the strength, peak moment,

generated strength as well as the range of the joint movement and distribution of the strength in the series of motions (Kannus and Yasuda, 1992).

In this research, the sample of the predictive variables for estimation of dynamic knee stabilizer maximum strength consists of the scope of eight (8) measuring indicators: maximum moment of the left leg extensor force-EXTLEF, maximum moment of the right leg extensor force-EXTRIG, maximum moment of the left leg flexor force-FLXLEF, maximum moment of the right leg flexor force- FLXRIG, total work of the left leg extensor - EXFLTW, total work of the right leg extensor- EXRGTW, total work of the left leg flexor –FXLFTW, total work of the right leg flexor-FXRGTW.

Testing the balance was performed using the following apparatus (Biodex balance system). Biodex Balance System measures the general index of stability, index anterior/posterior and index medial/lateral. Defining the limits of the stability was performed using the completely stable base and progressive changing of stability level. A very good bio-feedback graphics made the process of testing easier.

The sample of criterion variables for estimating the field of motoric variables in this research consisted of the scope of three indicators: the whole balance index-OVSIN, Anterior/Posterior Index-APSIN, Medial/Lateral Index- MLSIN.

The data got from the research were processed using the programme system for multivariate data processing. Analyses were performed using the programme SPSS 12.0.

Regressive analyse was applied in order to identify if there is any influence of dynamic knee stabilizer strength on the field of motoric balance.

Results

Analysing the results (see Table 1), you can see the regression analyse of criterion variable (BALANCE) in the field of variables of dynamic knee stabilizer strength and it offers enough information about the influence of applied variables of dynamic knee stabilizer strength on the criterion variable.

Common variability of predictive system variables is described with R SQUARE = 20%, while the coefficient of multiple correlation is RO= .45. which represents the connection of predictive system variables with the criterion. Multiple correlation is important on the level Sig. = .00

Table of results 1. Regressive analyse of criterion variable BALANCE in the manifest field of dynamic knee stabilizer strength.

RO	R Square	Adjusted R Square		Std. Error of the Estimate	
. 455	. 207	.155		. 91944750	
	Sum of Squares	df	Mean Square	F	Sig.
Regression	26,709	8	3,339	3,949	.000
Residual	102,291	121	,845		
Total	129,000	129			

Analysing the influence of the individual-partial (Beta) regressive coefficient (Table of results 2), it can be seen that there is no statistically important influence on the criterion variable (BALANCE) of any of the predictive system variables.

Table of results 2. Individual-partial results of regressive analyses of predictive system strength knee stabilizer on the criterion variable BALANCE.

Variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
EXTLEF	,002	,008	,084	,265	,791
EXTRIG	,008	,007	,329	1,125	,263
FLXLEF	,017	,012	,422	1,449	,150
FLXRIG	-,005	,011	-,110	-,416	,678
EXLFTW	,002	,002	,332	1,206	,230
EXRGTW	-,002	,001	-,452	-1,767	,080
FXLFTW	-,002	,002	-,360	-1,274	,205
FXRGTW	,001	,002	,131	,495	,622

Discussion and conclusion

Analysing the parameters in details, it can be seen that now we have statistically important multiple correlations, as well as there is no statistically important partial regressive coefficient from the predictive system of variables on the criterion variable balance. Taking these facts into consideration, it can be concluded that the prediction- prognosis of the influence of the predictors on the criterion variable can be made only with the help of all systems of predictive variables.

As the basic causes for not getting statistically important Beta regressive coefficients (i.e. individual influence of the given variables of dynamic stabilizer strength on the criterion variable BALANCE), we take evenly important influences of variables of dynamic stabilizers strength on the field of motoric balance.

During the performance of the balance test on the Biodex Balance System, the examinee standing in the upright position had the task to maintain the balanced position on the base of the information from the visible field about the position of the body relative to the reference point. Maintaining balanced position acquired balanced activation of the muscles of knee stabilizers of both legs. As a consequence, you can realize that the examinees who didn't have misbalance in relation between agonists and antagonists of knee stabilizer muscles, achieved better balance, i.e. better stabilizing index coefficient.

On the base of presented values of the regressive parameters of multiple correlation analyze and Beta regressive coefficients, it can be concluded that prediction-prognosis of the influence of predictive system variables on the criterion variable BALANCE, can be better performed with the help of the whole system of predictive variables, in relation to the reliability that can be obtained with the help of partial (Beta) regressive coefficients, i.e. partial influence of the predictive variables on the criterion.

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DYNAMICS OF SPECIFIC KINEMATICAL INDICATORS IN INDIVIDUAL RHYTHMICAL UNITS (RJ) AT THE HURDLE RACE - 60 METERS, WOMEN

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Abstract

Structural analysis of kinetic motion in short-distance hurdle race sprint (60 or 100 meters) enables to show us details and its practical and harmonic handling what completely determines a standard of an athletic performance. It includes crouch start, running to the first hurdle, crossing the hurdle (take off, flight, stride place after the hurdle), hurdle race, run down the last hurdle. All the activities are subject to one another and deficiencies are reflected in a motional unit as a whole – in a hurdle race.

An integral factor is the specific rhythm of running characterized by high dynamics as well as the stability of kinematical and dynamical structures of the kinetic motion. Fixed conditions of a hurdle sprint (running to the first hurdle 13 m, distance between hurdles 8,5, and height of the hurdles 84 cm) enable to increase the speed only through the 8 start up strides on the first hurdle, increase of the three unequally long stride rate and increasing of getting through the hurdle stride (running over the hurdle)

High standard of utilization of complex motoric skills into individual rhythmical units (stamping behind the hurdle, practising three interhurdle strides and running over the hurdle) with gradual increase of their speed and stability on the track, is an expectation for increasing of the athletic performance.

Time duration of rhythmical units about 1 second or faster (60 m hurdles/4 RU, 100 m hurdles/9 RU) create expectations for the total time to be 7,70 – 8,00 s /60 m hurdles and 12,50 – 13,00 s /100 m hurdles.

Key words: *kinematic indicators, rhythmical units, hurdle race, women*

Aim

The aim of this report is to reveal structural deficiencies at a top hurdle runner on the basis of analysis of chosen indicators in rhythmical units in hurdle race 60 m and soft run. The revealed deficiencies enable us to objectify an intraindividual programme for future improving of the athletic performance.

Methodic

The centre of the work consists in realization of 60 m flat sprint and 60 m hurdle sprint at a top runner M.B. Empirical data were obtained on the basis of Locomometre usage.

The measurement was taken in Elan, Bratislava – Athletic hall, 8.8.07 in connection with preparation for the World Championship in Osaka.

The sport form, culminating at that time, of the runner was shown in Osaka where she set up a new Slovak record for 100 hurdle race – 13,04s.

Figure 1 The Principle of Measurement

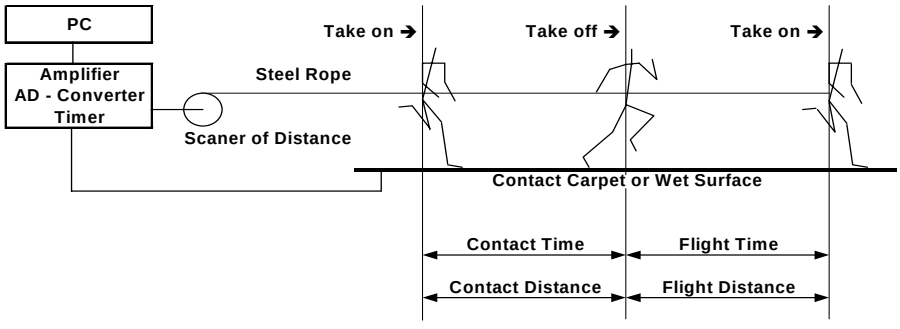

Figure 1. Measure methodic

A device for kinematical parameters measurement belongs to computer diagnostically devices based on "on line". Measure principal is based on measuring of closed and opened (contact and flight time) circuits and in measuring of a track.

The step length is scanned through scanning of electric impulses separately between contact and flight. The total time on the measured distance is computed by track scanner impulses. The device measures time characteristics with accuracy for 1 ms and length indicators with accuracy for 0,5 cm.

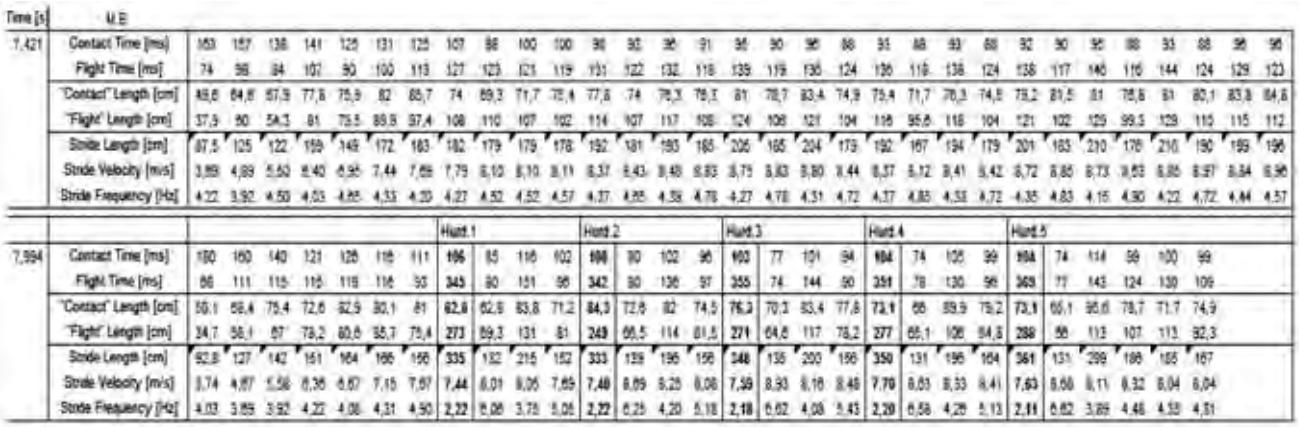

Chart 1. Dynamics of specific kinematical parameters

Selected kinematics markers	Rhythmical units				
	1. Rhytm. unit	2. Rhytm. unit	3. Rhytm. unit	4. Rhytm. unit	5. Rhytm. unit
Length of hurdle stride (cm)	310	315	345	325	358
Length place of take off ahead hurdle (cm)	195	210	220	200	200
Length place of take on beyond hurdle (cm)	115	105	125	125	158
Percentual proportion length of take off ahead hurdle and take on beyond hurdle from total hurdle stride (%)	62,9% 37,1%	66,6% 33,6%	63,7% 36,6%	61,5% 38,5%	55,8% 44,2%
Rhythmical unit (s)	1,13	1,06	1,03	0,97	
Frequency of 3 steps between hurdles (Hz)	4,95	5,21	5,37	5,31	
Frequency of hurdle stride (Hz)	2,21	2,22	2,18	2,19	
Frequency average of steps in rhythmical unit (Hz)	4,13	4,45	4,58	4,51	
Speed average in rhythmical unit (m/s)	7,785	8,152	8,318	8,247	
Steps number at running to the first hurdle (number)				8	
Running to the first hurdle (s)				2,18	

Chart 2. Dynamics of specific kinematical indicators in individual rhythmical units in hurdle race 60 m.

An overview of scanned kinematical parameters in soft sprint let us express the opinion about the length of contact at the accelerated run phase where monitored runner reaches 88 – 96 ms what is a good indicator.

In the stride rate and mainly in frequency there are potentional parameters that could be helpful, with more effective application, in hurdle conditions to increase the growth of an athletic performance.

It is shown that monitored kinematical parameters in hurdle conditions have a large variability what informs us about a low stability and backlogs in the area of possibility of more effective utilization of speedo-power qualities in rational hurdle motions techniques.

There are certain deficiencies resulted from the analysis of dynamics of kinematical indicators in individual rhythmical units in 60 m hurdle race (fig. 2). These absences (deficiencies) interfere to reach more distinctive performance growth in a hurdle sprint. The speed in a rhythmical unit as an integral specific indicator informs us about the level of harmonic handling of individual kinematical parameters at the realization of asymmetric lengths of 3 strides and a hurdle stride.

Progressive dynamics of frequency 4 rhythmical units (1,13, 1,06, 1,03, 0,97s) is a positive one but it is necessary the first unit to be realized at 1,02 s and the second at 1,02 s and the third under 1 s. This requirement could be reached with higher stability of stride length.

The best American hurdle runner´s stride length is 319+/-15, the place of take off 209 +/-14 and stride place after the hurdle 110+/- 0,17 cm (Garett and Voisin 1990). The stride rate and inter-hurdle stride rate are a part of limiting kinematical parameters. The monitored hurdle runner has big backlogs in both parameters. The stride rate of 3 strides is about 4,95 – 5,37 Hz (world top runner 5,4 – 5,6) and the hurdle stride rate 2,18 – 2,22Hz (world top runner under 2,0 Hz). It is shown that with improving of parameters there is suggestion to increase the speed in rhythmical units below 1 s and with its stabilization there is possibility to achieve a distinctive improvement of an athletic performance.

Discussion and conclusion

Kinematical analysis of motion structure has revealed certain deficiencies in individual rhythmical units. It will be necessary to transform acquisitions in individual conditional skills into the highest speed of elementary and then complex hurdle motions.

This aim requires raised frequency of impulses in the area of sprint hurdle drill. This ensures a higher stability at the optimal speed.

The main goals of the training process in the Olympic year:

- Improvement of hurdle stride techniques
- To increase the stride rate inter hurdles
- To stabilize the speed of rhythmical units at 1 s or faster (0,96 – 1,02 s)
- To increase the level of the acceleration phase by the hurdle speed
- To increase the level of the hurdle speed and endurance
- To increase the level of explosive demonstration
- To increase the level of dynamic flexibility – mainly a hip joint
- To increase the level of the total power and endurance readiness

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ALPINE SKIERS' SPECIAL FORCE TRAINING CONTROL

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Abstract

The aim of this study is to estimate the validity and reliability of the force and speed exercises as a traditional means of the control over the sportsmen's training in mogul. The experiments have shown that many exercises are not sufficiently informative for "competition result". The author offers the original methods to measure the forces of coxal, hip and shin muscles of Alpine skiers, reflecting the specific acting managing the downhill. It is established that the studied methods have the signs of validity ($r=0.45-0.55$, $p<0.05$) and reliability ($r=0.90-0.91$, $p<0.05$). On the methods applied the studying showed the features of the sportsmen and sports women's force and speed readiness in different Alpine ski sports and mogul.

Key words: *Alpine ski sport, mogul, special force training, control*

Introduction

The high profile in the Alpine-skiing progress (in downhill, super giant, slalom giant, and slalom special) and in such a ski Freestyle as Mogul, is the muscle force training for the lower extremities of sportsmen. The muscles of lower extremities when downhill have two basic functions simultaneous. First is in the maintenance of weight of all the other part of Alpine skier's body with loads added when downhill, overcoming of hill irregularities. Second is the downhill control due to the loading of skis on edgings, to form the curved motion path of all the "skier – ski" system which is set by placing of gates on the ski line or snow knolls in mogul.

Therefore, necessary are the special force training of Alpine skiers and the control for the muscular force preparation of their lower extremities, as an obligatory component of training in Alpine ski sport and mogul. Such preparation is usually conducted in the preparatory training period of Alpine skiers and realized with the various force exercises. By quantitative results of such exercises the strongest sportsmen set the control standards for all other Alpine skiers.

But the issue is more often aside: how full and reliable do results of control exercises show the features of sportsmen's legs muscular acting when downhill?

Relying to this, we put forward the following scientific hypothesis. It was supposed that with the means of the pedagogical control and on the specially developed measuring methods it is possible to establish the effect of sportsmen's force and speed readiness on the results of competitions.

For our hypothesis confirming, we made the attempt to estimate the validity and reliability of the control exercises developed by us on the theory of tests.

Method

We used the method of dynamometry to study the forces of the following three groups of sportsmen's leg muscles.

1. Examined in joint action were the force of medial hip muscles making the angulation of a hip (musculus gracilis, obturatorius, adductor longus, adductor brevis, adductor magnus, adductor minimus, pectineus) and the force of muscles rotating a hip (musculus obturatorius internus, piriformis).

To measure the force of the specified muscular groups, mechanical spring dynamometers were used, the total error in measurement methods was under 5%. The measurement data of muscular tractive force *"M"* calculated as moments under the formula:

$$M = \boldsymbol{F*L},$$

F is the maximal indication of a dynamometer in any attempt. The hip adductor force was fixed in decanewtons (dn) and the force of muscles rotating a hip in newtons (n).

L is the muscular force moment reach; it was measured in meters (m).

The hip-length as the adductor reach was measured from the head of the greater trochanter (trochanter major) to the femur lateral epicondyle (condilus lateralys).

The shin-length as the reach for hip-rotating muscles was measured from femur lateral epicondyle (corpus tibiae condilus lateralys) to a medial malleolus (malleolus medialis).

2. The traditional force and speed exercise of hip-expendor and shin-expendor (musculus quadriceps femoris) in the program "The high standing broad jump" has been changed by us as follows. The examinee in a jump starting position could stand on a special foundation unusing long flexor muscles of feet (musculus peroneus longus) and long flexor muscle of great toe (abductor hallucis, flexor hallucis brevis). Such moving exercise shows the better correlation with real conditions for the Alpine skiers' force actions when downhill in rigid boots. The height of a high jump was measured with the tape-measure device.

Our investigation was held directly during autumn and winter competitions. The measurement data were processed with methods of mathematical statistics.

Results

Examined were 48 male and 34 female Alpine skiers and 36 male and 25 female mogul competitors, at the age of 18-21. The summarized experiment data as the correlation coefficients of control exercises and downhill time are shown in Tables 1 and 2.

Table 1. The summarized correlation outcomes of sportsmen's force trainings and competitions

Sport	Downhill	Super giant	Slalom giant	Slalom	Mogul
100R	**0.35**	**0.36**	**0.37**	**0.37**	**0.15**
Lj	-0.25	-0.26	-0.29	-0.35	-0.26
10 Lj	-0.22	-0.25	-0.27	-0.32	-0.31
Sguat	**-0.23**	-0.24	-0.25	-0.26	-0.37
Aoth	**-0.41**	**-0.46**	**-0.50**	**-0.53**	**-0.57**
Roth	**-0.39**	**-0.47**	**-0.61**	**-0.67**	**-0.69**
HJ	-0.20	**-0.33**	**-0.35**	**-0.9**	-0.18

Indicated in Table 1: 100R - 100 meter running; Lj - long jump; 10 Lj - ten long jumps from one foot to another; Standing squat-squatting; Aoth - angulation of thigh; Roth - Rotation of thigh; HJ - High jump from the special foundation.

Table 2. The summarized correlation outcomes of sports women's force trainings and competitions

Sport	Downhill	Super giant	Slalom giant	Slalom	Mogul
100R	0.36	0.36	0.37	**0.40**	0.14
Lj	-0.24	-0.25	-0.27	-0.25	-0.12
5 Lj	-0.22	-0.25	-0.27	-0.22	-0.13
Sguat	-0.23	-0.23	-0.24	**-0.28**	-0.23
Aoth	**-0.42**	**-0.46**	**-0.47**	**-0.51**	**-0.57**
Roth	**-0.39**	**-0.42**	**-0.43**	**-0.46**	**-0.54**
HJ	-0.32	-0.34	**-0.40**	**-0.46**	-0.14

Indicated in Tables 1 and 2: bold-faced are the valid correlation coefficients when confidence probability is $p \geq 0.95$.
The reliability level of all valid correlation coefficients is not less than $r=0.95$, $p \geq 0.95$.

Discussions and conclusions

Our biomechanical analysis of fulfilled techniques in Downhill and Mogul showed the Alpine skiers' specific actions on downhill control undoubtedly connected to the characteristics of exertion and relaxation in leg muscles. These circumstances should help to form the control trainings which estimate the level force and speed readiness of Alpine skiers before a competitive season. The data of our experiment with Russia's qualified Alpine skiers have shown numerous unsolved problems in this direction.

Established is the fact that the most part of practiced tests which estimate the level of sportsmen's force and speed readiness does not meet even the lowest requirements showed to validity tests. This implies the application of similar tests not only does not give the necessary information of sportsmen's readiness, but also confuses trainers.

We consider that the performed study allows estimating the validity and reliability of the original techniques to control the changes in sportsmen's force and speed readiness in different Alpine ski sports. As a result of the experiments first appeared the opportunity to establish seriously a level of the readiness in snowless and competitive periods, therefore to control training.

It is significant that the validity of our tests is not as high as the theory of tests demands. But account must be taken that moving activity of Alpine skiers is realized in very difficult conditions determined by necessity of downhill control on a various relief, on the high speeds when different placing of gates Downhill and knolls in Mogul. This implies the information on a level of only force and speed abilities of an Alpine skier does not determine all his competitive opportunities, it is important but partial. It is necessary to create the whole complex of metrological indices for control the Alpine skiers readiness.

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COMPARISON OF BACKHAND AND FOREHAND TENNIS SHOT OF A TOP LEVEL PLAYER

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Abstract

Sport technique analysis, especially of tennis shots is highly important in player's performance. Because each player has his/her personal style and different quality of basic shots – forehand and backhand, it is useful to have more precise knowledge and information. With the help of three dimensional analysis and software SIMI MOTION we are able to compare forehand and backhand, achieve more accuracy and improve sport performance.

Key words: *3 dimensional biomechanical analysis, sport technique, tennis shot*

Introduction

Technique of tennis shots is very important in tennis performance and that is why it should be good analysed. However, there is still something what is unknown and changeable in personal tennis style. Of course, each player has different quality of basic shots – backhand and forehand and with the help of 3 D biomechanical analysis we can compare both of them and achieve more accuracy and different points of views.

Aim of the study

To achieve more precise knowledge and information which can be applied in sport praxis.

Methods

Two basic tennis shots – backhand and forehand of top level tennis player in age of 21 were recorded by two synchronized video cameras. This creates three dimensional space which is real and very clear for understanding of each tennis shot. Three dimensional biomechanical analysis with the help of software Simi motion 3D allows to find exact values of kinematic parameters. They are trajectories, angles, velocities and accelerations of each body segment. These main segments (points, joints) were taken into the consideration: head, left arm, right arm, left elbow, right elbow, left wrist, right wrist, left hip, right hip, left knee, right knee, left ankle, right ankle. But for purposes of our study we prefered segments on dominant (right) shoulder, elbow, wrist and two racket positions. For footwork analysis we recorded right and left ankles. Monitoring of all kinematic parameters can be realized in axis x, y, z directions and as absolute value. In sport testing then axis x represents forward – backward movement, axis y represents lateral movement and axis z represents vertical movement.

Results

Individual hitting technique is already stabilized at age of 21 and shots of one player have very common characteristics. There are interesting differences among tested tennis shots. Although sport performance and precision of shots are comparable and almost the same, hitting technique of each shot is realised.by specific way. Using 3 D biomechanical analysis we can explain better results at backhand comparing to forehand.

Backhand shot (Figure 1) is hitting the ball at time 0,704 s and his big advantage seems to be very high acceleration of racket (red line is steep enough). Secondly, there is ability of player to make correction in time 0,1 s before contact phase (velocity decrease) and be better prepared for the shot. Figure 2 recorded time of forhand shot (0,763 s) which is contact time during the shot and all values achieved higher levels. This confirms that forehand is better shot and stronger tennis weapon of this player. Also player is able to make correction by playing forehand shot in time about 0,1 s before contact time but it looks more gentle than in previous shot.

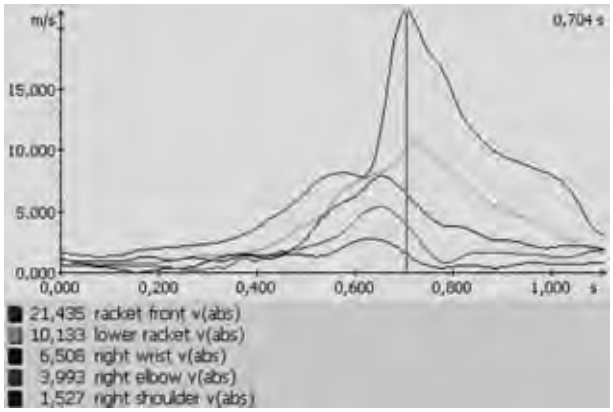

Figure 1. Velocity of dominant hand and racket at tennis shot backhand

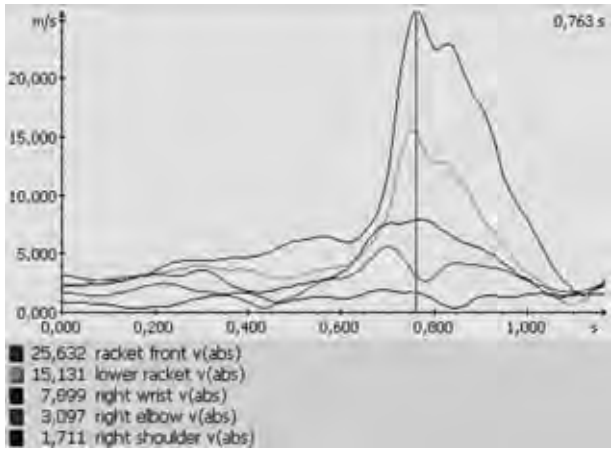

Figure 2. Velocity of dominant hand and racket at tennis shot forehand

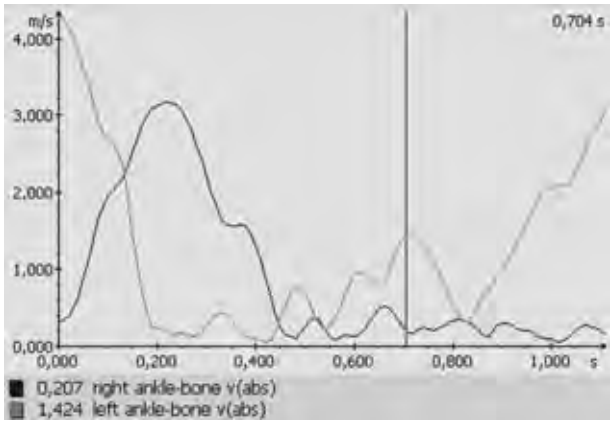

Figure 3. Footwork – velocity during backhand shot

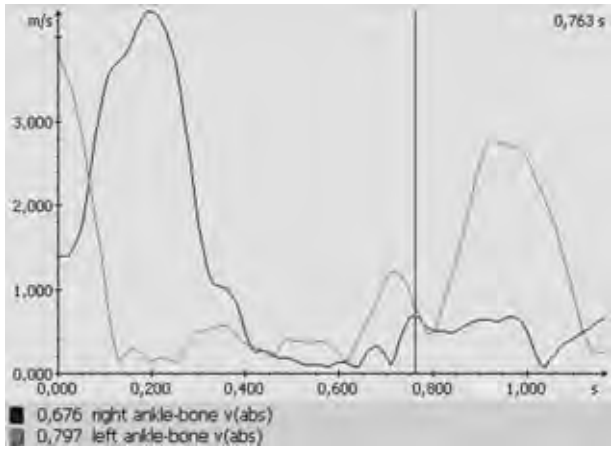

Figure 4. Footwork – velocity during forehand shot

Precise and fast footwork (velocity of both ankles) during preparing phase is visible at both tennis shots in Figure 3 and 4 but initial faster movement must be stabilized in certain time before shot (decrese of speed). It is important and clearly seen that in both recorded cases stabilisation work is done properly and in contact time lower velocity values had been achieved.

Finally, Figure 5 and 6 present high accelerations in time about 0,05 s before hitting the ball but quite big difference is in deceleration after this moment. By using backhand with both hands decrease is not so dramatic (racket values are 28,842 and 36,345 m/s^2). Forehand playing only with dominant right hand brings lower racket values (20,019 and -30,065 m/s^2). The reason for doing such decrease is accuracy of prepared shots.

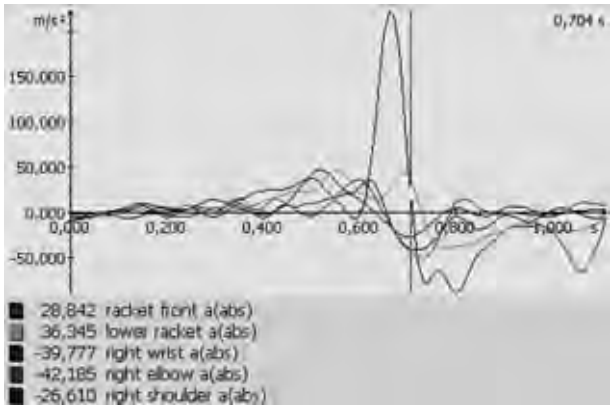

Figure 5. Acceleration of dominant hand and racket during tennis shot backhand

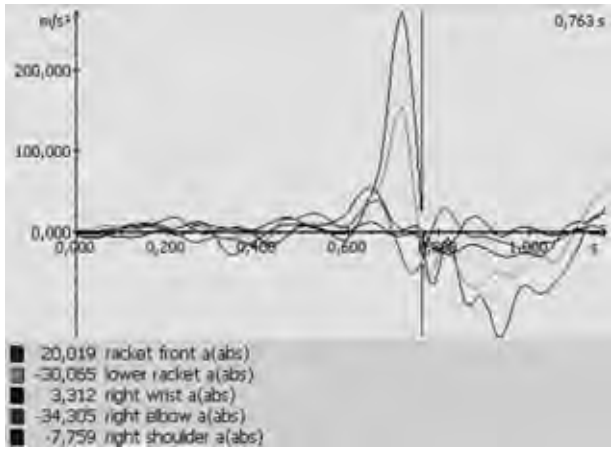

Figure 6. Acceleration of dominant hand and racket during tennis shot forehand

Conclusions

All recorded parameters are so precise that they can not be visible by using only own eyes. Based on this, we can confirm that 3D biomechanical analysis is an excellent mean for diagnostics of tennis shots. Further, it is worth to have individual access and there is posibility improve own personal style.

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A NOVEL METHOD FOR TESTING NEUROMUSCULAR FUNCTION

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Abstract

The purpose of this study was to evaluate a novel methodology for testing neuromuscular function. Muscle strength tests have been a standard form of testing muscle function in sports and exercises, as well as in other movement-related sciences for several decades. Maximum muscular forces and the temporal patterns of their exertions have been employed to assess both the neuromuscular function in general, as well as the efficacy of various interventions. The standard strength tests are typically based on long-lasting (~3-5 s) maximum isometric and isotonic contractions of relevant muscle groups. In the present study we evaluated two types of force profiles based on brief maximum and sub-maximum contractions, with the peak force (PF), and the rates of force development (RFD) and relaxation (RFR) as dependent variables.

The subjects were 19 male physically active university students. Their body mass was 77.9 (7.5) kg, while their body height was 1.83 (5.8) m. Subjects sat on a bench with a hips and thighs fixed by belts. The lower leg was attached to a force transducer by a wrist band and fixed into position corresponding to 90º of the knee angle. They were tested on the following tasks: (1) rapid exertion of maximal isometric contraction (MVC – standard strength test), (2) exertion of a series of discrete sub-maximum brief force pulses (BFP; forces exerted above 40%, 60% and 80% of Fmax), and (3) exertion of consecutive maximum contractions (CMC) at the frequencies within a full physiological range (i.e., 0.67-2.67Hz). The subjects were also tested several functional tests based maximum muscular.

The results suggested high reliability of all applied tests. BFP revealed approximately constant RFD/PF and RFR/PF ratios across series of BFP of different PF. Regarding CMC, the dependent variables remained constant across within the most of the tested frequency range. PF obtained from CMC demonstrated a strong linear relationship with MVC. Finally, the independent variables obtained from BFP and CMC proved to be better predictors of maximum functional performance than Fmax and RFD obtained from MVC.

We conclude that both BFP and CMC could be developed into standard tests of neuromuscular performance that could potentially replace standard strength tests. Particular advantage of the evaluated tests could be that they would involve only few trials (BFP could require a single contraction, while CMC a single series based on self-selected frequency), that would not require exposing subjects to sustained maximum contraction. Finally, the evaluated tests could provide a higher predictive power regarding the functional performance, as well as a higher sensitivity regarding testing various training, rehabilitation, or pharmacological procedures.

Key words: *tests, neuromuscular function, MVC, RFD*

PHASING AND VARIABILITY IN RHYTHMIC MULTILIMB TASK

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Abstract

Multilimb rhytmic tapping on specified frequency was investigated in 8 subjects. For the purpose of this study data from two of them were analyzed. Relative phasing, performance asymmetry of the limbs and overall variability of movement was assessed. Coupling in antiphase mode was heavier to sustain, large variability was seen across the tasks and coordination modes.

Key words: *multilimb coordination, relative phase, timing consistency, variability*

Introduction

Since seminal publication of Kugler et al. (1980) which defined theoretical frame for understanding movement coordination on the base of Bernstein insights and nonlinear dynamics, dynamical systems theory became probably most influential and dominant approach in motor control and learning. Another clasicall publication from Haken et. al. (1985) brought in forefront collective variable, called relative phase between limbs, which became main dependent measure in rhythmic coordination. Relative phasing between the limbs was conceptualized in an equation of motion model known as Haken-Kelso-Bunz model. The model was drawn from theory of nonlinearly coupled oscillators and self-organization based on Haken's work in synergetic (Haken, 1977), consequently coordination was interpreted in the light of evolving processes of pattern formation and self-organization. Thus, whole new experimental and theoretical frame of reference was built on in-phase (0˚) and anti-phase (180˚) coordination patterns defined as most stable in bimanual coordination. Movement paradigm of the basis of which HKB model was built became known as interlimb rhythmic coordination. Observing rhythmically coordinated movements was an opportunity to look at the intrinsic coordination patterns or coordinative attractor states. Patterns and attractors could be different which is defined by most common feature of interlimb coordination - maintaining or losing stability of coordination pattern. The key variable for assesing this feature is standard deviation of mean relative phasing between coordinated limbs. Stability in the same time defining exactly opposite concept which is, most common issue in dynamic patterns theory and probably in motor control in general, known as variability (Newell and Corcos, 1993). One of the most frequent question in multilimb coordination research is how constraints, ranged from cognitive and perceptual to neuromuscular, modulates coordinative stability, induce variability, respectively? Hypothesis that coalition of constraints most strongly influences stability has been popular recently (Li et al., 2004; Oullier et al., 2005). Interaction between mentioned constraints was investigated (Carson, 2004; Temprado et al., 1999) but the most interesting question - the role of directional constraint in maintaining the stability of rhythmic motor behavior is not answered fully. It has been shown in bimanual movements that mirror symmetrical movements in transversal plane are more stable than asymmetrical ones (review in Swinnen, 2002), while the coordination in sagittal plane with nonhomologous limbs is pretty different. Baldissera et all. (1982) showed that cooordination between hand and foot on the same side is much harder to perform in nonisodirectional mode (e.g. when limb segment moves in the opposite direction). Similar research on direction dependence of pattern stability has been repeated (Jeka and Kelso, 1995; Swinnen 2002; Sallese and Temprado, 2005) but there is still lack of the sudies which adressed stability (or causes of variability) in multilimb coordination patterns where there are more than two limbs engaged.

Methods

Eight subjects in a mean age of 25 years participated in the study. Participants were instructed to perform tapping with hands and feet simultaneously in saggital plane (up and down oscillations) on a frequency of 1 Hz, paced by auditory metronome. All participants were right-handed and without musical experience. Two experimental conditions were required. In the first condition feet moved together (in-phase pattern) while hands move opposit one from another - one upward the other downward (antiphase pattern). In the second experimental condition hands were coupled together while feet moved separated. Subjects had copper electrodes placed on the soles of their shoes and on the fingers of their gloved hands. The electrodes were connected to the analog-digital data acquisition card (DAQ Card 700, National Instruments, Austin Texas). Subjects sat at the desk and placed forearms on the top of the desk where the board with two contact copper plates (10x10 cm) was set, the other board was set on the floor and under the participant's feet, respectively.

When the subject contacted the copper plate, an electrical circuit (5 V) was closed which provided a time and duration of contact. Trials were collected for 60 s on sampling frequency of 100 Hz. The signal was acquired via LabVIEW 6.1 data collection software and after processing stored as ASCII file. Phasing was estimated as follows: $\varphi_i=((t_i^N-t_n^P)/(t_{i+1}^P-t_n^P))x360$ where t_i^N and t_i^P was the time of the strike of the preferred (P) or non-preferred (N) hand or foot for the ith cycle (Volman, 2002; Donker et al., 2001).

Performance asymmetry index (AI), the absolute value of difference between preferred and non-preferred hand or foot was calculated following AI=|(P-N)/(P+N)|x 100 (Larkin, 1993). Phase fluctuations were established via interactive graphs in time series. Because writing of specifically designed software for calculation of phasing relations between the effectors was not finished at the time of preparation of this article, two subjects was accounted and their data were calculated by hand, using common spreadsheet software.

Results

Estimates of mean relative phasing and standard deviations of relative phases for both subjects are shown in table 1. It could be seen from table1 that standard deviations, as a main measures of variability, of second subject are larger than those of the first subject. Size of range also confirms that finding. But overall, greater variability in both subjects could be found in limb pair which performed anti-phase movement, no matter whether that were hands or feet. Performance asymmetry index as a measure of symmetry of strike duration or timing consistency, shown in table 2, also revealed variability of performance. If we compare asymmetry index for feet and for hands - it was larger, in three of four measures, for feet than for hands.

Table 1. Relative phasing of homologous limb

Hands in-phase feet anti-phase (sub1, 2 – subject 1 and 2)						
subject (1, 2)	sub1 Mean (SD)	sub2 Mean (SD)	sub1 Min	sub1 Max	sub2 Min	sub2 Max
Phi hands	2,46 (8,32)	61,42 (45,21)	-19,76	20,12	0,00	159,05
Phi feet	115,61 (170,63)	14,24 (65,68)	-264,31	355,87	-204.98	102
Hands anti-phase feet in-phase (sub1, 2 – subject 1 and 2)						
subject (1, 2)	sub1 Mean (SD)	sub2 Mean (SD)	sub1 Min	sub1 Max	sub2 Min	sub2 Max
Phi hands	171.58 (46.38)	246,44 (221,83)	-21,34	194,30	101,00	298,00
Phi feet	-27.03 (33.50)	13,81 (94,88)	-175,61	25.01	-199,94	182,98

Table 2. Performance asymmetry index of homologous limb

Hands in-phase feet anti-phase (sub1, 2 – subject 1 and 2)						
subject (1, 2)	sub1 Mean (SD)	sub2 Mean (SD)	sub1 Min	sub1 Max	sub2 Min	sub2 Max
hands	-1,73 (4,56)	34.21 (52.17)	-9,30	6,64	-56.97	206
feet	-18,64 (34,70)	2.65 (58.86)	-70,82	22,00	-88.62	102
Hands anti-phase feet in-phase (sub1, 2 – subject 1 and 2)						
subject (1, 2)	sub1 Mean (SD)	sub2 Mean (SD)	sub1 Min	sub1 Max	sub2 Min	sub2 Max
hands	-3.82 (12.27)	26.03 (57.77)	-23.54	35.87	-118.05	102
feet	-6.95 (26.74)	27.74 (55.18)	-69.22	63.00	-51.12	105

In real data time series we can see relatively stable hands performance of the subject one (figure 1) but also periods of instability with shift to out-of-phase in feet movement (figure 2). That could also be seen in relative phase time series (figure 3) where feet phase wandering is visible. By simply visualizing the graph, phase transition (i.e. an abrupt switch from one coordination mode to another), or shift to out-of-phase could be observed. We considered leaving the range of ±45˚ as a shift or phase transition. Overall number of cycles in all modes considered to be shift to out-of-phase or phase transition ranged from 4 to 70%.

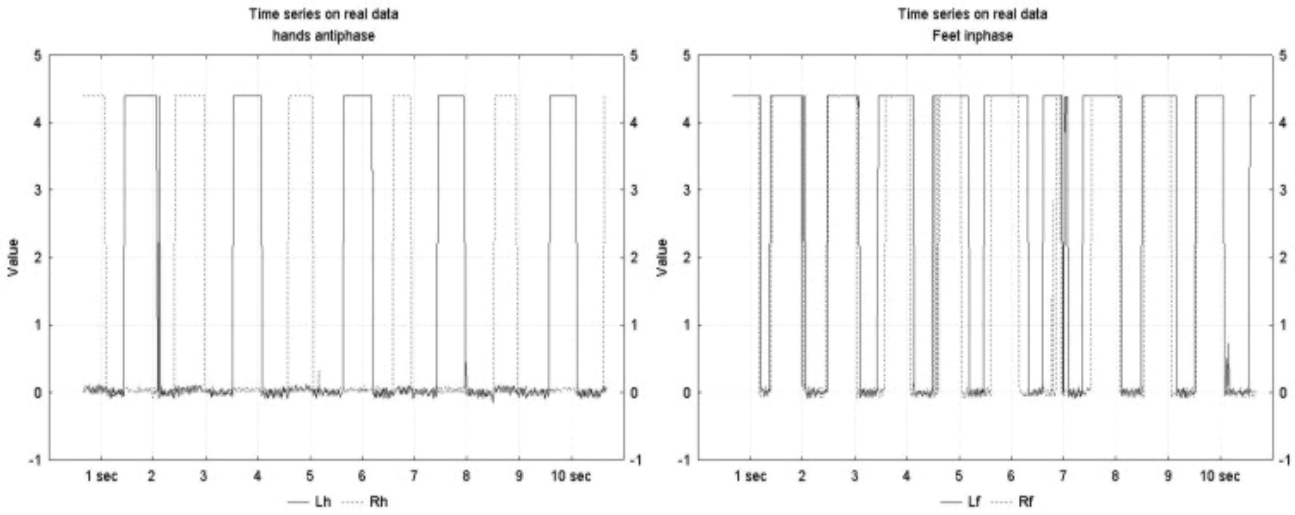

Figure 1. and 2. time series on real data from subject 1

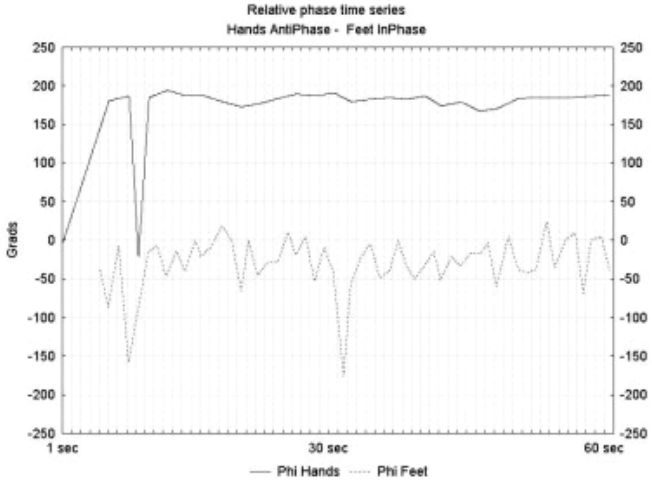

Figure 3. Relative phase time series

Discussion

The aim of this preliminary study was to examine stability, phase relationships and timing consistency between the homologous limbs (hand to hand and/or foot to foot) in multilimb rhythmic coordination tasks. We examined the dynamics of complex multilimb rhythmic movement patterns and tested the stability of these patterns. Several constraints appear to have influence on shown coordinated behavior. Baldissera et al., (1982), as mentioned earlier, demonstrated the role of the mutual direction between segments of limb as the factor that influences stability. It is obvious that in more complex movement patterns directionality becomes even more important. Although we hypothesized that only directional constraint modulates stability of the task in saggital plane, it has been shown that the role of attentional constraint (cognitive) should not be underestimated. Limbs in antiphase mode were attracted to more stable in-phase mode, which caused instabilities, partly as a product of cognitive attempts to sustain movement in opposite mode. Neurobiological studies involving auditory and motor coordination have already shown that the less stable syncopation patterns were associated with a greater activation of brain areas than more stable synchronization patterns (Mayville et al., 1999, 2001). Also, behavioral studies have shown that pattern stability and attentional demands are strongly connected (Temprado et al., 1999). Complex interplay between different constraints resulted in randomized fashion of appearance of phase wandering or phase transition. Perceptual and attentional processes along with the duality of the task – producing simultaneous movement of the limb segments in maintenance of two different coordination modes heavily influenced the stability of the movement. The fact that antiphase mode was affected heavier prove well known fact that this is less stable coordination mode. Variability was also seen in timing, some authors (Keele & Ivry, 1987; Franz et al., 1992) show that common timing

processes exist between tasks within a subject, which is also confirmed here – subjects had similarly large performance asymmetry indexes through tasks. Tapping behavior performed by different effectors was investigated in several studies, Wing (1977) demonstrated clock variance decreased with limb size but also that the variance in the movement period was a function of particular effector which explaines some results in the present study. Observed increased variability between effectors, especially seen in antiphase mode, could be interpreted by Turvey et al., (1986, 1989) findings that increase in the asymmetry between the effectors cause greater motor variance.

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COMPARATIVE KINEMATICS ANALISYS OF SUCCESSFUL AND UNSUCCESSFUL PERFORMANCES OF *BASKET TO HANDSTAND* ON THE PARRALEL BARS

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Abstract

Basket to handstand belongs to groups of highly evaluated (D) and respected elements in artistic gymnastics. The aim of this paper was to define the most appropriate conditions for an efficient performance of this element. The analysis of 15 successful and 15 unsuccessful performances *basket to handstand* on parallel bars, performed by elite gymnasts, has shown the average results of the angles in shoulders and hips, the angles between arms and bars, the angles between trunk and bars and the duration of performances. It has been determined that most of the statistically significant differences were manifested in the second and the third phase, which was especially noticed in the values of angles in hips. Therefore, we can conclude that spatial-temporal distribution of flexion/extension in the hip has a dominant part in this performance's efficiency. The average values of angles, noticed in the successful performances basket to handstand, can be used as model values in the process of learning these elements, or as parameters for evaluating the efficiency of this element's performance, and for objective detection and correction of errors.

Key words: *basket to handstand, parallel bars, artistic gymnastics, kinematics*

Introduction

Artistic gymnastics belong to groups of conventional sports events. In this group of sports esthetic performance of defined motion structured is evaluated, i.e. elements which are divided into valuated structures in regard with the difficulty of elements performance. In male artistic gymnastics elements are evaluated with scores A, B, C, D, E and Super E, starting from the simplest to most difficult. *Basket to handstand* belongs to group of highly evaluated (D) and respected elements. The high qualification of this element is a result of its difficulty, attractiveness and possibility to upgrade with rotations around longitudinal and transversal axis which increase its score value. Therefore, this element is almost unavoidable in athletes' routine on parallel bars. Because of its popularity the following variations have developed, like: *basket with* ½t., ¾t. and 1/1t to handstand (*basket* with rotation of 180º, 270º and 360º around longitudinal axis), which are evaluated with scores E and Super E. For making an objective kinematical analysis of this difficult element it is necessary to collect data of values of these parameters which have an importance part in forming an appropriate stereotype of motion. The aim of this paper is to determine the optimum attitude of angle in joint systems of shoulders and hips which accomplish a maximum quality/efficiency of a performance. The obtained results should be directly applied in praxis, in regard to the comparison of the training performances with obtained modal values, evaluation of efficiency and detection and correction of errors.

Methods

The gymnast whose performances of *basket to handstand* were recorded for this analysis is an active competitor and a national team member of Republic of Croatia. Among the large numbers of recorded performances the experts' team, consisting of one coach and two international referees, has selected the 15 successful and 15 unsuccessful performances. During this process, a successful performance was every performance which was in accordance with the valid Code of points; Rules and Regulation FIG, so which began with a handstand and finished in position of a handstand, and which did not contain the errors bigger than 0.5 of point. If the error was bigger than allowed, the performance was considered unsuccessful.

For the requirements of this research in all of the selected performances the angles in shoulders and hips, the angle between the arms and the bars, and the angle between the trunk and the bars, were analyzed. The analysis of selected angles was conducted in 15 chosen position in three individual phases of the performance of this element. They are chosen because of the significant role of a specific gymnast's body positions from the trained process aspect:

- *THE PREPARATION PHASE:* P1- handstand, P2- trunk in upper horizontal, P3RRP – angle between arms and bars - trunk in upper horizontal;
- *PHASE OF GENERATING ANGULAR MOMENTUM:* P4- arms in upper vertical, P5- legs in vertical – CM above the bars, P6- trunk in vertical – CM – below the bars, P7- arms in horizontal, P8- legs in vertical- CM below the bars, P9- arms in lower vertical – CM below the bars;

- *THE ASCENDANT PHASE:* P10- legs in lower horizontal – CM below the bars, P11- trunk in vertical – CM above the bars, P12- arms in horizontal – CM above the bars, P13- the moment of realizing the bars, P14 – the moment of repeated grip, P15- angle between trunk and bars in the position P14, PT – time.

Collecting video data took place, for this research, on specially organized trainings. The analyzed performances were recorded on the same location and in the same way. One video camera (25Hz) was used for recording, positioned in the extending axis of rotation (a place of grip arms on the bars) which was placed on height 175cm above the floor. In this way the camera was placed vertically (90º ± 5º) in the direction of a gymnast's movement.

The record of every single performance of basket to handstand was processed with programs system MAT (Motion Analysis Tools). Referent points on the body were marked manually on every chosen position and the angles in shoulders and hips, the angle between the arms and bars, and the angle between the trunk and bar were calculated. In this way, for all the performances, successful and unsuccessful, the value of angle in 15 specific position of the body was calculated. At all the performances, for every analyzed position the referent points were defined three times and the angle was calculated three times, so that the possibility of errors induced by manually digitalization of referents points would be reduce to a minimum. From three obtained values their arithmetic means were used for the analysis. On the basis of the obtained values of angles in the major joint system (shoulders and hips) spatial-temporal movement of a single parts of gymnast's body were calculated. After that basic statistic parameters (mean and standard deviation) of chosen variables were calculated, and with Analysis of Variance (ANOVA) the significance of differences means between successful and unsuccessful performances was tested.

Results and discussion

The obtained results indicate that in the first phase there are no bigger differences in obtained values of angles between successful and unsuccessful performances of basket to handstand.

During the second phase these differences are more significant, especially in the position P6 which relates to a position where the trunk is in vertical on the bars, in which position the angle in the hips is 6 º less in unsuccessful performances, which means that the body is in a more bending position than optimal. At the same time the angle in the shoulders in the successful performances is 2º less. A consequence of these changes is the disadvantageous positions of the gymnast's body in position P9, with a regard to a position of the body in a elevate basket, in which position the angle in the hips at the successful performances is bigger for a 4.7º in relation to the values of angles in the hips in the unsuccessful performances in the same position. It is also significant that these differences are permanently increasing during the third phase of elements (P10, P11, P12, P13, P14), and in this phase also the values of angles in the hips in the successful performances are bigger. In this phase the angles between the trunk and the bars significantly smaller in the unsuccessful performances, in position P15 PT differences is 10.2º, like the angle in the shoulders in the moment of repeated grip of bars which causes disadvantageous position of the CM and disables the final position of a handstand. From the presented values of the time from the beginning of the second phase to the moment of the repeated grip of bars it is also visible that unsuccessful performances last for 0.06 sec. longer. Tables 1, 2 and 3 show the values of arithmetic means and standard deviations of angles in the shoulders and hips, angle between arms and bars and angles between the trunk and the bars, in chosen positions of performances of elements.

Table1. Means and standard deviations of angles in the shoulders

	Successful		Unsuccessful	
vars	Mean	SD	Mean	SD
P2	57,33	1,68	57,33	1,95
P4	29,80	2,93	27,67	4,76
P5	31,60	2,90	31,07	5,04
P6	51,80	3,47	53,67	4,58
P7	74,13	2,50	73,47	3,72
P8	90,07	2,31	89,53	2,45
P9	68,60	3,89	68,00	3,66
P10	56,87	2,83	57,93	6,35
P11	62,73	2,43	59,87	3,54
P12	59,60	3,04	61,33	4,69
P13	47,27	6,12	49,13	13,28
P14	79,00	5,53	71,73	10,48

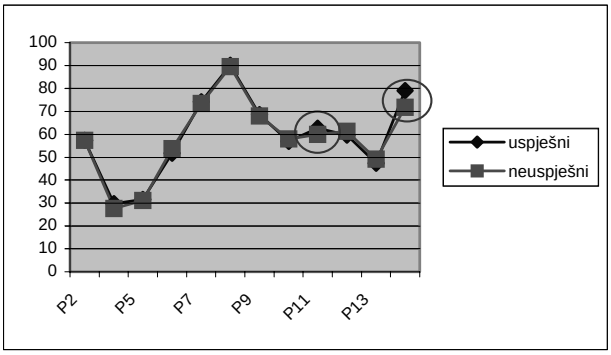
Table 2. Means and standard deviations of angles in the hips

	Successful		Unsuccessful	
vars	Mean	SD	Mean	SD
P2	193,13	4,29	193,67	2,44
P4	179,33	4,05	184,07	6,43
P5	162,60	3,40	163,93	4,67
P6	125,73	4,42	119,73	7,33
P7	80,13	4,03	80,07	5,05
P8	41,07	1,67	38,60	2,59
P9	42,07	3,33	37,40	5,54
P10	60,20	3,91	53,33	6,78
P11	105,07	3,81	93,07	10,15
P12	151,60	10,78	138,93	12,43
P13	173,80	5,56	163,00	13,23
P14	203,00	3,96	191,27	14,47

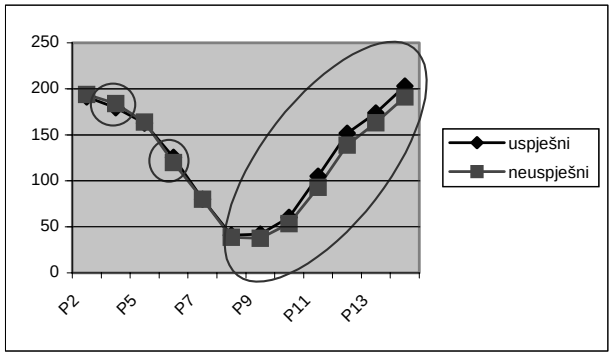
Table 3. Means and standard deviations of angles in positions P3RP, P15TP, PT

	Successful		Unsuccessful	
vars	Mean	SD	Mean	SD
P3RP	64,67	1,72	64,33	2,06
P15TP	57,13	2,17	46,93	5,51
PT	1,40	0,03	1,46	0,04

Analysis of Variance (– p < 0, 05) tested the significance of differences of arithmetic means between successful and unsuccessful performances (Tables 4, 5, 6). It has been established that in the variables P11R and P14R angles in the shoulders (Graph 1) and in variables P4K, P6K, P8K, P9K, P10K, P11K, P12K, P13K, P14K angles in the hips (Graph 2), the differences of mean between successful and unsuccessful performances are statistically significant.



Graph 1. Statistically significant differences in angles in shoulders



Graph 2. Statistically significant differences in angles in hips

Also, statistically significant differences of mean are identified in variables P15TP in regard to the angle between the trunk and the bars, and variables T of time last from the beginning of the second phase until the moment of repeated grip in the third phase. The body positions, in which statistically significant differences of arithmetic mean of selected variables have been established, can be considered as critical body positions during a performance of this element, i.e. they have an importance part in efficiency of this element's performance, and the coach must pay special attention to them. It has also been noticed that the angles in shoulders are not statistically significant in the successful and unsuccessful performances, except in the third phase in position P11R and P14R. Whereas the differences in hips, which have lower values during unsuccessful performances, could be noticed even at the beginning of the second phase of this element and increase during the third phase, which means that the body is in a more bended position than necessary. The time from the beginning of the second phase until the end of the third phase also has an important role because it is observed that is the unsuccessful performances are significantly slower.

Table 4. Differences in the angles of shoulders between successful and unsuccessful performances

	F	p
P2R	0	1
P4R	2,183369	0,15067
P5R	0,126411	0,724847
P6R	1,584753	0,218472
P7R	0,331596	0,56932
P8R	0,376471	0,544451
P9R	0,189189	0,666926
P10R	0,353103	0,557133
P11R	6,671649	0,015313
P12R	1,444004	0,239558
P13R	0,244346	0,624941
P14R	5,643415	0,024603

Table 5. Differences in the angles of hips between successful and unsuccessful performances

	F	p
P2K	0,175137	0,678779
P4K	5,821016	0,022633
P5K	0,800229	0,378651
P6K	7,369379	0,01123
P7K	0,001596	0,968413
P8K	9,640845	0,004326
P9K	7,823905	0,009219
P10K	11,54407	0,002055
P11K	18,3733	0,000194
P12K	8,893503	0,00587
P13K	8,497918	0,006922
P14K	9,169535	0,005239

Table 6. Differences in the angles of between arms and bars and angles between the trunk and the bars in chosen positions of performances of elements

	F	p
P3RP	0,231788	0,633943
P15RT	**44,52799**	**0,0000**
T	**20,78528**	**0,000092**

Conclusion

The analysis of 15 successful and 15 unsuccessful performances basket to handstand on parallel bars has shown the average results of the angles in shoulders and hips, the angles between arms and bars, the angles between trunk and bars and the duration of performances. The primary aim of this paper was to define the most appropriate conditions for an efficient performance of this element. It has been determined that in the first phase of elements a significant difference between successful and unsuccessful performances didn't exist. Statistically significant differences were manifested in the second phase and were the most obvious during the third phase, which was especially noticed in the values of angles in hips. Therefore, we can conclude that spatial-temporal distribution of flexion/extension in the hip has a dominant part in this performance's efficiency.

The average values of angles were noticed in the successful performances basket to handstand, especially in the variables which show statistically significant differences in relation to values obtained in the unsuccessful performances. They can be used as model values in the process of learning these elements, or as parameters for evaluating the efficiency of this element's performance, and for objective detection and correction of errors.

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THE EFFICIENCY OF ALGORITHM PROGRAMME IN FORWARD SALTO

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The sports gymnastics of the present day is characterized by the constantly increasing demands in terms of the overall difficulty and complexity and by the obvious amplitude in movement of particular training combinations and finally by the transformation of acrobatic training combinations into the individual gymnastic disciplines; both on their basic elementary level but sometimes the chosen alternative is much more demanding with the aim to approximate to the model technique. The prediction concerning the sport performance with all sports requisitions and articles is aimed to a constant increasing of the difficulty and complexity of the respective competition squad. In other words, as far as the sport practice goes, the above mentioned facts imply that the quality of technical preparation must be on such a level which would work as a basis that would provide for enriching the training shapes in terms of their performance in the highest complexity. The main base of a respective movement technique in each training shape is evaluated based on objective criteria according to the following aspects: time, space and spatio-temporal combination of characteristics. All these characteristics have precisely set norms; which you have to be familiar with especially during the key phases within the training shapes. These factors are also being reflected in transfer as well as in good performance if the conditions have been modified (e. g. changes on the equipment, relations, etc.). According to Arkaev and Sučilin (2004), the groundwork of every technical preparation which is supposed to help an athlete reach professional performance, is to accept the following principles:

1. Focus of the training exercises is to become familiar with the basic technical essence of movement.
2. Repeating of the necessary quality of training exercises in the movement technique.
3. Economization and autoimmunization of the training exercises in the necessary movement technique.

These authors emphasize that only a decent quality and standard of technical preparation may guarantee success in preparation of top gymnasts. They call these training exercises which are part of the technical preparation the profiling or essential exercises. These should be formed and stabilized in the long run of the sport preparation. Bearing in mind the experience of Mr. Sučilin (2004), a successful gymnast, as well as the ideas of Mr. L. A. Arkaeva (2004), a coach and a research worker, we chose a ground-breaking training conception for the needs of our research: we chose a forward salto . This is because the forward salto in general constitutes the technical basis for elementary as well as for more demanding alternatives and it is also essential for a transfer to other gymnastic apparatures.

The main focus and aim of our research was to obtain knowledge based on the kinematics of a forward salto, to improve the technique involved according to a computational procedure (algorithm program) within an experimental group and to determine the transfer of the optimal technique for the forward salto into other gymnastic apparatures.

H 1 – We expect that an algorithm which would be focused on improving the key phases and micro-phases of the forward salto shall also have an impact on its technique in terms of performance in the basic elementary alternatives as well.

H 2 – We assume that the quality of the technique involved in the forward salto shall have a significant influence on its transfer onto a balance beam, eventually onto other gymnastic apparatures.

U 1 – Record the kinematics of the forward salto.

U 2 – Determine and evaluate whether the technique involved in the forward salto in the basic elementary alternatives has any impact in terms of the transfer onto other sport requisitions and articles in the women's gymnastic disciplines.

Our sample consisted of two groups: the first one was the experimental one and the second was the control group. We included two professional gymnasts into the experimental sample, namely Mrs. I. K. (pro-band no. 1) and Mrs. A. K. (pro-band no. 2) who have experience with the representation of the Slovak republic in the sports gymnastic. The control group also consisted of two professional women athletes who have represented the Slovak republic in the sports gymnastics – Mrs. J. K. (pro-band no. 3) and Mrs. M. A. (pro-band no. 4).

We based our research methods on an experiment; where we applied our algorithm program which we developed within the experimental group of professional gymnasts. The computational procedure of this algorithm was focused on perfecting the technique for the forward salto. After the experiment we compared the performance in terms of the technique used with the gymnasts from the control group.

We evaluated the performance in terms of the technique used by means of observation – both in the beginning, as well as in the final phase of our experiment. Our observation was then objectified by means of repeated records of the

kinematics and later evaluated – using the ADOBE PREMIERE program. We used the so-called timeline window which is actually a computer analyzer; we provided it with the necessary data by inputting the video recordings and the software analyzed the data for us by dividing the recordings into pictures.

By analyzing the kinematics of the forward salto's kinematics we were able to obtain and consequently describe the basic spatial, time and speed characteristics. Afterwards, we compared these characteristics against each other in the respective micro-phases of the training shapes and combinations within the individual members of each group.

We determined all the dynamic movement characteristics, especially the synergism of external and internal forces indirectly – using logical methods.

We implemented the methods of direct observation to evaluate and determine the transfer; where the quality standards of the performance in terms of technique used were professionally evaluated with the help of an expert whose major is sports gymnastics and who has also worked as a certified coach or an international referee.

Based on the analysis of the technique involved in the forward salto we propose the following computation procedure of our algorithm program. Since our research was not focused on improving the individual phases and micro-phases of the forward salto, we did not implement the whole algorithmic procedure – only some of its parts. The women gymnasts from the experimental group underwent the algorithmic procedure which was focused on improving the individual phases as well as micro-phases of the flipping training figures two times a week at the beginning of each training unit during one year. However, here it is necessary to mention that the members of both groups – women from the experimental as well as from the control group participated in the activities aimed to develop fitness abilities; due to the fact that otherwise we would not have been able to carry out our research work.

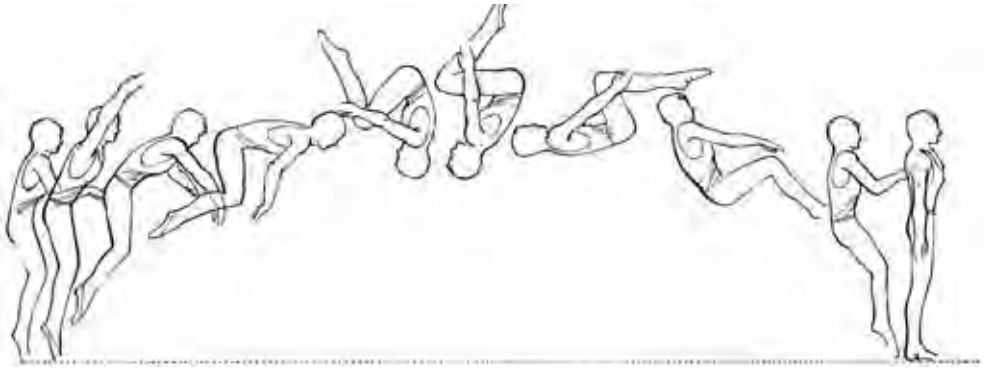
The main focus of our research was to develop methods that would improve the individual phases and micro-phases during the forward salto; these being namely the jumping off phase – where we made sure that the trunks, shoulders as well as the head were properly positioned during the final phase of the jumping off. During the landing phase we emphasized that the gymnasts landed safely and properly, without unnecessary steps; so that they would be able to perform the same training figure on a balance beam.

a.) When the group was practicing the jumping off phase we emphasized the final phase of the jumping off; so that the trunk of the body does not lean forward, so that the shoulders are raised upward and the head is on a level with the trunk – it should not either bend forward or backward.

b.) The gymnasts also performed the forward roll onto an elevated pad in the height of 1 meter and they also performed the forward salto onto the same pad.

c.) The gymnasts also performed a forward salto on a trampoline; where we made sure that the shoulders were raised upward, the head was in the proper position between the shoulders and on the same level with the trunk. The gymnasts were even asked to perform the forward salto repeatedly.

d.) The forward salto from a heightened pad with the landing onto a leveled pad – either similar or identical with the professional conditions during competitions. Here we emphasized that each athlete kept their trunk, head and shoulders in the proper position. Moreover, especially during the landing phase we made sure that the landing was performed in such a way that from the least possible number of attempts the minimum of ten attempts were performed properly and safely, the best result achievable being ten good jumps out of ten attempts. The important thing was that during landing phase the trunk was not leaning too much forward or backward and that the shoulders were raised upward and that the athletes landed onto slightly bent feet and not into a deep knee-bend and finally that they did not make any steps backward or forward after they had landed since this could mean they would lose points during a competition or they could fall from the balance beam.



Picture no. 1 – The model of the technique for the forward salto.

Based on the results that we obtained during our research work, we can conclude, that the algorithmic program for the forward salto in the basic elementary alternative has a positive effect on the performance of the technique. The application of the respective steps of the algorithmic program focused on improvement of the individual phases and micro-phases of the flipping training figures proved to be effective within the experimental group.

The results support our theory that the forward salto, in terms of the transfer to other gymnastics apparatures, is subject to the performance level of the technique of the necessary standard. Its strong influence can be observed during practicing on a narrowed supported are, e. g. on a balance beam. The women from the experimental group increased the requirements and complexity of their competition figures on the balance beam by virtue of preceding improvement of the technique for jumping the forward salto and their implying relations. The gymnasts from the control group did not increase the requirements and complexity of their competition figures that significantly due to the fact that the forward salto and the implying relations were not present in their case.

However, it is necessary to conclude that the records of the kinematics of the technique when performing the forward salto is helpful in revealing those details of the technique which might improve and speed up the process of kinetic learning. The flipping training figures, for example the forward salto must be gradually studied and improved in the necessary quality which will consequently have a positive impact even in the more demanding and complex alternatives as well as in the transfer to other sporting requisitions and articles.

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History of Sport and the Olympic Movement

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"SPORT, THE NOTION OF MODERN, TIME - APPROPRIATE PHYSICAL EDUCATION"

(History of sports societies in Ljubljana in the view of the societies rule books)

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Abstract

Sport as an activity and a sports club as an organizational form of the modern era have entered the Slovene national and cultural space in the second half of the 19th century. The organizing of sports societies, which is related to the common societies development after the cessation of the Bach neo-absolutism, has contributed to the increasing recognition and identification of "sport" - the physical culture novelty in the domain of the "physical education" of that day. In this article, we are focused on organizing societies and clubs according to the sources from the archives – the "card index of societies" stored in the Archives of the Republic of Slovenia, and we then follow the "revival of sport" after World War I based on the example of sports organizing in Ljubljana – which became a leading town in Slovenia at the end of the 19th century and the capital after World War I. In the archive material are preserved the society rule books, the rules that had to by law be submitted to the administrative authorities to be approved. Articles of the rule book gives us an insight to when these societies were established, how they were constituted, and the articles on society's termination, tell us about the opinion or interest backgrounds of the founders.

Key words: *history, sport, society, club, society rule book, Ljubljana*

Society and club

Sport and the organizational form of sports club have entered the Slovene as well as the South Slavic national and cultural space in the second half of the 19th century. From a historical point of view, we need to distinguish among gymnastics, mountaineering and sports organizations – it particularly needs to be stressed that "Sport" was an inferior conception or an instrument of "physical education". In practice, it was at first understood to be considerably multilayered – intended for various socially-entertaining or free-time physical activities and games as well as for competitions. In the years between the two Wars, "sport" was asserted as an independent and specific activity. While clarifying the contents, it significantly influenced the organizational development, since the term "sport" was more and more related to the functioning of specific sports organizations and particularly to the sports competitions.

The fundamental organizational characteristic of "sport" as a social activity of interest and a services activity is a society or a "club". All further organizing or interest-based relations on the national as well as on the international level is based on this. The occurrence and development of sports societies coincides with the general development of societies.

The societies entered the Ljubljana public life in the second half of the 19th century. The organizing or establishing is closely related to the political conditions in the Austrian Empire. At the end of the fifties of the 19th century, after military and foreign affair defeats, bad economy state and after a longer period of the hateful Bach absolutism, the emperor Franz Joseph was forced to "promise the time-appropriate changes in the legislation and the constitution". [1] What followed was the fall of the Minister of the Interior Bach and the adoption of the October Diploma in 1860 and the February Patent in 1861, both bringing back the constitutional life. The establishing of societies in all areas of national activities – from politics, culture and physical culture, to economy, adequately followed in the Slovene region. The societies also represented the practical side of the then Slovene as well as German nationalism.

The establishment and development of sports organizations was bound to the urban centers. In the second half of the 19th century, Ljubljana – then the capital of Carniola and a town where the municipal authority was taken over by the Slovenes at the end of the 19th century – took over the leading national, politically-cultural centre in the Slovene region. From the mid 19th century to the beginning of World War I, a number of gymnastic, mountaineering, shooting and sports societies, and in 1912 the Ljubljana chess club were established in Ljubljana. We must though stress that various societies

[1] *Pavlin, Zanimanje za sport [The interest in sports]..., p. 48-50.*

or associations, whose purposes were either educational or cultural, social or merely sociable or nationally-defensive and not political (but yet mostly bound to various political conceptions and political sides), included gymnastics or/and sport into their rules, while hiking was indispensable for almost all of the society founders. Physical activity served the societies as an "instrument" for "achieving the society's purpose".[2]

In line with the catholic politics of "re-catholisation" at the end of the 19th century, the catholic camp decided to introduce a gymnastics organization at the beginning of September 1905. Dr. Anton Korošec, cleric and later a recognized catholical politician but then still an arbitrator for society's entertainment events, advised to organize gymnastic sections, which resulted in an independent gymnastics organization Orel (Eagle)[3]. In 1911, Orel was joined to the catholic nationally-defensive organization Slovenska straža (Slovenian guard).[4] Gymnastics, sport and various games acquired their place also in the educational programs of the Salesians. Among the clerics or the catholic professional community, the opinions whether to hold festive parties, parties and various games as well whether to let functioning new catholic organizations, were divided. But in the Vzajemnost gazette, gazette of clerics, we can find a liberal spirit stressing not all festive parties should be prohibited, since "where these games are held, the Legion of Mary communities thrive too". Where there were no cultural events, these communities were asleep too, stated the author and continued that "the Salesians and other convent leaders of youth around different seminaries know that very well". Therefore, they organize parties and games and sport societies. These innocent games do not harm the Legion of Mary communities, so away with the pessimism! Let us be young with the young, merry with the merry ones! Too strained a string breaks!" For the author games were absolutely better than "drinking and other faults that lead our nation to destruction!"[5]

Similar organizing was found among the labor class; in the first place within the Splošna delavska zveza Vzajemnost (General labor association Reciprocity), dissolved in 1913, and within the Splošna delavska izobraževalna zveza Svoboda (General labor educational association Freedom), founded in the same year. In Vzajemna, they tried to achieve the society's purpose – "to advance the spiritual and economic progress" by fostering "among others sports and gymnastics"[6], while in Svoboda by fostering "all sports such as gymnastics, tourism, football, light athletics, swimming etc." After World War I, in Svoboda distinguished between gymnastics and sports. Gymnasts were organized within gymnastic sections or "units", joined in the Zveza telovadnih enot (The gymnastic units association), –functioning until the end of 1929, and the sportsmen were organized within sports clubs Svoboda – they were affiliated to sports branches associations.[7]

The Southslavic political overthrow and the "sports revival"

The beginning of World War I interrupted the society activities. The resumption of Slovene societies started in 1918, after the resumption of the Austro-Hungarian parliament life. Thus in spring 1918, the Ljubljana sports club held a general assembly. The mountaineers, members of the Slovene mountaineering society were also getting ready for opening of the season and in spring 1918 started to prepare facilities for seasonal mountaineering, particularly the facilities that the military had withdrawn from. Also the gymnasts started awakening – at first only the catholic Orel. The nationalist Sokols, whose activities where in some places forbidden by the government, re-appeared before the Ljubljana public at the end of August 1918 on the occasion of their elder member's funeral.[8] In October 1918 Austria-Hungary capitulated. The events at the end of World War I that followed are well known: political "overthrow" of the Slavic nations, separation from the Habsburgs entity and establishing the South Slavic state of Serbs, Croats and Slovenes, which on 1.12.1918 incorporated with the Kingdom of Serbia to form the Kingdom of Serbs, Croats and Slovenes. With this new state, Germans and pro-German Slovenes were ousted from the public circles and German cultural strongholds, such as Kasina for example. This signified the "Slovenization" of the public life.[9] After World War I, there were no traces of German gymnastic organizations, bikers and "alpiners" in Ljubljana. The Laibacher Sportverein stopped functioning even before World

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2 *AS, society rules: Splošna delavska zveza Svoboda (4567), mladinsko izobraževalno društvo Enakost (4523), Krekova mladina (5674), društvo Slavija (5849-followed by some sports societies with the same name), Ljubljanski sportni elitni klub (8178-does not appear at competitions), Poljedelska delavska zveza (4814), Rokodelsko pomočniško društvo Edinost (4810), Zveza za tujski promet v Sloveniji (8773), Švapska zveza (4621), Bratstvo (4910), Narodno-socialna zveza(2315), Slovenska straža (1852).*

3 *Pavlin, Zanimanje za sport [The interest in sports]..., p. 70.*

4 *Stepišnik, Telovadba na Slovenskem [Physical exercising in Slovenia], 1974, p. 213.*

5 *Vzajemnost, gazette of the clerics I/6, 1913. Regarding the female gymnastics organizations, there was a concern that the Orli would deduce members form the Legion of Mary communities; more on this in F. Pernišek, n.d., p. 83/84. About the role, purpose and attitude of the Orli association towards the Legion of Mary congregations, see also Franc Zabret, Orlovstvo [The Orli movement], 1924.*

6 *AS, d.p. 1668. In Ljubljana in 1913, there was a football team named Vzajemnost that played a couple of games with Ilirija. After Vzajemnost was dismissed, the team was to be renamed to Concordia, as announced toIlirija secretary's office. However, the majority of the team then joined Ilirija.*

7 *AS, d.p. 567.*

8 *Pavlin, Zanimanje za sport [The interest in sports]..., p. 98-101.*

9 *Dolenc, p. 11-93.*

War I.[10] After World War I, the old municipal shooting society Rohrschützen Gesellschaft, having roots in the late middle ages, continued their activities on their firing place under the name Društvo ljubljanskih ostrostrelcev (The society of Ljubljana snipers).[11] Likewise, there was no Laibacher Reitschülverein after the war; riding was to be fostered by Ljubljansko jahalno društvo (the Ljubljana riding society) that also planned to build and maintain the riding grounds in Ljubljana. The society rule book was submitted for approval to the administrative authorities in 1920 – whether it was a continuation of the pre-war Laibacher Reitschülverein, we can only guess; a more detailed picture could be obtained by comparing the membership and location.[12]

After the overthrow, Slovene mountaineers began to rule the Slovene Alps and bought out the German mountain huts in the Julian Alps, the Karavanke Mountains and the Savinja Alps.[13] According to international political events, a part of members remained across the borders of the new state. The Ljubljana and the Slovene mountaineers sympathized with their colleagues on the occupied territories. At the end of 1918, during the New Year celebration merrymaking, they announced they would not hold a New Year's Eve evening " because the times are too serious and too harsh for the Slovene mountaineers to be able to indulge themselves in undisturbed joyfulness." Because the mountaineer's ball in the past had normally united "friends of the Slovene mountaineering from all our regions in a spontaneous entertainment, and we would have to miss the visit of our friends from Notranjska and Primorska (occupied by Italy, according to London Treatment 1915 with Aliance), the society will for now dismiss every noisy performance, and we asks the members to remain supporting the society's activities." [14]

On the other hand, the overthrow and the formation of the Yugoslav state indicates the renascance of the national sport, because the Slovene sports organizations in Ljubljana were not actually in full operation until after World War I. According to the Ljubljana Directory from 1928 – so the year before the January 6th dictatorship that authoritatively intervened the functioning of sports-culture societies – there were 473 societies and associations in Ljubljana, among which 79 or 16.7% were sports-culture societies and their number was increasing up until World War II. By rule, upon establishing a society or its associations, the founders had to submit the society rule book to be approved. In case the authorities did not prohibit the society within one month, the society was considered to be established and it held a general assembly. The society rule books up to 1941, as submitted to the authorities, are preserved in the card index of societies materials stored in the Archives of the Republic of Slovenia. While making an overview of the societies established between the two wars, we will focus to societies that – firstly characterized themselves as sports societies and functioned within the sports associations, – secondly were indirectly related to sport or sports club, and – thirdly their activity included agonistics or contests, regardless of the physical component or educational value. This overview will not involve gymnastic, scout, woodcraft rangers and mountaineering organizations, but only those activities that more and more round up the conception of sport. In this overview, we are going to give a statistical picture of societies and not the state of sport in Ljubljana. Many societies, or in this case clubs (term was equivalent) that characterized themselves as "sports clubs", were heterogeneous organization-wise. They comprised more sports sections, through which they were affiliated to several sport branch associations. The entire period will be split into two chronological sub-periods; the first one up to 1930 and the second one after 1930. The reason to do this is because with the January dictatorship announced by King Alexander, he intervened also the "physical education" - although it did not affect the sportsmen as it did the gymnasts.[15] The Kingdom of Yugoslavia law on the Sokol organization passed at the beginning of December 1929. The law namely abolished all till then existing gymnastic organizations. By this law, Sokol of the Kingdom of Yugoslavia became the all-state gymnastic organization; however, the law did not affect sports; the authorities allowed the organization of sports clubs, regardless of their conception background. We must though add that in conformance to the politics of the state centralization, the sports branch associations consolidated into the Zvezo športnih zvez (Association of sports associations) – established at the sports board meeting in December 1929 in Zagreb. The task of the "association of sports associations" was to help the sports movement in Yugoslavia, and to attend to a consistent development of all sports branches, as the "association" consolidated the olympic as well as the non-olympic sports. The founders of the "association" were the delegates of the Yugoslav sport branch associations for football, tennis, cycling, winter sports, car and motor sports, athletics, swimming and handball.[16]

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[10] *AS, d.p. 891. In the entire sports history, the Laibacher Sportverein was a mystery. The club was established in 1900 and was, as revealed by Borut Batagelj (Začetki ljubljanskega nogometa [The beginnings of the Ljubljana football], Ljubljana, Jan/Feb 2002, p. 57), the club of the German football players form Ljubljana. As noted on the club rules folder in AS, the club was dismissed "ausgelöst" in 1909 (see also Pavlin Tomaž, "Pri nas je ta panoga sporta še docela neznana [This branch of sport is a total mystery with us]", Zgodovina za vse [History for all], 1999/2, p. 84-85).*

[11] *AS, d.p. 7859; up until 1918 the card index no. was 162.*

[12] *AS, d.p. 8174.*

[13] *Dolenc, p. 61.*

[14] *S, 30.12.1918; SN, 31.12.1918.*

[15] *To illustrate the course of events in gymnastics – according to the Ljubljana directory from 1928, there were 6 Sokol societies in Ljubljana, 10 Orel sections and 2 Svoboda sections; in 1938 there were 10 Sokol societies and 4 sections of the catholic gymnasts or the so called Fantovski odsek [The boy's section], organized after 1935.*

[16] *EFK, II. zv., 1976, p. 224.*

1. Overview of "Sports" societies in Ljubljana

Activity	1919-1930	1931-1941	1919-1941
Moto sport	1		1
Boules	1	1	2
Billiard		1	1
Bridge		1	1
Ice skating	1	(1)*	1 (1)
Kayaking	1		1
Riding	3 (1)		3 (1)
Cycling and motorcycling	3	1	4
Aviation	1		1
Dancing	1	1	2
Shooting	15 (1)	6 (4)	21 (5)
Skiing	2 (1)	3	5 (1)
Chess	7	6	13
Sport	26 (8)	7 (4)	33 (12)
Sum	62 (11)	27 (9)	89 (20)

* in parentheses the number of societies dismissed from the registry of societies

2. Societies whose activities include elements of "sport" or are related to it

Activity	1919-1930	1931-1941	1919-1941
Sports-tourist	1	2 (1)	3 (1)
Sports-social	1	1	2
Economic	1	1	2
Other	1	2	3
Sum	4	6 (1)	10 (1)

As shown in the above tables, the majority of activities were organized in the first sub-period of the Yugoslav state – the time of euphoria of the national emancipation after World War I and the time of the independent national life. Activities such as cycling, ice skating and skiing could also be organized within the sports clubs, which were heterogeneous in the first place, but some of them were also homogeneous. All of the listed activities did not represent novelties in the Ljubljana cultural life, but there were new society organizations that were thus making a step across the threshold of sports (for example, billiard that was previously bound to the development of the Ljubljana coffeehouses). Boules however is new and came to Ljubljana with the emigration from Primorska after the Italy occupied it (Primorska is the region between Adriatic see and Julian Alps) and became a part of the Kingdom of Italy in 1920 (according to Rappalo contract between italian and yugoslav state), while a similar traditional entertainment of the Ljubljana residents was bowling[17]. Likewise, the novelty was "bridge", a mind card game of Anglo-American origin[18], and sports activities. It is interesting to see the high number of shooting societies. It is necessary to distinguish between those whose purpose was "to foster free entertainment with shooting and to practice shooting, particularly contemporary shooting with a 3mm air target gun".[19] The latter mostly had their headquarters in Ljubljana pubs, and according to their rules, they left their possessions to undefined "war blind men". No tangible sources about these societies can be located in the newspapers; we can learn about them only through the society rule books, which were, compared to others, substantially shorter. They only consisted of eight articles included no description of the shooting. Looking at it chronologically, the majority of such societies were established up until 1925. The purpose of other shooting societies was to foster "the sport of shooting". Such shooting societies wanted "to arouse the interest for shooting by holding shooting practice and ceremonial shootings, by training their members in the usage weapons, by educating the young shooters and by promoting to strive for the greater war and defense power of the state. Also the sociability and good comradeship shall be the goal of the society." According to society rule books, shooting was divided to "regular and remunerating practice"; the remunerating further divided to

[17] *Mal, Stara Ljubljana in njeni prebivalci [The old Ljubljana and its people], p. 102-127.*

[18] *Fröhlich, Bridž [Bridge], p. 19.*

[19] *As far as shooting with an air gun is concerned, the Bolzschützengesellschaft society was established in Ljubljana already in 1820. (Zalar, Ljubljansko društvo ostrostrelcev [The Ljubljana society of snipers], p. 57).*

"yearly and exceptional", taking place at "shooting evenings" or "closed public and competition shootings". Among these societies, there was the "Ljubljana governmental shooting family". It was closely related to the military; it was lead by the military personnel and the military provided the weapons for shooting[20]. It is necessary to stress though that shooting societies were independent and represented one of the organizational verticals of "physical education".

In the group "sports club", there were three clubs – LSK (the Ljubljana sports club), Ilirija and Slovan - stablished before World War I and renewed their activities in the years 1918 and 1919. Other clubs were newly established. In the period 1919-1941 there were 12 clubs that were dismissed or "crossed out" from the administrative registry of societies, and 5 more clubs dismissed after the Italian occupation in 1941 (Primorje, Jadran, Sloga, Slavija and Grafika). Some clubs run into organizational and financial problems soon after being established. The solutions were either to dismiss the club, to consolidate, or to acquire a guardian. For example, Sparta disintegrated by 1925, and LASK (the Ljubljana academic sports club) consolidated with Sport club Primorje into Academic sports club Primorje – the club was established by Primorje emigrants in 1920. Similarly in 1933 Svoboda-Ljubljana joined Primorje, but for sports reasons. While facing the club material crisis in the mid twenties, the sports club Hermes came under the railroad administration and became the railroad sports club but kept its previous name (clubs were usually named Železničar). There was another railroad sports club established in Ljubljana – Sloga, which did not have a significant role. The majority of clubs were established between 1926 and 1930. According to the fact that the most of those clubs were also "crossed out", their functioning is questionable. The reason for establishing these clubs could lie in the struggle for predominance in individual branch organizations, as each club member represented one vote at the assembly. In addition to merging of clubs, there is case of Panonija from the suburban area Koseze; the club stopped functioning and later restored its activities.

Quite some of the club names were related to the Slavic sea and territories, which belong to Kingdom of Italy: Jadran (Adriatic sea), Reka, Istra, Velebit and Primorje – the latter having a special social role as it was established and led, as mentioned above, by the Primorje emigrants in Ljubljana. Some sports sympathizers likewise identified themselves with Koroška (Carinthia) – the territory lost at the October 1920 plebiscite, belonged to Austria. This is evident form the club named Korotan; however, it is not clear whether it was established by the Koroška emigrants (the number of which was far lower than the Primorje emigrants), or by the nationally-aware Ljubljana residents. Additionally, in the early thirties after the January 6th dictatorship, there were two catholic sports clubs established in Ljubljana: Planina and Mladika.[21]

The development of organizations, activities and the question of the sports progress were related to the question of infrastructure, which was left to private initiatives. Modest facilities were owned by the societies. In 1933, there were 14 societies that owned Ljubljana house properties, which however did not mean they were the land owners too. According to the Ljubljana Directory from 1938, we can get a picture of the sports facilities in Ljubljana before World War II. Larger sports facilities were primarily in the domain of more powerful clubs, while smaller clubs made guest appearances or hired the facilities belonging to the larger clubs for as long as they did not find a piece of land and modestly equipped it to be suitable for their activities. According to records in the Directory, only the following clubs had arranged playgrounds: Hermes had a football playground and a "racetrack" for bikes and motorbikes, Ilirija had tennis courts, in winter the ice skating ring and a modern artificial swimming pool – a unique one in Yugoslavia too, Jadran had a football playground and an athletic field with a running track, LSK had a boathouse and a swimming place, Reka had a football playground and the society of snipers or the pre-war Rohrschützen Gesellschaft had its own firing place. Besidre those clubs facilities there are records in the Directory of the Stadion, which was gymnastic and athletic field of the catholic gymnasts and sportsmen, and a bowling alley Trata.[22]

In 1921, the majority or a good half of sports organizations were located in Ljubljana[23]; however, in the course of the twenties of the 20th century, sports spread across all of Slovenia. The characteristics of the Ljubljana sports clubs was that they first fostered one and later a variety of sports branches organized within the club sections, through which they were affiliated to branch associations. Football was generally the leading sport – this changes the perspective of the stereotyped Slovenes (Kranjski Janezi) who were thought to be skiers only. The statistics however shows that they did become skiers within a decade of the Yugoslav state and skiing – organization-wise – became the leading sport in the Slovenia, specially in the northwestern part of Slovenia.

[20] *AS, d.p. 7753; Stepišnik, Oris [The outline], p. 348.*
[21] *AS, society rules; Pavlin, Zanimanje za sport [The interest in sports]..., p. 128-132.*
[22] *ZAL, Adresar [Directory]1938.*
[23] *Sport, 25.3.1921.*

3. Overview of the branch units (BU) as per individual sport in 1933[24]

BRANCH	BU in Ljubljana	BU in Slovenia	BU in Yugoslavia
1. Athletics	2	7	18
2. Carsport	1	2	8
3. Boxing/heavy athletics*	1	3	24
4. Golf	0	0	1
5. Handball	2	8	27
6. Grass hockey	0	0	4
7. Kayak-canoe	1	1	2
8. Cycling	6	24	54
9. Riding	1	1	23
10. Aircraft	1	2	18
11. Motosport	3	6	18
12. Table tennis	3	4	20
13. Football	13	44	593
14. Swimming	2	7	26
15. Fencing	1	2	10
16. Tennis	2	8	50
17. Rowing	1	2	18
18. Winter sports**	12	63	97

* Data from 1930; later the branch divided into boxing, wrestling and weight lifting
** skiing, ice skating, ice hockey

The constitution of a sports club

According to the overview of societies in Ljubljana, 33 of them characterized their activity as "sport", "the notion of modern, time-appropriate physical education", and also as "the notion of modern, time-appropriate physical education" that implemented their purpose by offering "their members the possibility to foster various sport branches". The purpose of some clubs – particularly the newly established ones in the thirties, i.e. after the January 6th dictatorship – was to "educate their members in the spirit of sport and state." The club structure was defined by the rule book, approved by the administrative authority, and in the thirties also by the Ministry for nation's physical education, established in 1932 (the ministry was competent for Sokol or gymnastics, sports, shooting, mountaineering, fire brigade, scout and tourist organizations)[25]. In the rule book, the society founders defined the society's "purpose", "instruments used to reach the purpose", administrative structure, activities, and in one of the articles, where they predicted the circumstances upon a society dismissal. The club was an administrative integrity that could be constituted of individual sports sections with internal independence. If the club had assembled a playground, the administration would normally also have the playground administration. The club was managed by an extended board elected at the general assembly; it was further broken down to a select committee or the executive committee. The business period of the board was one calendar year, which was followed by a general assembly at which reports on the past activities were given. The general assembly formed a quorum if 2/3 of the members with a voting right were present. Propositions were passed with absolute majority. The board could call an extraordinary general assembly in case of a crisis situation in the club; for example management crisis, or strained relationship between the club and related societies or superior organizations – the protocol that many an older sports club member could still remember and that is in many places disappearing. The board was constituted of the president, vice president, secretary, treasurer, members of the board and the head of sections. The number of members of the board depended on the number of sections or the organizational size of the club. Larger clubs had two presidents, two secretaries and two treasurers, who shared out the "external" and "internal" club management. The board met at the "plenary" or "regular" sessions. Plenary sessions were held once a month and were attended by the extended board, while the regular sessions were normally held once a week or as necessary and were required to be attended by the select committee or "the head" tha solved current problems and managed the club life. The club membership was divided into four groups: honorary members (members who deserved special merits for the development or functioning of the club and were appointed by the general assembly), founder-members (members who paid larger sums of money, i.e. the

[24] *The table is based on data obtained from the annual publication Jugoslavenski sport, 1933, godišnjak Saveza sportskih saveza Kraljevine Jugoslavije and by considering the almanach Almanaha jugoslovenskog sporta 1930.*

[25] *AS, Bibliografija indeksiranih informativnih sredstava sređenih i obrađenih fondova Arhiva Jugoslavije I.*

founding money and was the sum approved by the general assembly), supporting members (members who were paying a membership fee as determined at the general assembly) and regular members (could become anyone who wanted to practice sports and who fulfilled a certain age that was defined by the article on membership). The club rules did not allow professionalism; whoever "did sport for a living", would be "expelled". At the general assembly, honorary, founder and regular members had an active and voting right, while the supporting members only had a passive right or a consulting vote. In the second half of the thirties, the club rule books allowed a full voting right for the supporting members and we can also trace the possibility for business organisation to become club members.[26]

The review of articles on club dismissal gives us a lot of interesting information or indications on the clubs' social origin or their relations to conceptually-political camps and similar. Among others, we can track down the charity of the founders of societies. The war syndrome of WW I., the unstable economic situations and social poverty must have obviously been strong, and the social intuition above materialism (that had just then started to burst) still prevailed. In case the government prohibited functioning of certain societies, the societies would donate their possessions either to "the society of disabled soldiers, widows and orphans", "the city poor", "the poor school children", "the poor fund", "the orphan children", "the bishop society for protecting orphans in … parish", "the charity society", "the society for children and youth care in the Ljubljana court district" or to "supporting society of Yugoslav academicians in Ljubljana". Other societies, for example the emigrant Primorje, favored the national idea and entrusted their "possessions" to nation-defendant organizations such as Jadranska straža (Adriatic Guard), Jugoslovanska Matica (Jugoslaw Society) or to Sokol organizations. And yet other societies left their "possessions" either to the local or related society, or to institutions such as the University of Ljubljana, national-cultural Slovenska Matica (Slovene Society) in Ljubljana, the school society of St.Cyril and Methodius in Ljubljana, the catholic youth home in Kodeljevo, the Crusade students boarding school or the Salesian institution on Rakovnik. While the two "economical-sports societies" left their "possessions" to their central branch clubs (ASK Primorje and Ski club Ljubljana), the Society of sports friends for example left heir possessions to the owner of the Ilirija swimming pool. An interesting example is the ski club Polž leaving their ski hut "at Sv. Duh above Višnja gora together with the debit entries to joint ownership of the villages Zavrče, Pristava, Kriška vas, Nova vas, Male and Velike Vrhnje". If the villages did not accept this, the hut would become the property of the Yugoslav winter-sports association.[27] Among the successors, we can find the superior organizations or associations the societies originated from, for example "labor" associations: The natural history society in Zagreb, the board of the graphical workers association of Yugoslavia – Ljubljana branch office, cultural-educational association Svoboda. It was typical for sports clubs to have left their possessions to superior sports branch associations such as the Ljubljana football sub-association, the Yugoslav winter-sports association, the Slovene chess association, the Cycling committee for Slovenia and also to the un-named female organization that was supposed to use the "possessions" for activities of the female sport club. This example was Atena, the special female sports club in Ljubljana, a unique one in Slovenia. Sports clubs usually could have female sections, where women mainly practiced athletics, swimming, ice skating, tennis, skiing and handball.[28]

Conclusion

Sport as an activity and a sports club as an organizational form of the modern era have entered the Slovene national and cultural space in the second half of the 19th century. The organizing of sports societies, which is related to the common societies development after the cessation of the Bach neo-absolutism, has contributed to the increasing recognition and identification of "sport" - the physical-culture novelty in the domain of the "physical education" of that day. The widespread development of sport in Ljubjana as well as in Slovenia started after World War I and its organization was society-based. The society rule book was a fundamental act, today stored by the Archives of the Republic of Slovenia. The archived society rule books enable us to obtain data on organizing societies and the constitution of clubs according to the society rule books; on the other hand, these rules provide evidence on the social background of society founders within the historical time and place. These facts at the same time form a good starting point for complex studies and syntheses on the development and state of the civil society in time, milieu and place, and for a comparison to the neighboring environments.

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[26] *Examples of Ilirija and Primorje, see AS, d.p. 8039 and 8040.*
[27] *AS, d.p. 8184, 8235.*
[28] *AS, society rules of "sports clubs"*

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THE VALUES OF OLYMPISM IN THE UPBRINGING OF CHILDREN AND YOUTH

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Abstract

The aim of this paper is to present values of Olympism in the upbringing of children and youth, as the basis for understanding the Olympic movement. For Pierre de Coubertin, the Olympics were only a means of accomplishing higher goals. He did not want, in any way, that the Olympic movement omit the ambitions for accomplishing higher moral, intellectual, pedagogical and national goals. The concept and the notion of the "Olympic education" emerged in the 1970s. Today, the promotion of the Olympic education is emphasized as one of the major goals of the International Olympic Committee and the Olympic movement as a whole. The main carriers of the activities connected with Olympic education are the International Olympic Academy and National Olympic Academies.

Key words: *olympism, Olympic education, International Olympic Academy, Croatian Olympic Academy*

Introduction

The basis for understanding the Olympic movement lies in its focus on the upbringing of children and youth. Indeed, it is not possible to fully understand the Olympic movement, its goals and its role, without knowing its pedagogical values and educational aim.

For Pierre de Coubertin, the Olympics were only a means of accomplishing higher goals. He did not want, in any way, that the Olympic movement omit the ambitions for accomplishing higher moral, intellectual, pedagogical and national goals. He was of the opinion that, from a historical point of view, at the first Olympics, the International Olympic Committee dealt only with technical issues, without any moral or pedagogical contribution (Muller, 1981). Therefore, he considered it necessary not failing to emphasize the intellectual and philosophical nature of the Olympic movement. From the early beginning, he wanted to determine the role of the International Olympic Committee, so it would not be a mere sport organizer that brings the world's youth together every four years for sports competition. In 1897, Pierre de Coubertin said: 'But, gentlemen, the periodical organization of a big international competition, however difficult and complicated it may be, do not give enough, from our point of view.' (Boulongne, 1997). When speaking of the Olympic Games, de Coubertin and his closest associates would speak of a connection of physical and intellectual strength, of how sport positively influences the youth as no other means of education and that the purport of the Olympic movement is fulfilled only by spreading moral and pedagogical values among children and youth. They believed that sport develops self-confidence, the awareness of national affiliation, pride and a fighting spirit but also the patience that the youth needs. They considered sport an ideal means for upbringing children and youth and that the Olympics would fulfill their purpose and goal only after paying their full attention to the world's youth (Čustonja, 2006)

De Coubertin was a pedagogue and a humanist, his motives for the restoration of the Olympics arise from his wish to reform the educational systems and values of his time. He wanted to spread and popularize his pedagogical and humanistic ideals. The Olympics needed to serve this purpose.

Olympic education

The concept and the notion of the "Olympic education" emerged in the 1970s (Mueller, 2004). They first appeared as a result of a need to give a meaning and universal values to the Olympic movement that would be acceptable to every nation, religion and culture of the world which was burdened with the Cold War, and later with the serious endangering of the Olympic movement by the policy of boycotting the Olympics in Montreal (1976), Moscow (1980) and Los Angeles (1984). Olympic education is also the result of the research interest increase and the scientific insights about Pierre de Coubertin and his ideas that were almost forgotten since his resignation from the presidential position of the International Olympic Committee in 1925 and until the second half of the 20th century.

Today, the promotion of the Olympic education is emphasized as one of the major goals of the International Olympic Committee and the Olympic movement as a whole. It is evidential in the Olympic Charter, the fundamental document of the world's sport and Olympism. The Olympic education is directly or indirectly mentioned in the Olympic Charter at

least four times and always in a highlighted place. It is mentioned for the first time in one of the six fundamental principles that define the Olympic Charter and the Olympic movement: 1) Olympism is a philosophy of life, exalting and combining in a balanced whole the qualities of body, will and mind. Blending sport with culture and education, Olympism seeks to create a way of life based on the joy of effort, the educational value of good example and respect for universal fundamental ethical principles (The Olympic Charter, 2004). Furthermore, the first chapter of the Olympic charter defines the goal of the Olympic movement: ' The goal of the Olympic movement is to contribute to the forming of a peaceful and a better world by upbringing youth via sport, in congruence with Olympism and its values' (The Olympic charter, 2004). The same chapter presents the first duty of the International Olympic Committee as: '… to encourage and support the promotion of ethics in sport as well as education of youth through sport and to dedicate its effort to ensuring that, in sport, the spirit of fair play prevails and violence is banned (The Olympic charter, 2004). While the fourth chapter mentions the duties and the role of the National Olympic Committees and it emphasizes that the NOC: 'promotes the fundamental principles and the values of Olympism… in the areas of sport and education, by promoting the Olympic educational programmes on every level of education, in sport and physical education institutions as well as with encouraging the foundation of institutions dedicated to Olympic education, such as National Olympic Academies (The Olympic charter, 2004).

From the 1970s until today, a whole range of scientists, ideologists and pedagogues have been trying to clearly define the meaning, the role, the purpose, the attainments and the practical use of the Olympic movement. Deanna Binder (2005) points out all the major authors who have dealt with the notion of Olympic education and its basic theory. By analyzing and uniting, she defines the basic pedagogical goals of the Olympic education: 1) the ennobling of life with physical activities and sport which, blended with culture, represent a whole life experience 2) the development of awareness of human solidarity, tolerance and mutual respect that is connected with fair play 3) the encouraging of peace, mutual understanding, the respect for different cultures, environmental protection and fundamental human values and rights in consistence with the attainments of other nations and cultures 4) the encouraging of excellence and high attainments in accordance with fundamental Olympic ideas and 5) the development of consciousness of the continuity of human civilization by teaching ancient and modern history of the Olympic movement (Binder, 2005). Based on the goals mentioned, Bender formed five basic topics, that is, five areas that are enclosed and defined by Olympic education: 1) Body, mind and spirit: encouraging children to take part in sport 2) Fair play: sportsmanship in life and community 3) Multiculturalism: teaching how to live with those different than us 4) Achieving excellence: the identity, self-confidence and self-respect and 5) Olympism yesterday and today: celebrating the spirit of Olympism (Binder, 2005)

International Olympic Academy and National Olympic Academies

Although the modern societies are not fully aware of the fact that the Olympic movement is essentially both a pedagogical and an educational movement which addresses the youth of the entire world, that does not reduce its significance. On the contrary, all the things mentioned above are the reason why Olympic education should be emphasized and insisted on now more than ever. That is, the history of the Olympic movement has been marked with difficult moments and several times in its history, the Olympics could not have taken place. The turning point in the Olympic history were the Olympics in Seoul in 1988 and in Barcelona in 1992. After the mentioned Olympics were successfully organized, the Olympic movement records a high increase in every respect. It is best shown by economic statistics. The profit of the International Olympic Committee during the 28th Olympics (the four year period from 2001 to 2004) had almost doubled when compared to the 26th Olympics (1993-1996). There were sold twice as many tickets for the Olympics in Sydney in 2000 than for the Olympics in Barcelona in 1992, and the proceeds of ticket selling were increased nine times. The sponsor profits for the Olympics in Beijing in 2008 will be four times higher than for the Olympics in Barcelona. The Olympics in Athens were transmitted in 220 countries and were watched by 3.9 billion people. TV rights were sold for a 2.5 times larger amount of money than for the 1992 Olympics (official data of the International Olympic Committee, www.olympic.org). Although one could claim before that the Olympic movement neglected its original role and importance in its fight for survival, today, this is not the case. Anyone who is well acquainted with the International Olympic Committee will recognize an enormous effort and considerable financial means that are invested into the concept of Olympic education. The main carrier of the activities connected with Olympic education is the International Olympic Academy.

The International Olympic Academy started working on July 14, 1961 in Olympia, in the vicinity of the remains of ancient Olympia on the Greek peninsula of Peloponnesus, just over 300 km to the north-west of Athens. Athens is today the world's centre for the research and promotion of Olympism and its philosophical, cultural, sociological, historical, economic, ethical, educational and other aspects. Its duty is to preserve Olympic ideas, to spread pedagogical and humanistic world views about sport, to blend sport with culture and to present a higher, wider and more significant sense about the Olympics, from mere sport competition and record chasing. The most significant goals of the International Olympic Academy that functions as an international academic centre for the research of the Olympic movement are the promotion and the development of Olympic education, that is, of de Coubertin's philosophy of education through and with the help of sport, in other words, with the help of the Olympics. Its other important goal is encouraging National Olympic Committees and National Olympic Academies to function in that sense on a national and an international level.

Pierre de Coubertine first encouraged its foundation in 1927: 'I was not able to end something that I wanted to make perfect. I believe that a centre for the research of Olympism would more than anything help in preserving and continuing what I have started and prevent the Olympic movement from going in a wrong direction'. (http://www.ioa.org.gr/ioa.htm) Much credit for the realization of de Coubertin's idea goes to a German called Carl Diem and to the secretary of the Greek Olympic Committee, Ioannis Ketseas.

Every year, the International Olympic Academy organizes about 40 seminars, consultations, study tours and postgraduate studies. The most important educational programmes are: the International gathering of young participant (students and athletes), International seminar for postgraduates about Olympism, International gathering of NOA's presidents, International gathering of pedagogues and officials of higher-education institutions for sport science, International consultation of sports journalist etc. In an almost idyllic atmosphere of ancient Olympia, conclusions about numerous current issues about Olympism and the Olympic movement are discussed. The goal is to gather and educate people who would later on spread the gained knowledge about the Olympic movement and the values of Olympic education in their own countries.

As already emphasized, the Olympic Charter stipulates that the National Olympic Committees have the duty to found and take care of institutions for Olympic education. On a national level, the most important institutions are the National Olympic Academies. National Olympic Academies are founded in just over than 100 countries and today they work as subsidiaries of the International Olympic Academy, with the same goal and the range of activities as the IOA – spreading Olympic education on a national level. The Croatian Olympic Academy was founded in 1996.

Croatian Olympic Academy

Since its foundation, the Croatian Olympic Academy is the carrier of different programmes for Olympic education in Croatia. Although it operates in relatively modest conditions, it succeeds in realization of more than 50 programmes a year that are dominantly oriented towards various aspects of Olympic education. Even though it seems that sport in Croatia is very popular and developed, compared to most of the countries in the European Union and several countries in the world, a small number of Croatian children take part in some sport. The available data report that about 40 000 young athletes are registered in the Zagreb area (Puhak, 2001) or just 23% of the entire youth population under 19 years of age. We can presume that the data for the entire country can significantly differ, that is, that the situation is much worse in the entire Croatian area than the mentioned example for the City of Zagreb. In Finland, four out of five children (80%) under 18 years of age practice some sport in their free time. 40% does that four or more times a week (Nieminen, L., 2003). Our first duty has to be providing favorable conditions for engaging a significantly higher number of children in sport activities, which already is the main goal of the Olympic educational programmes.

Furthermore, our elementary and secondary school children learn very little or nothing at all about the Olympic movement, its history and values. They are left to the public media in forming their view of sports and its values, that emphasize sport results and winning medals as a dominant value of sport. Is it wrong to claim that today, the upbringing of youth in sport and through sport is approached in a slapdash manner and that very little people are capable to understand and accept sport not as achieving sport results of the chosen competent elite, but as something that achieves results in higher pedagogical ideals of a larger number of youth. Social, anthropological, sociological and many other values that children need to obtain through sport are almost immeasurable. Not too many are capable of achieving excellent sport results, but sport is not intended just for them. The duty of the Croatian Olympic Academy is to function in that area as well – to enable children and youth that are not capable of achieving excellent sport results to continue practicing sport.

There are numerous other areas of Olympic education that the COA deals with that we can summarize under several specific programmes that are being realized or planned: 1) 2) promoting cultural aspects of sport by organizing annual competitions of elementary and secondary school students and by organizing thematic exhibitions in painting, sculpture, film and video art, photography, music, literature etc. 3) organizing annual seminars and workshops about Olympism for physical education students (but not only for them) 4) implementation of Olympism into the curriculum and physical education programmes in schools and universities 5) publishing educational material about Olympism for school teachers 6) organizing Olympic camps for the youth.

However, it is possible and necessary to teach about Olympism in some of the following programmes we are planning to realize: 1) organizing seminars and workshops for sports journalists about Olympism, the Olympic idea and the Olympic values 2) organizing consultations and round tables for the exchange of ideas and experiences of sport officials and sport administrators 4) publishing and distribution of educational material about Olympism, intended for every age and the general public 4) encouraging and awarding scholarships for the research of Olympism in Croatia etc.

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WINNING MEDALS AT THE OLYMPIC GAMES – DOES CROATIA HAVE ANY CHANCE?

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Abstract

As the Olympic Games were developing and their popularity and relevance grew winning medals also became important and a matter of national and political prestige. Despite International Olympic Committee's refusal to recognize countries rankings by medals, the medal table is updated on a regular basis and plays a dominant role in media coverage and public interest (Rathke and Woitek, 2007). Naturally, this has led researchers to explore the socioeconomic, cultural and geographic underpinnings of Olympic success. The aim of this paper is to review the current state of the research on factors that influence national Olympic Games success. Majority of studies consider variables like: population, GDP and GDP per capita, hosting or neighboring country advantage, political system, sports system, health expenditure per capita, climate, etc., as factors that potentially have impacts on a countries' medal count. The research has shown that economical factor, mainly GDP per capita, has statistically significant influence on the explanation of numbers of medals won by a certain country at the Olympic Games, as does the political system, but the influence of population size was not confirmed. Having in mind mentioned factors it is unlikely for Croatia to significantly increase the number of the Olympic medals in the future.

Key words: *Olympic medals, GDP, population size, political system*

Introduction

It was Pierre de Coubertin idealistic concept that the most important thing in the Olympic Games is not winning but taking part. Genuine Olympic spirit emphasizes participation rather than winning. However, as the Olympic Games were developing and their popularity and relevance grew winning medals also became important and a matter of national and political prestige. Similar thing happened with idea that the Olympic Games were created for the glorification of the individual champion. Even today according to Olympic Charter (2007:19) "The Olympic Games are competitions between athletes in individual or team events and not between countries". Despite this statement and the International Olympic Committee's refusal to recognize countries rankings by medals, the medal table is updated on a regular basis and plays a dominant role in media coverage and public interest (Rathke and Woitek, 2007). Naturally, the tremendous interest in national Olympic achievement has led researchers to explore the socioeconomic, cultural and geographic underpinnings of Olympic success. The intent of such research has not been to discount the primary importance of individual athletic talent, but rather to explore the fundamental factors affecting the ability of this talent to develop, flourish, and ultimately win medals at the Olympics.

The Olympic movement celebrates a spirit of international competition, of global athletic excellence. Yet all nations do not have an equal ability or willingness to participate in the Games, nor do they have an equal ability to win medals if they do participate. At the Summer Olympics Games 2004 in Athens, more than 11 thousand athletes from 201 countries competed for medals in 301 different disciplines. In total 929 medals were distributed. More than half (56%) of all medals (514 medals), and 60% of all gold medals (180 gold medals), were collected by the 10 most successful countries which only comprise one third of the world population, and excluding China they account for only 14% of world population (Groot, 2007). About 63% of the participating countries (124) did not get any medal, and only one out of four participating countries succeeded in winning at least one gold medal (56 countries) (Groot, 2007).

However, a greater distribution of medals won at Olympics to a greater number of countries can be noticed. Since 1988 and Olympic Games in Seoul when five strongest national teams won 64% of all gold medals Olympic Games become more competitive and in Athens 2004 their share had shrunk to 42%. Accordingly, in 1988 gold medals were won by 31 countries while in Athens 56 countries managed to won gold medal, and 7 of them were new states founded after 1990.

With the growing competition at the international level country like Croatia must consider factors that contribute to Olympic success in order to maintain its good Olympic results or even to excel them. Croatian athletes competed for the first time at the Olympics in 1992 at the Winter Olympic Games in Albertville. Since than Croatia has won 12 medals (three gold, four silver and five bronze medals) at the Summer Olympic Games and 7 medals (four gold and three silver medals) at the Winter Olympic Games.

The aim of this paper is to review the current state of the research on factors that influence national Olympic Games success. Majority of studies consider variables like: population, GDP and GDP per capita, hosting or neighboring country advantage, political system, sports system, health expenditure per capita, climate, etc., as factors that potentially have impacts on a countries' medal count. Theoretical background for these studies is simple. It is assumed that athletic talent, as most physical attributes, is most likely distributed normally in the population. If medal caliber athletes were randomly distributed in the world population, one would expect medal share of a country should be equal to its share of population of participating countries at the Olympics (Bernard and Busse, 2000; Lui and Suen, 2008). However, as was already shown, this is not the case.

Population and economical factors

To our knowledge the first study to analyze the factors influencing success at the Olympic Games appeared after 1952 Olympic Games in Helsinki. Jokl et al. (1956) (according to Rathke and Woitek, 2007) in the study *Sports in the Cultural Pattern of the World: A Study of the Olympic Games 1952 at Helsinki* where first to use Gross Domestic Product (GDP) as potential predictor of Olympic success. Using GDP is more than justifiable since it can indicate on countries' economic development and assumptions about available resources for athletes' training, building and maintaining training facilities, developing better educational system for coaches, supporting scientific research and consequently developing better training methods can be made. Numerous later studies used GDP as a variable in national Olympic Games success studies. (Johnson and Ali, 2000, 2004; Bernard and Busse, 2000, 2004; Matros and Namoro, 2004; Kuper and Sterken, 2005; Roberts, 2006; Groot, 2007; Rathke and Woitek, 2007; Lui and Suen, 2008)

Importance of population size on Olympic success is a logical assumption. Size of population, if nothing else, determines how large the base or pool of potential talents for future success is. Although, we can find enough examples of countries like India, Bangladesh, Thailand, Brazil, Indonesia, Nigeria, Pakistan or Iran that despite large population have relatively low success rate at the Olympic Games. Nevertheless, in combination with GDP as an economical indicator, size of population is the most frequently used parameter. (Johnson and Ali, 2000, 2004; Bernard and Busse, 2000, 2004; Matros and Namoro, 2004; Kuper and Sterken, 2005; Roberts, 2006; Groot, 2007; Rathke and Woitek, 2007; Lui and Suen, 2008)

Bernard and Busse (2000) examine the question of how many Olympic medals a country should win regarding its size of population and economical power. They begin with a simple hypothesis that athletic talent is randomly distributed and therefore medal winning should be proportional to population. The authors concluded that size of population cannot adequately explain the distribution of medals across countries, and find significant evidence that other resources, GDP in particular, are better predictors of national Olympic performance. They calculated that if the average country were to double its total GDP, it could expect the number of medals it wins to rise by 1-1.5% of the totally awarded medals. Insignificance of population size or its small influence on Olympic medals winning comparing to other factors was reported in some other studies. Roberts (2006) using count data analysis concluded that the size of population has no explanatory power on Olympics medal count. Rathke and Woitek (2007) reported that size of population has negative sign in estimation of Olympics success. According to them only very rich counties with relatively small population can gain from population increase, which is reasonable: for poor countries, a population increase reduces resources available for producing Olympic success. Studies of Johnson and Ali (2000, 2004), Matros and Namoro (2004) and Lui and Suen (2008) find that population size together with GDP and other factors have positive effects on Olympics success.

Regarding influence of an economic condition of a country on Olympic success, Johnson and Ali (2000, 2004), Bernard and Busse (2000, 2004), Matros and Namoro (2004), Kuper and Sterken (2005), Roberts (2006), Rathke and Woitek (2007) and Lui and Suen (2008) results suggested that high GDP per capita is associated with success at the Olympic Games. Roberts (2006) concludes that GDP per capita has a positive impact but show decreasing returns to scale (a smaller positive impact at higher levels of GDP per capita). He calculated that increase in GDP per capita of $10.000 will increase medals count for approximately two medals. The effect is more pronounced for gold medals than for all medals, with much larger nations seeing very little increase in gold medal counts for each successive increase in size. A small decrease in importance of economic conditions comparing to other factors on Olympic success was reported by Kuper and Sterken (2005) study especially after World War II Olympic Games.

Although the studies used different statistical models and methodology for researching the influence of GDP per capita and population size on medals won at the Olympics, they can, in some way can explain why richer and lager countries win more medals at the Olympics. Nevertheless this approach relying only on population and economical factors has limitations, as it is explained by Matros and Namoro (2004). For example, former European socialist countries have experienced dramatic changes in their Olympic performances. These changes can hardly be accounted for by observing the trends in indicators such as GDP per capita, population etc. They show a drastic drop in the number of medals won by Bulgaria, Hungary, Poland and countries that formed former Soviet Union after 1988. Moreover, the total number of medals won by the unified Germany in 2004 is, by far, less than the number of medals won by East Germany alone in 1988. The changes in the GDP per capita and the populations of these countries are disproportionate to the changes in

the number of medals won. Logical assumption is that other factors influence Olympic success more than pure GDP and the size of a population. Also, no single nation is able to dominate the Olympic Games in all sports. If they were, than success would be based solely on population and GDP for each country.

Above mentioned reports about influence of population size and economical factors (in most cases GDP per capita) are not encouraging for countries like Croatia. Relatively small population size and, comparing to richest nations, lower GDP per capita does not promise further and significant raise in Olympics medals. Nevertheless, unclear data regarding importance of population size and in recent studies (Roberts, 2006 and Kuper and Sterken, 2005) not so high GDP per capita influence as well as importance of other factors on winning the Olympic medals opens some space for future optimism for Croatia.

Political system

At the Summer Olympic Games in Seoul 1998, Democratic Republic of Germany (DDR) with population of about 17 millions won more gold medals (37) than the USA (36). About 56% of all gold medals (133) went to the communist countries, while five communist countries (account for 4.1% of the world population) in top 10 won 120 gold medals or about 50% of all gold medals. Although extensive claims have been made that the use of doping may have played certain role in these results, for sure these former communist countries have shown that purposive sport policy can breed Olympic success (Groot, 2007). Therefore, it was logical to include political system variable in studies that are trying to explain what produces Olympic medals.

Johnson and Ali (2004) argue that countries under single party and communist regimes send similar number of athletes to the Olympics as non communist countries, but win more medals in both summer and winter Olympics. Higher medals count for communist countries than expected was confirmed by Bernard and Busse (2000, 2004) and Kuper and Sterken (2005). Matros and Namoro (2004) argue that change in political system of communist countries to free market countries resulted in lower medals count at the Olympics. Rathke and Woitek (2007) reported that former communist countries used to outperform the other participants in absolute terms, given the same amount of available resources. However, in post Cold War era effect of having a communist political system or being a former communist nation is no longer significant. (Roberts, 2006) Experience of strong political will in former communist Yugoslavia to do well at international sport level could be used, with certain modification, in countries like Croatia. As a nation we have a good tradition of government and public interest in sport. Nowadays we have to use this public interest in sport for good and strategic use of resources in order to develop new elite sport system as well as for mobilization of new resources by government. According to findings presented in this paper it seems that only strategic approach to sport development at the governmental level can affect future success at the Olympic Games for Croatia.

Hosting the Olympic Game and other factors

Apart from above mentioned factors we can find in current literature other potentially significant variables influencing the Olympic success. For example, according to Bernard and Busse (2000, 2004) host countries typically win an additional 1.8% of the medals beyond what would be predicted by their GDP alone. Similar results were reported by Johnson and Ali (2000) and Rathke and Woitek (2007). They concluded that there are undeniably large advantages to being the hosting nation, both in terms of participation and medal counts. Lui and Suen (2008) predicted that China at the 2008 Olympic Games only on account of hosting the Games will win about 14% more medals than in 2004. Kuper and Sterken (2005) underlined that host effect is strong especially for participation, but it used to be more important at the older edition of the games. Host effect was not confirmed by Roberts (2006).

Kuper and Sterken (2005) build on the economic model to show that climatic conditions are an important variable for outdoor sports and that this will affect medal success. Countries with temperature warmer climates (Australia, China, Russia and USA) or colder humid countries (Canada and Sweden) are expected to win more medals. Johnson and Ali (2000) and Roberts (2006) indicated that colder climate nations perform better than the warmer ones.

Research has shown that some other factors like health expenditure per capita (Roberts 2006), education and life expectancy (Lui and Suen, 2008) do not contribute to Olympic success.

Conclusions

After reviewing the current state of the research on factors that influence national Olympic Games success we can conclude that an economical factor, mainly GDP per capita, has statistically significant influence on the explanation of numbers of medals won by a certain country at the Olympic Games. Although logically quite clear reported research data does not firmly support relevance of national population size on Olympic Games success. Importance of political system in winning Olympic medals was confirmed especially in the case of former communist countries. Hosting the Olympic Games and certain climate conditions also significantly contribute to Olympic success.

Having in mind mentioned factors it is unlikely for Croatia to significantly increase the number of the Olympic medals in the future. Only strategic approach to sport development that is, good and strategic use of resources for developing new elite sport system as well as for mobilization of new resources by government, can make a difference in future success at the Olympic Games for Croatia.

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THE LAST AUSTRO-HUNGARIAN TRIESTE (1900-1918)

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Abstract

The connection between gymnastics/sports and nationalism/irredentism during the period between the beginning of 1900 and World War I in the Kingdom of Italy and in the territories belonging to the Austro-Hungarian Empire, characterised by an Italian majority of population, is well-known and analysed. We are going to consider it with particular reference to the town of Trieste and its surroundings, in order to prove that this connection was wider and more complex.

Key words: *history, sports, irredentisms, patriotism, internationalism, 20th century*

The new century

Trieste, in the north of the Adriatic sea, has 175,000 inhabitants of Italian majority, but it is one of the most important towns of the Austro-Hungarian Empire, growing both from an economic and from a demographic point of view. The town also hosts many Slovenians and various other minority groups who, in addition to the frequent travellers, are a connection to the latest innovations (sports included) coming from the European capitals. The ruling class is the cosmopolitan business class. A large part of the working class lives in small, unhealthy houses, working hard, with a low wage and without protection. The socialist movement has therefore a great development also in this town, almost constantly supporting a federal reform of the Empire. The liberal-national movement, contrary to Slavic people and to socialism, which protects the interests of many Italians belonging to the lower and middle class and their wish to get closer to their mother country has a high influence over the town government. The sport societies of Italian language will often represent and expand this wish. Some of them are and will be a very powerful instrument of the liberal or republican irredentists. On the other hand, following a new Slavic linguistic and cultural conscience, Slovenians too begin having their own Sokols, sport and cultural societies already existing in the empire, which support and promote this conscience, together with other cycling, climbing and hiking societies. The German-speaking minority group in the town belongs to the Civil Service, to the army and to the middle and upper class in general, and it has its own newspapers and circles, also sport ones. (Amodeo 2004; Stener 2002; Zanetti Lorenzetti 2002; Rupel 1981)

An in-depth chronological analysis

Elisabeth of Austria is murdered in **1900**: in Trieste, some pro-Empire people besiege the liberal-national Unione Ginnastica –UG (Gymnastic Union), defended by its gymnasts. The King of Italy is murdered too: the UG, in mourning, suspend its activity until the funeral. The cosmopolitan Adria organises a rowing regatta with local societies of Italian and German languages, Eintracht and Hansa, the latter however composed also by Italian-speaking upper class exponents. In the upper class and distinguished Lawn Tennis Club of Trieste there are irredentists as well as moderate persons. The only Sokol in town, which is just interested in gymnastics of all sports, has 172 members. It has and will have contacts with the Sokols and other associations of the current Slovenia. Finally, it is to be remembered that also the Jewish sport circle Maccabi is operating in the town. (Pagnini et al. 1993; Caroli 1997; Lipott 2005; Stener 1988; Del Campo 1998; Pavletic 1999 and 2004) In **1901** the famous Italian composer Verdi died: UG commemorates him and for this reason it is closed by the Hapsburg authority. The smaller society Juventus is established, an irredentist one as well. Some athletes from the Kingdom of Italy take part in an important rowing race in Trieste. This will often occur until the world war, as well as the presence of local German-speaking athletes and Italian-speaking athletes from the Adriatic regions of the Empire. The best tennis tournament hosts upper class and aristocracy athletes from Italy and from the Empire. The Sokol organises parties and gymnastic competitions with the Sokol of Gorizia, a close and multilingual town, but the Municipality of Trieste (with an Italian majority) obstructs this kind of entertainment. (Pagnini et al. 1993; Stener 1988; Del Campo 1998; Pavletic 2004) In **1902**, after a long wait, UG is replaced by the sports club Società Ginnastica – SG (Gymnastic society), also a liberal-national one. It takes part in competitions in Italy and entertains not less than 1000 members. The Sokol too combines and will combine gymnastics and entertainment. Finally Italy gets closer to France and England; the nationalist movement becomes stronger at home as well as the irredentist movement gets powerful abroad. (Pagnini et al. 1993; Pavletic 1999 and 2004; Burba 2006) In **1903** an ultranationalistic movement is established in Italy; two renowned SG instructors take part into it; they prepare in their premises an armed crossing of the frontier by Garibaldians (Pagnini et al. 1993). In **1904** the police finds in the SG, whose athletes compete and will often compete in Italy, two bombs and

some explosive material; the society is closed by the authorities a couple of days later. Several other sport societies are established in Trieste, especially Italian irredentist ones, such as Edera, at first inspired by Mazzini's ideas, later by republican ones; many times closed by the authorities, it will continue its sport activities by slightly changing its name. The same for the rowing society Nettuno, inspired by Mazzini's ideas too, and the sailing society Adriaco, of upper class extraction, which always maintained good relations with the Italian sailing societies of the Kingdom and of the Empire. Later, the local Slovenian branch of the Climbing Circle of Ljubljana is established, with 103 members, as well as the International Circle, which takes inspiration from the Mitteleuropean socialist sport societies and will deal with walking tours, in addition to various sports and entertainment. As far as the town Sokol is concerned, which is middle class, contrary to trade-unions and to socialism, it has a new, large office and a new gymnasium; in its president's opinion, the Sokols have a clearly irredentist purpose. (Pagnini et al. 1993; Caroli 1997; Lipott 2005; Pavletic 1999 and 2004, Bourlot 1984; De Szombathely 2003; Rupel, 1981) In **1905** the patriotic German sports club Eintracht, with 130 members, opens the premises of its rowing society in the presence of many German-speaking people, but there are also some Italians. The rowing is therefore a means of confrontation, as well as of coexistence. Slovenians, on the contrary, are always absent from this context, however their Sokol is a member of the new League of the Slovene Sokols; the alpine branch has much more members. In the Italian community, the SG is replaced by the new Unione Triestina with 400 members, in addition to Juventus. The Edera's soccer team will never be allowed to cross the border, and it will never participate in Hapsburg championships; it will always play in Trieste with local teams, even not Italian ones, or with Italian teams from the Kingdom and from Istria, always before a large audience. Many athletes of irredentist belief are denied the possibility to take part into the Italian championships. (Stener 2002; Pavletic 1999 and 2004; Pagnini et al. 1993, Rupel 1981, Lipott 2005, Bourlot 1984; Zanetti Lorenzetti 2002) In **1906** Juventus and Edera compete in Italy. In Trieste, some Italians coming from the Empire take part into a motorbike meeting. Besides, the president of the Sokol of Trieste, whose athletes compete in Zagreb, is appointed vice-president of the Slovene League. (Pagnini et al. 1993; Pavletic 1999 and 2004; Lipott 2005, Zanetti Lorenzetti 2002) In **1907**, the Associazione Ginnastica – AG (Gymnastic Association) is established in Trieste, replacing the closed SG; it is a liberal, national sports club too, which also provides entertainment for its members. In the meanwhile the liberal-national climbing society Alpina delle Giulie, has more than 500 members and it sets itself against the town branch of the German-Austrian Alpine Club. As to the Slovene Sokols, they not only got together in a League, but for the first time they take part in the meeting of all Slavic Sokols in Prague, where there are also some people from Trieste. (Pagnini et al. 1993; Società Alpina delle Giulie 2008; Pavletic 1999 and 2004) In **1908** also the AG competes in Italy; in mourning, it sends volunteers and money to the south of Italy, which has endured a tremendous earthquake. Besides, the Unione Velocipedistica of Trieste wants to create a federation of the Italian cycling societies of the Adriatic area of the Empire. As to the Slovene environment, the town Sokol, influenced by the energy of the Slovene and Slavic movement, almost redoubles its members (274) for the first time, and it parades through the town in uniform. Later, another Sokol is established, along with two branches of it in the surroundings, but only one Orel, a catholic society similar to the Sokols in its moral strictness and in its narrow-mindedness as far as women's sport is concerned. (Pagnini et al. 1993; Pavletic 1999 and 2004; Zanetti Lorenzetti 2002) In **1909** AG and Edera are closed because of their clear irredentism. Meanwhile, the Sokols of Trieste take part in some celebrations along with the Czechoslovak, Croat and Slovene ones. They participate in the first congress of the Sokols of the coastline, together with other 7,000 followers and 5,000 sympathisers coming from the surrounding areas of Slovenia, Croatia and Austria. The local Sokols are therefore more and more thriving, organised and they are part of a larger context. Finally there are other contacts between Slovene cyclists from Trieste and Gorizia, and between these and the Croat ones. (Pagnini et al. 1993; Bourlot 1984; Pavletic 1999 and 2004; Rupel 1981) In **1910** Trieste is larger than Prague, third town of the Empire after Vienna and Budapest. The Slovenians, in great number, consider the town a cultural and political centre for all the Slavic people of the southern part of the Empire. The AG is replaced by the Ginnastica Triestina – GT (Gymnastics of Trieste), which is a liberal, national sports club, which very soon counts 3,000 members, to which supporters, families and youth are to be added, for a total of 7,000 persons! A federation of gymnastics is established later by the Italian societies of Trieste, with the purpose of promoting gymnastics and other sports. The various local Italian clubs meet during the cycling tour of the town. The wrestling and swimming competitions allow the Italians of the Kingdom and of the Empire to meet. The activity of the Slovenians also increases: other 6 new Sokols are established in Trieste and its surroundings. At the end of the year, the opinion of the president of the Sokol of Trieste is that the town is to become Slovene. There is an increase also in the members of the Slovene alpine club (213), but the Italian nationalists have the authorities forbid the cycling race Ljubljana-Gorizia. Finally, a Slovene rowing society is established during these years. (Amodeo 2004, Pagnini et al. 1993; Zanetti Lorenzetti 2002, Pavletic 1999 and 2004; Rupel 1981) In **1911**, with the opposition of the local working class, another Sokol is created in the most socialist neighbourhood of the town; in the surroundings, as a further sign of irredentism, the Yugoslavian cycling championship starts and arrives, as will happen in the future. Czech and Polish athletes will also take part into it. (Pavletic 2004, Rupel 1981) In **1912** other three Sokols are established. The Sokol of Trieste increases its members. The Sokols of Trieste meet all Slovene and Slavic Sokols in Prague again. The Italian people of Trieste on the other hand compete in Italy, in sailing, gymnastics and athletics. The Adria organises instead some rowing competitions with Austrian and local German-speaking people as well. (Pavletic 1999 and 2004; Zanetti Lorenzetti 2002, Pagnini et al. 1993; De Szombathely 2003, Caroli 1997) In **1913** the Italian irredentist movement gets stronger also in Trieste; as a

reaction, some pro-Hapsburg people steal almost all the collection of medals of GT, which often competes in Italy. The GT then celebrates its fiftieth anniversary with the Italian majority of the town council, as well as with delegations of the Italian sport societies from the Empire. The tennis club of Trieste also thrives, with more than 100 members, athletes form Italy and Austria as well; some of its athletes compete in the Veneto region. It is therefore a moderate association. In the Slovene environment other two Sokols are established in Trieste and its surroundings. The president of the Sokol of Trieste, a deputy in Vienna, reports about the prohibition of organising a large meeting of all Slavic Sokols. The meeting of the Sokols of the area of Trieste takes place on the contrary, with more than 100 gymnasts and 10,000 supporters, a clear sign of their being deep-rooted in the territory. (Burba 2006, Amodeo 2004, Pagnini et al. 1993, Del Campo 1998, Pavletic 1999 and 2004) In **1914** the members of the Sokols of Trieste and surroundings are over 2,300, the members of the Sokol of Trieste are 895; the latter has remarkably increased, as is to be said for the Slovene alpine society, but the relations with the Italian sports societies of Trieste and of the Empire are still non-existent. The international and local situation is becoming dangerously worse; many people have already been called by the emperor's army. A bomb is thrown against the Sokol of the socialist neighbourhood. The GT organises a huge gymnastics meeting of the Italian sports societies of the Empire; the foreman of the jury belongs to the Italian gymnastics federation. But at the end of the day the event, attended by a large audience, stops: Francis Ferdinand and his wife have been murdered in Sarajevo. Two weeks later, there is a meeting of the Sokols of the area of Trieste with 729 gymnasts, 2,000 spectators and the leaders of the Sokol of Ljubljana. It is the last one, with a low profile. After two weeks World War I begins. GT and Edera lose more and more members, as many managers, instructors and athletes escape to go to Italy. They will be the majority of all the volunteers from Trieste in the Italian army. Many people belonging to the Adriaco escape to Italy or hide themselves, whereas the majority of the tennis club will fight on the Empire's side. Many members of the Sokols are sent to the front with the emperor's troops, others are imprisoned. (Amodeo, 2004, Pavletic 1999 and 2004 Società Alpina delle Giulie, Pagnini et al. 1993; Bourlot, 1984; De Szombathely, 2003; Del Campo 1998) In **1915**, Italy too enters the war. Some pro-Hapsburg extremists rob and set fire to the GT; all pro-Italian societies are closed by the authorities, their members are persecuted and often imprisoned. Raicevich, the famous wrestler from Trieste, enters the Italian army as volunteer. (Amodeo 2004; Pagnini et al. 1993, Lipott 2005, Zanetti Lorenzetti 2002, De Szombathely 2003; Trifari 2006) In **1917** the president of the Sokol of Trieste proclaims: "Independent Slovenia". Associations of workers, rowing, physical education and sailing ones also die, while the dream of a socialist unity inside the Empire is disappearing. (Pavletic 2004, Caroli 1997) **At the end of the war**, Trieste becomes part of the Kingdom of Italy. 130 volunteers from GT and Edera are dead; many acts of heroism have been performed. The German-speaking minority goes back to their mother land or stays in a now foreign land. The Eintracht sadly closes; only the rowing Hansa survives for a little time. The Slovene sportsmen had to fight for almost another year, and sometimes they had to die for an empire which had clipped their dreams of freedom, often against other Slavic people like Serbs and Russians. They have performed many acts of heroism too. However , an independent Slovenia with Trieste as capital is still a dream. (Amodeo 2004, Pagnini et al. 1993, Bourlot 1984, Pavletic 1999 and 2004; Stener 1988 and 2002)

Conclusions

In the brief space granted to us, we tried to prove that the connection between gymnastics/sport and nationalism/irredentism during the period between the beginning of 1900 and World War I in the Kingdom of Italy and in the territories with an Italian majority in the Austro-Hungarian Empire, in the case of Trieste and its surroundings was wider and more complex. As a matter of fact, it has included opposed irredentisms (the Italian and the Slovene ones), patriotism (the pan-Germanic one), as well as socialist internationalism. We have also proved that, in the field of sports, these irredentisms have been even wider and more radicalised by the decision to have contacts only (in the case of Slovenians) or almost only (in the case of Italians) with one's own ethnic group, culture and reference organisations. During the war the members of the sport societies of the opposing factions have often reacted with consistency, sometimes with great courage, trying to achieve their ideals by the only way which war allows: the violence.

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HISTORY OF SPORT AND GYMNASTICS AS A UNIVERSITY COURSE AND SUBJECT OF PUBLICATION IN CROATIA

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Abstract

The first higher education institution for sport teachers in Croatia was a *Training Course for Gymnastics Teachers* organized in Zagreb 1894–1896. Course *History of Gymnastics* was being taught there and the lecturer was Franjo Bučar. For this reason we consider him to be the first History of sport and gymnastics lecturer in Croatia. Ever since the Faculty of Kinesiology was founded in 1959, history of sport and gymnastics (under different course titles) was an integral part of the program. There where three History lecturers at the Faculty of Kinesiology since than Živko Radan 1960-1991, Zdenko Jajčević 1991-2007 and Zrinko Čustonja 2007 - present. First book on sport history was published in Croatia in 1908 by Franjo Bučar. There are about 2000 publications dealing with the Croatian history of sport and gymnastics. There where several Sport History societies in Croatia established in the last 50 years.

Key words: *history of sport, Croatia, teaching subject, publications, societies*

Sport history as a course on institutions of higher education

The first higher education institution for sport teachers in Croatia was a *Training Course for Gymnastics Teachers* organized in Zagreb 1894–1896. Course *History of Gymnastics* was being taught there and the lecturer was Franjo Bučar. For this reason we consider him to be the first History of sport and gymnastics lecturer in Croatia. He also lectured the same course at the junior college for physical education in Zagreb in 1941. Being that he wrote several significant papers on the subject, he is also considered a pioneer of sports and gymnastics historiography. Ever since the Faculty of Kinesiology was founded in 1959, history of sport and gymnastics (under different course titles) was an integral part of the program. From 1959, *History of Sports Culture* course consisted of 84 hours of lectures in 3rd and 4th semester; from 1963, of 70 hours of lectures in 3rd and 4th semester; from 1968, of 56 hours of lectures in 1st semester; from 1970, of 40+20 hours of lectures in 1st semester; from 1977, of 45+15 hours of lectures in 1st semester; from 1981, of 45+15 hours of lectures in 1st semester; and from 1993 of 30+15 hours of lectures in 3rd semester.

Subject of the course History of Sport and Gymnastics

Sport history lectures dealt with sport and gymnastics in world and Croatia since their first appearances in primeval communities to modern world. Till 1990 (while Croatia was a part of Yugoslavia) significant part of lectures referred to sport history in other Yugoslav republics. Basic lecture topics were: the ancient world – Assyria, Egypt, Crete, Greece, Olympic Games in antiquity, and Rome; the Middle Ages – Renaissance, Enlightenment and Philanthropies; the Modern World – Gymnastic Systems, Modern sport, Modern Olympic movement, Pierre de Coubertin, Olympic charter, International Olympic committee and Olympic games; Croatia - the Ancient World, the Middle Ages, the Modern World, Ancient sports till 1903, Modern sport, Croatian Sport Federation, Croatian Sokol (falcon), Franjo Bučar, Physical Education, Olympic movement, and evolution of different sports in Croatia.

Sport history lecturers

Živko Radan

Živko Radan was the first Sport History lecturer at the Faculty of Kinesiology. He graduated in sports in 1949 at the State Institute for Sports in Belgrade, and he also graduated history in 1960 at the Faculty of Philosophy in Zagreb. In 1960 he became a lecturer, and in 1964 a higher lecturer of Sport History. He finished his post-graduate studies in 1965, and in 1967 he defended his master thesis *Franjo Bučar and the Origin of Sport and Gymnastic Movement in Croatia*. In 1977 Radan became a PhD holder by defending his doctoral thesis *Olympic Movement on Yugoslav Territory until 1919*, at the Faculty for Physical Education in Belgrade. Since 1960 when he became a Sport History lecturer, Radan wrote many significant papers concerning the field. His papers include accounts on evolution of different sports, but also very complex works on Franjo Bučar's biography and advance of Olympic movement in South Slavic countries. The facts in

his writings are reliable, and he is a gifted observer of historical correlations in regard to physical education and sport in Croatia. We can state that Živko Radan founded scientific contemporary sports historiography. His master thesis, probably his most important work, describes the basics of Croatian sport history. Through the life of brilliant Franjo Bučar, Radan depicts the evolution of sport in the difficult period of Croatian history from the mid 19th to mid 20th century. The life of Bučar is as tragic as Croatian sport history and Croatian history in general. At the end of 19th century, Hungarians were in charge of all sport events in Croatia. After the First World War, Zagreb - although the city with most developed sport organizations in Yugoslavia, had to obey orders from Belgrade. Radan also writes about Sokol organization, and the struggle of Croatian Sokol for Croatian cultural identity. He depicts the development of physical education and its affirmation in schools. Being that Franjo Bučar was the originator of many different sports in Croatia, Radan also writes about the development of skating, skiing, fencing, tennis, football, hockey and other sports. In 1977 his doctoral thesis *Olympic Movement on Yugoslav Territory until 1919*, was published. In this work he gives an excellent narrative of the evolution of Olympic movement in south Slavic countries. In his thesis he explains the main idea of the movement and its historical evolution from antiquity to its revival in modern time. He also describes the founding of International Olympic Committee and the work of Pierre de Coubertin. Croatia, being the most developed country in terms of sport and Olympic movement, made the biggest contribution to founding of Yugoslav Olympic Committee. For this reason, Croatia holds a central point in the book. Živko Radan wrote many valuable articles for the *Encyclopaedia of Sport* published in 1977, and *Encyclopaedia of Croatian History and Culture* published in 1980. For ten years he was a contributor to the *History of Sport* magazine. He mostly wrote about the history of skiing and football, education of coaching and sport personnel, Olympic movement, sport organizations' documents, falconry, international meetings of sport historians, museums and museum collections, university sport and other topics.

Zdenko Jajčević

Zdenko Jajčević became an associate at the Sport History course on 7th of December 1989. On 29th of September 1991., he became a lecturer, and on October 1st 1996., a higher lecturer of Sport History. He held this position until 2007, when he was replaced by Zrinko Čustonja. In 1997 Jajčević wrote a course material *Brief History of Sports and Gymnastics.* He also wrote several sport history books: *Sport Publicist Writing in Croatia* (1987), *Hundred Years of Skiing in Zagreb* (1994), *Olympics, Olympic Games, Olympic Movement* (2000), *A Century of Table Tennis in Croatia* (2002), *Olympic Movement in Croatia* (2007), *Memorial Centre Dražen Petrović* (2008), *Ancient Olympic Games and Modern Olympic Movement until 1917* (2008). He wrote a number of sport history articles for encyclopaedias, and he is the editor of *Croatian Sport History* feuilleton in the magazine *Olimp.*

Publicist writing and History of sport and gymnastics

Books on history of sport and gymnastics

There were several authors who wrote about the history of Croatian sport and gymnastics. The first of them was Ivana Hirschmann who wrote *Brief Excerpt from History of Gymnastics* in 1906. Franjo Bučar's book *History of Gymnastics* from 1908 is the first work that describes the subject chronologically by historical periods. Between two world wars, two authors contributed to new understandings on the subject. Dušan Bogunović wrote *Summary of Physical Education and Falconry* in 1925, and Milan Mudrinić wrote *History of Physical Exercising* in 1932 and 1938. In 1954 Vladimir Janković wrote the first integral overview of the evolution of physical education in Croatia, *From the History of Physical Education in Croatian Schools.* Živko Radan wrote a manual *Survey of the History of Sport and Gymnastics*, in which he gave a thorough description of the subject. The manual was published in 1977 and 1981. In the second part of the manual, Radan gave an overview on history of sport and gymnastics in ex Yugoslav republics, and the third part contained a chronological table of general history of sport information and facts. One of the few foreign books, translated to Croatian, dealing with the subject is *History of Sport* by Bernard Gillet (1970). Valuable contribution is Zrinko Čustonja's book *Evolution of Physical Education in Croatia* from 2004. Some books from this field published in Croatia cover certain regions - M. Leich's *History of Sport in Međimurje 1886-1936* (1979); cities – M. Petković's *Sport and Gymnastics in Dubrovnik from 14th Century until 1941* (1993); sport organisations – *Twenty Years of Croatian Academic Sport Club 1903-1923* (1923); events - Bučar's *Memorials of 1st Croatian svesokolski slet* (all falcon gathering) (1906); sports – M. Flander's *Evolution of Croatian Handball* (1986). There are about 2000 publications dealing with the Croatian history of sport and gymnastics, and the conclusion is that there should be much more.

Periodicals and history of sport and gymnastics

The first periodical edition, in which the main subject was history of sports and gymnastics, was issued by Federal Commission for Sport History from Zagreb. The first number of *History of Physical Culture* magazine was issued in 1966, and the last in 1971. The first number of *History of Sport* magazine was issued in the beginning of 1970, and the last, 120th number, in March 1999. The magazine changed the name, and from the 108th number was called *History of*

Croatian Sport. The editor-in-chief was Franjo Frntić. Feuilleton History of Croatian Sport is published in the official magazine of the Croatian Olympic Committee *Olimp*, since 1999.

Commissions for sport history

Federal Commission for Sport History

On 2nd February 1965, Federal Commission for Sport founded the Commission for Sport History. Drago Stepišek from Ljubljana was nominated president. Three of thirteen Commission members were Croatians – Hrvoje Macanović, Živko Radan and Stjepan Cerjan. Commission headquarters were in Belgrade in the Yugoslav Institute for Physical Culture, but on the 11th February 1966, it was moved to Zagreb. Being that the Yugoslav republics founded their each separate Commission for sport history; the Commission changed its name to Federal Commission for Sport History. The Commission issued a bulletin *History of Physical Culture* from 1966 to 1971. The editor-in-chief was Živko Radan. The editors were Hrvoje Macanović and Stjepan Cerjan. In 1968 Ivica Sudnik became a member of the Commission. Federal Commission for Sport History organized three symposiums. In 1972 symposium "Question of Place, Role and Character of Sokol (falcon) Movement in Our Regions" was organized in Belgrade. In 1970 symposium "Evolution Ways of Developed and Workers' Sport in Our Regions Since its Origins until 1945" was organized in Vukovar, and in 1972 symposium "On the Origins of Modern Sport Movement in Our Regions until 1914". Federal Commission for Sport History ceased to exist in the end of 1970. New Commission for Yugoslav History of Sport and Gymnastics was founded on 9th December 1972, and existed until 1991.

Croatian SFK (Federation of Sport Organizations) Commission for Sport History

Croatian Museum for Sport Incipient Committee was founded on the 15th January 1965 (on the meeting of the Croatian SFK Commission for Marketing). First meeting of this Incipient Committee was held on 22nd of February 1965 with Živko Radan as president. Also present on the meeting were: Vladimir Blašković, Stjepan Cerjan, Mladen Delić, Ivan Hrestak, Hrvoje Macanović, Milivoj Radović and Ivica Sudnik. In 1966 Croatian Museum for Sport Incipient Committee, changed its name to Croatian SFK Commission for Sport History. The Commission was active till 1989. The president of the Commission was Živko Radan.

Croatian Society for Sport History

Founding committee for Croatian society for sport history was set up on the *History of sport* magazine Council meeting on February 8th 1991. Inaugural session was held on 2nd April 1991, in the premises of Croatian Convention for Education and Culture in Zvonimirova street in Zagreb. There were 68 representatives present. Stjepan Cerjan, Mladen Delić, Zdenko Jajčević, Ivan Očak, Miroslav Matovina, Mario Glogović, Josip Cvetković and Toni Petrić were elected members of the Executive Committee. Stjepan Cerjan was the president of the Society, and Zdenko Jajčević was the secretary. In 1997, due to certain changes in Croatian Statute (which weren't coordinated with the organization of the Society), Croatian Society for Sport History ceased to exist. A new inaugural – restoring session to find the Society was held on 26th May 2007. Darko Dujmović was elected for president, with Milka Babović and Mihovil Radja as vice-presidents, and a secretary Krešimir Kristić.

Section for History of Sport and Gymnastics at HNOPZ (Croatian National Committee for History Science)

Section for History of Sport and Gymnastics was accepted to Croatian National Committee for Historic Sciences on 11th February 2004, at the moderator meeting for 2nd Croatian Historian's Congress on the Faculty of Philosophy. Section participated on the 2nd Croatian Historian's Congress in October 2004. The theme of the congress was "Croatia and Europe – History Integrations". Zdenko Jajčević was moderator of the section, with participants: Antun Petrić, Jelena Borošak-Marjanović, Zlata Živaković-Kerže, Petar Kerže, Zrinko Čustonja and Zlatko Virc. In October 2008, Section for History of Sport and Gymnastics will participate on the 3rd Croatian Historian's Congress.

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SPORT MUSEOLOGY IN CROATIA

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Abstract

As a country with long sport tradition ideas about sport museum appeared early. The tradition of collecting, exhibiting and storage of items related to physical exercise and sport exists in Croatia for more than a hundred years. Central historical figure of Croatian sports and physical exercise movement Franjo Bučar early realized the importance of collecting and exhibiting sport heritage. He organized first exhibition of Croatian sport and physical exercise movement in Prague in 1895 and in 1938 he was the first one that suggested opening of Croatian Sports Museum.

With the construction of new High School of Physical Culture building small rooms (12x7 sq. m.) was finally in 1977 put in order as a place for permanent exhibition of the future Museum of Physical Culture. With the decision of Croatian Museum Council No K-8331/1 on December 3rd 1979 Croatian Museum of Physical Culture was officially registered and incorporated in the official list of museum institutions in Croatia. Only one year later Croatian Museum of Physical Culture was connected with Faculty of Physical Culture University of Zagreb.

In the year 2003 Croatian Museum of Sport passed all formal evaluations and was recognized as an independent museum institution.

Key words: *sport, museum, sport museology, Croatia*

Introduction

Modern scientific analyses of history, respecting the knowledge of laws of social development, are based on the authentic findings. The most valuable among them are certainly the material objects and written documents that directly contribute to the successful lightning of past events. Increasing scientific interest in historical events and the development of methods, historical, natural and technical-scientific research, initiated the establishment and improvement of work of museums and archives. These institutions collect and preserve diverse museum items. During time the specialized museums for certain areas of human activities, including museums of sports were established.

Sports museums started to unfold in early XX century and had many difficulties finding their place among the classic museum institutions. Private collectors collecting athletic items from different periods created the first sets of future sports museum. To the recognition of sport museology contributed various sports organizations collecting and presenting various items - evidence of their activities. Fast development of sports activities and production of different sport items, strengthen the global sport movement and created sympathy towards the systematic study of the history of this new culture. Despite the need for historical registration beginnings of sports museology were not easy. Forerunners of such museums have had to win the right to existence and constantly prove that they are necessary and relevant. Sport, an entirely new social phenomenon in the beginnings, was barely able to connect to the concept of the museum.

In the U.S. there are many so called "Halls of Fame" dedicated to the great sportsmen or one particular sport. Halls of Fame have national, but also the international character. Hall of Fame of Boxing is located in New York, Naismith, Memorial Basketball Hall of Fame in Springfield, The International Swimming Hall of Fame in Fort Lauderdale, National Baseball Hall of Fame and Museum in Cooperstown, The International Lawn Tennis Hall of Fame in Newport etc. The core of these collections, which are usually, opened in the early XX century are the sports trophies, sport equipment and machines and works of art with sports themes. In the international Halls of Fame exhibited objects are from the best sportsmen in that particular sport branch in the world. So the trophy items of Croatian basketball star Kresimir Ćosića and Drazen Petrovic located in Springfield, and water polo players Zdravko Ježića, Zdravka Kovačića and Perica Bukića in Fort Lauderdale.

The first museum institution that collects material related to the history of ancient and modern Olympics and the Olympic Movement has opened 1934 in Mon Repos castle in Lausanne thanks to the impetus of Pierre de Coubertin. The museum has unique materials from the history of modern Olympic Games and from life of Pierre de Coubertin. The museum is thoroughly refurbished in 1973, and on June 23rd 1993 a new building of Olympic Museum was opened in Lausanne. The permanent exhibition currently takes about 11000 sq. m. of space. The museum of ancient Olympic Games in Olympia, Greece collects originals or copies of archaeological findings in relation to the ancient Olympic Games. In Olympia there is a museum of modern Olympic Games under the direction of the International Olympic Academy and

Greece Olympic Committee. The first time was open to the public in 1961 during opening of the International Olympic Academy. In 1972 Museum was moved into a new building.

Beginnings of Sport Museology in Croatia

Croatia and Zagreb in particular, with its rich tradition and pioneer role in the field of physical exercise and sports, has a compelling interest, to collect materials from that area, process it and keep it for future generations. The tradition of collecting, exhibiting and storage of items related to physical exercise and sport exists in Croatia for more than a hundred years. Central historical figure of Croatian sports and physical exercise movement Franjo Bučar realized the importance of exhibiting at the exhibition which is prepared on the occasion of All Sokol slet in Prague in 1891. He was specially impressed by photographs as extraordinarily documentation and publicity means. Franjo Bučar prepared first exhibition of photographs, documents, books and magazines of Croatian Sokol at the great Sokol exhibition in Prague in 1895. Bučar was also exhibited at the International Exhibition for physical education in Innsbruck in 1896. That same year Franjo Bučar got recognition for his exhibition at Millennium exhibition in Budapest. On the occasion of organizing the Croatian All Sokol Slets in 1906, 1911 and 1925 Bučar has prepared and wrote exhibition catalogues. In one of his inscription Bučar mentioned in 1938 the necessity of establishment of sports museum in Zagreb, in which should be stored and his valuable collection.

Croatian Sports Museum

With the founding of the High School of Physical Culture (VŠFK) in 1959 the idea of establishing the Museum of physical culture occurs. Part of materials for future museum was collected earlier. In the project of new building of the High School of Physical Culture space for the museum was also anticipated. However, since the construction of new was not finished until early 1970s all actions on founding of museum ended for several years.

In 1966 Commission for History of Physical Culture of Croatian Sports Federation was established and Živko Radan, first Croatian sports historian and lecturer of Sport History at the High School of Physical Culture, was appointed as the president of the Commission. Commission has organized several meetings with old sportsmen and sport workers, and questionnaire was made in order to identify possible valuable materials for museum. Work of Commission was wholeheartedly supported by Croatian Sports Federation general secretary Mr. Darko Dujović and several presidents (Branko Gazvoda, Vladimir Pezo and Miško Juras).

The first major action of the Commission was the organization of the exhibition on the occasion of one hundred years of birth of Franjo Bučara, first Croatian IOC member (1920-1946). The exhibition was opened on December 5th 1966 in the premises of the Tourist Association of Zagreb.

With the construction of new High School of Physical Culture building small rooms (12x7 sq. m.) was finally in 1977 put in order as a place for permanent exhibition of the future Museum of Physical Culture. With the decision of Croatian Museum Council No. K-8331/1 on December 3rd 1979 Museum of Physical Culture of Croatia was officially registered and incorporated in the official list of museum institutions in Croatia.

Latter, after the decision of the Council of Faculty of Physical Culture University of Zagreb from May 15th 1980, the Museum of Physical Culture of Croatia was formed as an organizational unit of the Faculty of Physical Culture University of Zagreb.

Since 1984 the director of Museum of Physical Culture was Mr. Zdenko Jajčević, and funds for the work of the Museum were received from Republic Ministry of Culture as well as Croatian and Zagreb Sports Federations.

Since June 1988 the museum is thanks to the efforts of the Commission for History of Physical Culture of Croatian Sports Federation, was moved to the new location (118 sq. m.), and in June 1998 the museum was due to the repossession to former owner, moved to new location (120 sq. m.) in Zagreb downtown where it still is.

Since 1990 in the line with new social changes in former Yugoslavia and war for Croatian independence Museum has changed the name to Croatian Sports Museum. In 1995 custodian, Mrs. Djurdjica Bojanić was employed, and since September 1999 as a librarian works Mr. Zrinko Grgic. In the year 2003 Croatian Museum of Sport passed all formal evaluations and was recognized as an independent museum institution. Since than all funds for museum comes from the Ministry of Culture of the Republic of Croatia.

Collections and funds of Croatian Sport Museum

The holdings of Croatian Sports Museum are classified in the archival collections and funds. Archival collections are: Trophy cases, Library, Photos, Posters, Printed publications, calendars and catalogues, Diplomas and awards, Flags and textile items and equipment, requisites and large objects. Archival funds are: Biographies, Graduate work, Master thesis and Doctoral thesis, Video, CD-ROMs and DVDs, Indoc Museum and Records – documents.

The Drazen Petrovic Memorial Centre

The Museum - a memorial centre dedicated to famous Croatian basketball player Dražen Petrović is situated in the mezzanine of basketball club Cibona skyscraper in Zagreb. The Dražen Petrović Memorial Centre has a total of 288 sq. m. Museological, historic and sports, educational and cultural importance of the project Museum - the Memorial Center Drazen Petrovic wrote Zdenko Jajčević, who is also the author of the permanent exhibitions.

Between the supporting pillars in the central area is located, the five large cabinet. In these cabinets is exposed permanent exhibition. In the first cabinet exhibited objects shows life of Dražen Petrović in his born town Šibenik, Croatia. In cabinets 2 and 3 is shown his stay in Zagreb, and year spent in Basketball Club Cibona, Zagreb. Cabinet 4 is dedicated to the time he spent in Madrid, Spain while he was playing for Basketball Club Real Madrid and the cabinet 5 is dedicated to his life in America and time spent in NBA League.

At the end of the cabinets line leads to the northern wall along the stairs that lead to the 1st floor. Along the stairs that lead to the gallery one cabinet is located in which are exposed medals and awards of Drazen Petrovic. On the first floor there is a promenade with a gallery and office with support facilities. The promenade allows watching projection on a large projection wall and a tour of exhibits exhibited in cabinets on the floor. In these cabinets exhibit items are associated with the performances of D. Petrovic in the national basketball teams (cabinet 6 and 7), the world's recognition (cabinet 8) and items from Croatia (cabinet 9 and 10). At the end of the promenade office with the support facilities is situated. Along with the presence of a large number of citizens and prominent sports, political and cultural persons from Croatia, The Dražen Petrović Memorial Centre was opened on June 7th 2006. The Centre is under direct administration of Croatian Sport Museum.

Split Sports Museum

Split, the second biggest city in Croatia, in December 2001 founded the Initiative Committee for the establishment of the Split Museum of Sports. Initiative Committee has elected Mihovil Radja as head of the founding Split Museum of Sports. As a city with long and fruitful sport tradition Split has 58 athletes that won Olympic medals. Sports Museum in Split is not yet founded, but in 2007 a Hall of Fame of Split's Sport was opened. The Hall of Fame of Split's Sport was conceived as a transition to real museum. First 12 famous Split's athletes that were selected in Hall of Fame of Split's Sport are: Djurdjica Bjedov, Vladimir Beara, Deni Lušić, Frane Matošić, Miro Mihovilović, Petar Skansi, Ratomit Tvrdić, Bernard Vukas, Rowing Club "Gusar", Fabjan Kaliterna, Luka Kaliterna and Branko Radović.

Conclusion

As a country with long sport tradition ideas about sport museum appeared early. The tradition of collecting, exhibiting and storage of items related to physical exercise and sport exists in Croatia for more than a hundred years. Central historical figure of Croatian sports and physical exercise movement Franjo Bučar early realized the importance of collecting and exhibiting sport heritage. He organized first exhibition of Croatian sport and physical exercise movement in Prague in 1895 and in 1938 he was the first one that suggested opening of Croatian Sports Museum.

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INTERACTIVE TECHNOLOGIES IN DEVELOPING STUDENTS' COGNITIVE ABILITIES AT SPORTS UNIVERSITIES

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Abstract

In the wake of the information explosion and the era of rapidly progressing technology, there is growing demand for well-grounded and flexible multimedia devices for fostering learning in the field of physical education and sports. The present research investigates the use of modern interactive multimedia technologies in developing cognitive abilities of sports universities students.

Key words: *multimedia learning, professional skills, constructive thinking*

Introduction

Looking forward into the 21st Century, the challenges that face each country will mainly come from the following three aspects: greater freedom in global trade; more protection of ecology and the environment and an acceleration of the informational society. In order to satisfy skills for survival and life, it is asserted that everyone should possess abilities in organizing computers, processing information and problem solving. The main goal of informational education therefore is to foster students' utilization abilities and information processing skills, as well as their logical thinking and problem solving abilities. Students can then adapt to the demands of the informational society of the future (Tai et al., 2003).

Methods

The importance of teaching problem solving to students has been widely recognized by teachers, administrators, and other educational stakeholders. The advent of computer technology, particularly multimedia learning, has changed the landscape of problem-solving instruction. Computer-based problem simulations, for example, begin to replace the traditional paper and pencil approach with more vivid, interactive approach that provides both auditory and visual information. The psychological and cognitive benefits of using multimedia to teach problem solving are palpable: the multimedia motivates students to learn, promotes deep understanding, and engages them in the educational process.

Problem solving skill is highly valued. In the last five decades, many theorists and educational institutions have placed a heavy emphasis on this ability. For example, the movement of "discovery learning" (e.g. Bruner, 1961) was spawned, at least in part, by the perceived importance of fostering problem-solving skills. This emphasis on problem solving was not associated, however, with the knowledge of cognitive resources involved in the problem solving process. That is, it focused on procedures of problem solving rather than investigating the relationship between procedures of problem solving and cognitive resources that affect such procedures. In the last twenty years, this state of affairs has begun to change with our knowledge of relevant mechanism (e.g. working memory, cognitive load, etc.) increasing markedly (Zheng, R. & Zhou, B., 2006).

Offering a rigorous comparative analysis of multimedia conditions, Stalcup K. A. (2005) noted that with the development of user-friendly multimedia design tools engendered by increasing accessibility of the World Wide Web and computer technology, researchers began to examine the use of multimedia in the learning process. Much of this work was conducted from the vantage point of technology design and optimizing attributes of the interface. Mayer (2001) contended that investigations have focused on manipulating and testing specific aspects of the interface or the content structures, and most of the work has lacked a unifying theoretical approach grounded in cognitive psychology. Mayer (2001) defined multimedia learning as any electronic presentation involving words and pictures that is intended to foster learning; based on how the mind works. He outlined three prominent approaches to the design of multimedia: the delivery media approach focused on the technology and centers design around the technology, not the learner. Presentation mode spotlighted the quantity of the material displayed to the learner in two or more modes. The sensory modality view revolved around the congruence of multimedia modality and cognitive structure. In reviewing computerized learning materials, Mayer (2001) concluded that the majority were centered on technology, not learning. He suggested that this technology-centered approach was driven by the delivery of information, not in promoting learning. In an effort to bridge the gap between current empirical interface investigations and cognitive psychology, Mayer (2001) developed and empirically tested a theory of

multimedia learning based on cognitive psychology. Mayer's (2001) Cognitive Theory of Multimedia Learning (CTML) was a mixture of the presentation and sensory modality approach. He proposed a learner-centered approach that used our knowledge of human cognition to create materials that fostered learning. The goal of the information delivery method was to promote information acquisition, which Mayer argued is different from knowledge construction. The CTML contends that active learning is more that kinesthetic activity and requires cognitive engagement (Stalcup, 2005).

Khvalko (2007) drew attention that according to the official data, only 30 percent of secondary school graduates can understand learning materials and only 2 percent can analyze them and make independent conclusions. Considering the growing body of knowledge and decreasing amount of academic hours, educators observe the rapid decline in quality of the educational process. Khvalko (2007) conducted experiments with physical education and sports students to teach them techniques developing reasoning abilities, memory and attention-controlling mechanisms. One relevant conclusion that Khvalko posited is that teaching students logical skills, advanced information processing techniques and developing their cognitive abilities prior to basic studies fosters students' intellectual skills, resulting in a substantial increase in their professional level.

Results

The present research investigates the use of modern interactive multimedia technologies in developing cognitive abilities of sports universities students.

Amount of knowledge doubles every 10 years and in some fields every 5 years. So does the amount of information to be learnt at university in order to acquire necessary professional skills. Considering growing health problems due to the poor environmental and economic situation, rising university demands may lead to psychological stress and lack of motivation with students. Consequently, the main task of modern teachers is to find new approaches, enabling students to apply their intellectual abilities at their fullest, in order for learning to be transferred and retained.

There are many deeply investigated ways of developing intellectual skills in the world's practice. Most of them rest on seminal work of Jean Piaget and his colleges. But in the wake of the information explosion and the era of rapidly progressing technology, there is growing demand for well-grounded and flexible multimedia devices for developing cognitive abilities as well.

The present research offers an interactive multimedia complex "BRAINTEASER", designed to accompany a sports university course to develop students' spatial abilities, working memory and reasoning abilities, meeting demands for different sports specializations.

Underlying the technology there is knowledge of the basic cognitive processes and the CTML principles, suggested by Mayer:

- multimedia principle (people learn better from words and pictures than from words alone);
- spatial contiguity principle (people learn better when related words and pictures are in close proximity);
- temporal contiguity principle (people learn better when related words and pictures are close together in time);
- coherence principle (people learn better when irrelevant words, pictures, and sounds are eliminated from the presentation);
- modality principle (people learn better from narration and animation than from text and animation);
- redundancy principle (people learn better from narration and animation compared to animation, narration, and text);
- individual differences principle (individuals with low prior content knowledge and individuals with high spatial skills benefit most from animation and narration-presented materials) (Mayer, 2001).

"BRAINTEASER" consists of two parts:

1) Testing spatial abilities, working memory and reasoning abilities, issuing a personalized report and an individual development program.
2) Developing students' cognitive abilities, with the use of interactive logical tasks of different complexity level.

Conclusions

Multimedia learning is a two-sided process, having educators, psychologists and programmers at one side and students at the other. The former are supposed to design quality materials, benefiting from modern scientific investigations. The latter are supposed to actively process by attending to incoming information, organizing the information into a coherent mental representation, and integrating the current mental representation with prior information.

In our opinion, integration of the offered multimedia complex into the educational process and teaching student principles of constructive thinking will enable them to gain more confidence during their university course, resulting in higher information level acquisition and better professional performance results in future.

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MODERN GAMES AND COMPETITIONS OF PEOPLES OF RUSSIA "NORTHERN MULTIATHLON": A CONDITION, PROBLEMS, PROSPECTS OF DEVELOPMENT

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Abstract

Radical, small peoples of Russia save up unique and invaluable experience of use of traditional games and competitions, in physical training of children and teenagers in extreme climatic conditions of the North. This experience was widely used and used now and other peoplesoccupying Uraland Siberia.

At present traditional games and competitions were transformed to a new kind of sports "Northern multiathlon". By federal agency on physical training, sports and tourism of the Russian Federation, Federation of northern multiathlon (chairman - A.V.Nazarov, general director O.V.Dolumadzhanova) from November, 21 till November, 25, 2006 have been organized and lead to Zavolzhie, the Nizhniy Novgorod area the Championship and Superiority of Russia by thiskindofsports. 11 teams have taken part in competition from various regions of Russia (the Khanty- Mansiysk, Yamalonenetskiy, Taymir, Evenki, Chukchi autonomous regions; Republics - Saha (Yakutia), Tatarstan; the Sverdlovsk and Nizhniy Novgorod area.

Key words: *traditional games, northern multiathlon, Ural, Siberia*

Introduction

"Northern multiathlon" - technically difficult kind of sports consisting of 5 kinds: a throwing of a lasso (tinzayn) on a pole (a breadboard model pole for management deers), a throwing of an axe on range, run with a stick on a cross-country terrain of 3 km, a threefold national jump, jumps through narti (sledge-breadboard models).

Methods

In these competitions active participation the scientific group of students and teachers of faculty of physical training of the Russian State University (Ekaterinburg) again accepted. The dean of faculty Valery Krasilnikov headed scientific group. Have been made by a photo and videorecordings of games and competitions. Work on their processing is conducted now

Results

Throwing of a tinzayna-lasso on a pole

Lasso (tinzayn) is a deer specially plaited from several thin leather belts a lasso (tinzayn), which thickness of 0,5-1 cm, and length within the limits of 25 and more meters. On the end lasso (tinzayn) it is fixed plate, made of a bone of a deer through which the loop is passed. On manufacturing tinzayna usually there leave 4 skins of a deer. The throwing tinzayna on a pole is carried out on play-ground. For this purpose the pole is established in the center of a platform vertical. The throwing is made from any point of a circle (R - a circle it is equal 15 meters), the height of a pole is equal to 3 meters (Picture 1).

Picture 1. Throwing of lasso (tinzayn) on a pole

At performance of a throwing lasso (tinzayn) on a pole exist a little rule of competitions:

- the participant has the right to three attempts (each of three attempts of a throwing proceeds up to the first miss);
- in test there is the best result from 3 attempts;
- the participant should have the acts with the lasso (tinzayn);
- the participant leaves on a line of a throw on a call of the judge "on start" and throw on a command it "is possible";
- on performance of one throw it is given two minutes (readout time is made from the moment of a command of the judge it "is possible");
- each participant has on assembly lasso (tinzayn) only 3 minutes;

Run with a stick on a cross-country terrain

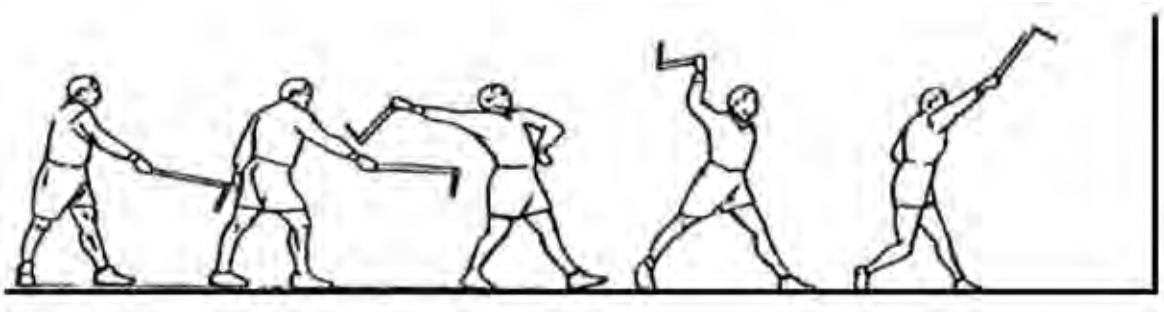
In sports practice for cross-country run participants use a stick (which length is supposed up to 130 cm, diameter not less than 10 mm, weight - any). The stick can to be metal, duralumin, wooden or from other material. Sportsmen are forbidden to apply for track and field athletics shoes with thorns.

Competitions are carried out for adults on a distance of 3000 m, for youthies 2000 m, for young men on 1000 m. The distance competitions on running with a stick on a cross-country terrain are laid on wood footpaths, earth roads, in tundra.

Throwing of an sports axe on range

Sports axe throwing in a corridor which width is equal 60 m, and also the sector is necessary for start, which length should be not less 20 meters (Picture 2).

According to rules of competitions, it is necessary to execute the following requirements: in competitions the axe has weight not less than 350 gr. is used; the participant is authorized to execute 3 attempts; in offset there is the best result; on performance attempts 3 minutes are given; if in sector for a throwing the participant has not left on a call of the judge on performance of attempt in distance screw sheer "absence" is put down.

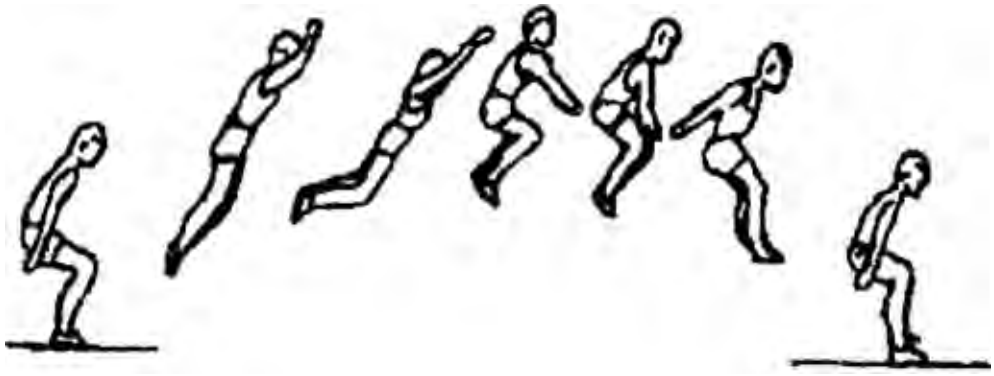


Picture 2. Film-gramme of techniques of a throwing of axe on range

The techniques of a throwing of a sports axe includes start with assignment of a shell, a throw (final effort) and braking before a line of a throw (Picture 3). The anthropometrical data influence length of a working way of a shell and are within the limits of 160-220 see. The throwing of an axe on range is carried out from direct start.

Threefold national jump (with simultaneous pushing away by two foots)

Competitions on a threefold national jump (with simultaneous pushing away by two foots) are carried out by the following rules: the participant has the right to 3 attempts. In offset there is the best result which is defined by measurement of the shortest distance from things in common by any part of a body with the ground (floor) before initial pushing away. It is necessary for the participant on a call of the judge and a command it "is possible", a rising of a tag upwards, to execute attempt of a jump. The result is not set off, the judge declares "is not present" and makes repeated wave below or lifts a white tag.



Picture 3. Threefold national jump

Jumps through narti (sledge-breadboard models)

Jumps through narti are made by the following rules:

- jumps are carried out with simultaneous pushing away two foots from a place; narti are placed strictly as the crow flies, them place it is marked by lime or others, not creating To the participant of a handicap that it was visible, are shifted narti whether or not;
- it is authorized to make carry of foots through narti only directly before itself;
- the participant who has overcome 10 narti, does makes by a jump turn a mouth on 180°, pushing away two foots is necessary with simultaneous;
- on turn 5 seconds (readout of time is made from the moment of a landing after overcoming by last narti till the moment of pushing away for jump through) are given.

Picture 4. Jumps through narti (sledge-breadboard models)

Discussion and conclusions

The conducted investigations make possible for us to glimpse into the near future (to 40-50 years) in order to consider the influence of different factors on the development of the northern regions of Russia, and at the same time to the formation of the cultural heritage of peoples. In the present period occurs gradual urbanization, and together with this and the assimilation of the radical peoples of Siberia with the Russian nation, the loss of national culture and mastery by petroleum, gas and chemical industry newer and newer territories.

It is necessary to manufacture the general trend in retention and development of national physical culture, which will make it possible to avoid the errors of the past. Over the long term in connection with the impoverishment of hydrocarbons and the appearance of alternative energy sources northern territories declare by the zones of the natural preserves, in which they will live indigenous peoples. Will be artificially here developed ecological trade and reindeer breeding, necessary for the vital activity of peoples, and also local trades: the preparation of the skins of deer, the production of souvenirs, different national clothing. Through the regions will pass tourist routes, and also 3kstrim- tourism, bearing profit to local residents. Will change the appearance of the inhabitants of the north, who are presented to us by the educated people, which manage the Internet and the equipped cell phones.

In the new economic conditions traditional physical exercises serve as the means of the association of the natives of different regions, and also formation and training. Is possible to assume that not will be forgotten the races on the deer and canine harnesses, races on top of deer, horse sport, the throwing of lasso on choreas, the leaps through the sledges, shooting from bow, throwing of axe, run with the staff, pulling of stick and so forth is completely possible and the modification: race on the "snow-storms", automobile rally (with the special wheels on the impenetrable taiga places, the tundra). In the international arena the national forms of the sport of the radical peoples of Siberia will be included in spartakiadas and festivals, which will pass as the forums of peoples with the use of health-improvement, educational and educational functions of national physical exercises.

Traditional games and contests must become the connecting link between the culture of the past, present and future of the natives of Siberian region.

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THE CROATIAN SOKOL POSTER

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Abstract

The aim of this paper is to present Croatian Sokol posters, not as an object of art history, but as a tool for sport history research. Posters range from simple printing work notices with textual part only, to large scale artistically designed broadsheets with national identity symbolics. Sokol organization hiring the best artists for most important posters, is the evidence of a high level of intellectual and cultural awareness. Posters normally incorporate national symbols that correspond to political situation and Croatian people's national sensibility of the period. Regardless of their artistic quality, they all represent valuable source for sport history research.

Key words: *sport history, national identity, symbol, visual communication, mass meeting*

Introduction

Sport poster

Poster is a work of art of a distinctive social role and of specialized contents. Ever since it was printed for the first time, its main role as a specific media for both textual and visual communication, remained the same. It has to express, in a concentrated art version, its certain and unambiguous message (Mohorovičić, 1987). For this reason, sport posters are an important source for sport history research (Ćurić, 1982). They were used to announce and advertise certain sport competition, game or event. From the textual part we get details like location, date, hour and program. Visual part is somewhat more complex and can vary from basic to symbolical meaning. In a more detailed research, a sport historian can study graphics, aesthetics and symbolism of a visual part, but also language, grammar and syntax of a textual part of the poster. Naturally, time distance emphasizes its cultural importance.

Picture 1. Blank poster template

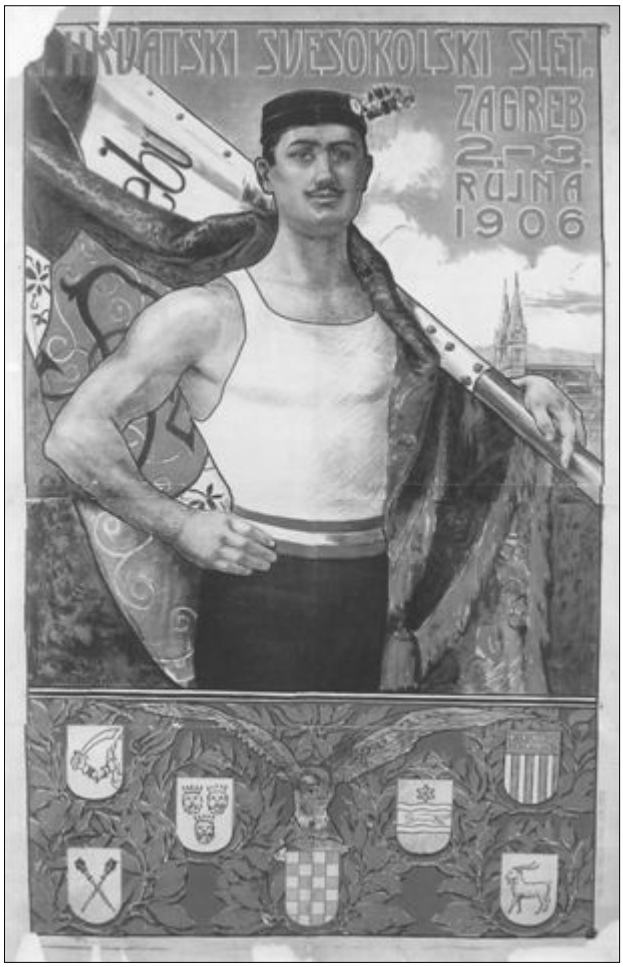
Croatian Sokol

Croatian Sokol (sokol = hawk or falcon) organization founded in 1874 (after a similar Czech society) played probably the most important role in the affirmation of sport as urban culture phenomena. Sokol traditionally emphasized mass calisthenics as a means of promoting communal spirit and physical fitness, but it also included practicing sports like tennis, rowing, equitation, cycling, athletic, skating. Enhancing and developing the awareness of national belonging and power was one of the main goals. The society was abated in 1929; the year that the Yugoslav king Alexander Karađorđević abolished the constitution and introduced dictatorship (Jajčević, 2008). Activities of the Sokol society are documented by many posters, from simple printing work notices with textual part only, to large scale broadsheets with elements of national identity and artistic design.

Slet (mass meeting) posters

Posters produced in the second half of the 19th century, did not differ much from the newspaper advertisement of the period (Kavurić, 1999) (Picture 1). Many of them included solely textual information. In time, posters ceased to be a typographically unattractive piece of information, and became artistic statements with their own structure and laws.

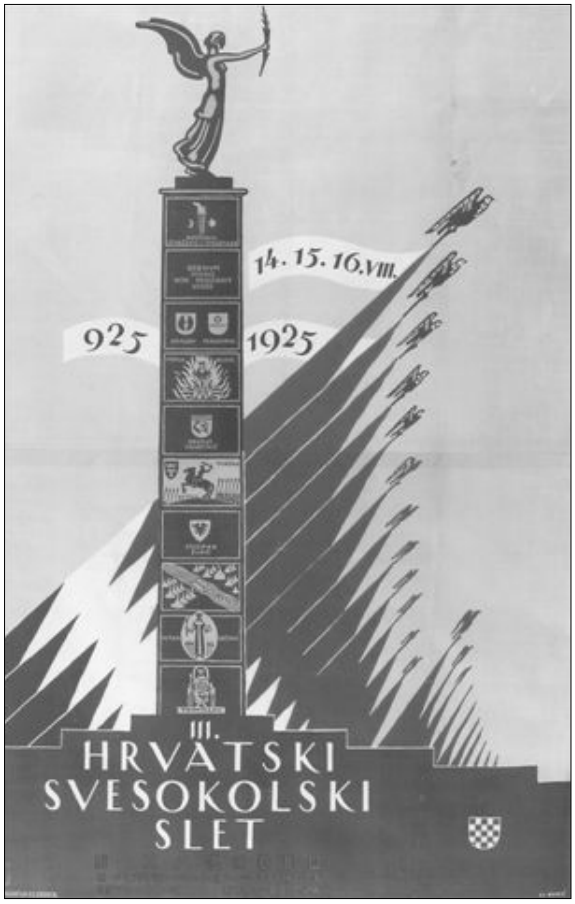
Menci Clement Crnčić designed a poster for the 1st Croatian svesokolski slet (all falcon mass meetings) in 1906 (Picture 2). Crnčić is a well known Croatian painter, founder of Zagreb Academy of Fine Arts, and founder of Croatian modern graphics. Many authors (Gotthardi-Škiljan, 1975; Kavurić, 1999; Kedmenc Križić, 2004) agree that graphic design of this Sokol poster marks the set out for the Croatian sport poster. In close-up there is a Sokol gymnast with Sokol flag on his shoulder. Flying falcon holding a Croatian emblem occupies the lower part of the poster, with additional six regional emblems (three on each side). This narrative composition, with distinguishing iconographical elements is typical for the period when the poster was created (Kedmenc Križić, 2004). Crnčić also designed the poster for the 2nd Croatian svesokolski slet in 1911 (Picture 3). This time he treats the subject more freely; it is stylized and clearly reflects Modern style.



Picture 2. 1st Croatian svesokolski slet in Zagreb 1906.

Picture 3. 2nd Croatian svesokolski slet in Zagreb 1911

After the First World War, 1919, Croatian Sokol joins the Sokol federation of Serbs, Croats and Slovenians (organization that will in 1921 become Yugoslav Sokol federation) with headquarters in Ljubljana. Due to a political situation, members of the Croatian Sokol soon became dissatisfied with the united Sokol organization, and in 1922, an independent, Croatian Sokol organization is founded once again (Jajčević, 2008). Disappointment with the long desired union with other south Slavic nations puts Croatian national symbols once more in the foreground of Sokol graphic design. That fact is particularly obvious in Ljubo Babić's poster for the 3rd Croatian Svesokolski slet that was organized in the year 1925. Babić is renowned Croatian painter, art historian, art pedagogue, illustrator and scenographer. The fact that Sokol organization hired Crnčić and Babić to design posters for most important events is, above all, a demonstration of its highest intellectual and cultural level. 1925 was the year when one thousand years of Croatian kingdom was being celebrated, and Babić designed a large scale poster (Picture 4), filled with symbolic references. In the main focus there is a victory column consisting of ten stone elements, each representing one century from Croatian history, with related illustrations. Backplane is dinamyzed by simple composition of falcons each holding a Croatian flag (Kedmenc Križić, 2004).



Picture 4. 3rd Croatian svesokolski slet in Zagreb 1925.

Yugoslav Sokol posters in Croatia

Yugoslav Sokol organization was present in Croatia till the beginning of Second World War and it is interesting to notice difference in poster design regarding to Croatian Sokol. Radovan Tommaseo, Vladimir Filakovac, Jozo Kljaković, Pavao Gavranić are the authors of the most interesting posters for Sokol mass meetings in this period. Pavao Gavranić designed two posters for Zagreb mass meetings in 1931 and 1934 (Picture 5) that stand out from typical production of the period. Example from 1931 (Picture 6) is particularly interesting for its creativity and content visualization. It has an almost caricature symbol of Sokol – flying falcon holding a weight to demonstrate and emphasize its strength and superiority. It is interesting to notice the absence of Croatian national symbols. The colors (blue-white–red) in the 1934 poster represent Yugoslav national flag.

Picture 5. 3rd Sokol mass meeting in Zagreb 1934.

Picture 6. Sokol mass meeting in Zagreb 1931.

Other Croatian Sokol posters

Here mentioned examples of Sokol poster (except for the first one, Picture 1) represent high quality art realizations, and that is the reason why their authors are documented. Many other authors of Sokol poster remain anonymous until today. Another thing - posters were usually printed in black and white. If they were color printed – national colors - red, white and blue were used most of the time. That is particularly true for mass meeting posters, because those were the most formal occasions. Sokol organization printed posters for other society activities, such as: academies, lectures, displaying films and dancing. Fine example of Sokol social event poster is Rozankowski's (Rogović, 1994) 1921 poster for masquerade (Picture 6). Colors do not hold on to a red-white-blue pattern. It is interesting to point out that members of Sokol society did flag consecration and a special Mass, even at less formal events like academies and displaying films (Rogović, 1994).

Picture 7. Poster for Sokol masquerade in Zagreb 1921.

Conclusion

Poster is essentially characterized by its clearness, simplicity, good layout, and unambiguousness. Naturally, same rules apply for posters produced by Sokol organization, and the nature of these posters makes them a perfect source for more detailed research on Croatian Sokol. Firstly, the mere number of preserved posters give evidence about vide band of Sokol activities and its intensity. Secondly, it is interesting to observe the difference in quality of the posters. It shows not only that there was a big demand for Sokol posters, but also that the public for which these posters were intended, was very different also. Sokol was a huge organization – in 1905 there were 15000 members (Jajčević, 2008), and these members were representatives of all social classes –from uneducated countrymen to university teachers. Even though the aim of Sokol organization was somewhat socialistic in aspiring equality and unity for all members (they all used first names when addressing each other), some poster designs are very simple and others quite complex. The high quality of the design for some Sokol posters demonstrates the level of intellectual and cultural awareness. Thirdly, the use of national symbols in poster design, corresponds to political situation and national sensibility of Croatian people.

All Sokol posters are not high quality art realizations; there are those which are not but monuments of cultural historical or only documentary importance. For a sport historian they all represent valuable source, a tool for research. Unfortunately, the research on Croatian sport poster is very sparse, and most of them are made by art history methods and standards. Hopefully, this paper on Croatian Sokol poster will encourage better use of sport posters in the sport history research.

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EVOLUTION OF ART HISTORY PRESENTATION OF STRENGHT AND HUMAN BODY THROUGH THE EXAMPLE OF DAVID

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Abstract

The aim of this paper is to present the evolution of the idea of human body and strength throughout history, notably in the periods of Middle Ages, Renaissance and Baroque. The change in the concept of the idea is represented through art representations of Old –Testament king David. Subject is the same, but treatment is essentially different. The main idea of this paper is that the highlights of human civilization are the periods when there was harmony between the idea of physical and spiritual.

Key words: *middle ages, renaissance, baroque, physical, spiritual, harmony*

Introduction

One should always have in mind that the term strength has two meanings – physical and spiritual, which are in a way opposite. Throughout history, one or the other meaning was emphasized, and the opposite neglected or even totally denied. These periods (of the domination of spiritual and physical) rotated cyclically, like action and reaction, but the highlights of every culture and civilization is characterized by harmony between these two extremes.

This paper will try to explain the evolution and the change in the concept of human body and strength on some art presentations of Old-Testament king David in the period of Middle Ages, Renaissance and Baroque. Truly a painting (or sculpture) is worth a thousand words, not only in its descriptive value but also in its symbolic significance (Janson, 1995). Middle Age philosophy considers earthly life to be temporary, and that the real life is the one after death – the afterlife. Thus, the human body represents an impediment that chains the spirit and prevents it to reach its true existence. Therefore the body needs to be neglected or even destructed, so that the spirit can develop. Period of Renaissance and Humanism revives the ancient Greek understanding of earthly life as the only true existence, and human body as an ideal of beauty. According to the ancient Greek idea – body sustains spirit and therefore needs to be taken care of and trained so that there will be *Mens sana in corpore sano.* (Mudrinić, 1932-1938). A work of art is the statement itself and a separate and self-contained reality which has its own ends and responds to its own imperatives, but it also expreses the „genius“, the basic qualities of the civilization that produced it. Therefore it is possible to interpret the change in the relation of physical and spiritual strength, from the chosen art presentations.

David

The David personage from the Old Testament is the Israeli king, the ancestor of Christ, a hero, a prophet, a musician, a sinner and a repentant. He is represented in art history as a young man with a sling, a king, a bearded old man with harp or a prophet with a volume. David is one of the most depicted characters in the Christian iconography. (*Lexicon of Western Christianity's iconography, liturgics and symbolism*)

Middle Age presentation of David

Throughout the Middle Ages, David is presented as a king-figure and a prefiguration of Christ. In most cases he plays a harp or a lyre. According to Middle Age philosophy, his strength lies in the supernatural, divine (in other words – spiritual) characteristics. The physical strength is completely neglected, and to emphasize the spiritual component, he is usually represented as an old man. In *King David playing on the Lyre*, David represents a symbol of Christ and the four musicians surrounding him symbolize the four evangelists (Picture 1).

Picture 1. King David playing on the Lyre, surrounded by four Musicians, 13th Century

Picture 2. Donatello David c 1430

Picture 3. Andrea del Verrocchio David. 1st half of the 15th Century.

Renaissance presentation of David

In Renaissance Florence, David becomes the political symbol. 15th century Florence, ran by the Medici family was rich and powerful, but still a small state that was often threatened by the Papal aspirations. For this reason the people of Florence chose Judith and young David as symbols of their state. The two biblical personages symbolize the triumph of the small and physically weak that is righteous and moral. Judith, being inferior since she is a woman, manages to outsmart and behead the enemy king Holofern, and from the vast number of biblical stories about the life of David, the one chosen is the Goliath episode. When Israeli king Saul took his army in battle against the Philistines, the Philistine leader, giant Goliath, offered to resolve the conflict with one single fight. Young David volunteers, refuses the armor offered by Saul, and takes his sling and five stones from the ground. He kills the Goliath with the first stone, takes his sword and beheads him.

Donatello's David

Donatello's (1386-1466) sculpture of David (around 1430) (Picture 2) is the first life-size nude statue since Classical times. He achieved a balance between Classicism and the realism by presenting a very real image of a boy in the form of a Classical nude figure. Although Donatello was inspired by Classical figures, he did not choose a Greek youth in his prime as a model for his David. Instead, he chooses a barely developed adolescent boy whose arms appeared weak due to the lack of muscles. After defeating Goliath, whose head lies at David's feet, he rests his sword by his side, almost too heavy to handle. It seems almost impossible that a young boy like David could have accomplished such a task. David himself seems skeptical of his deed as he glances down towards his body. Apparently, David's intellect, faith and courage made up for his lack of build (Fichner-Rathus, 1995)

Verrocchio's David

Andrea del Verrocchio (cca 1435-1488) was the most important and imaginative sculptor of the mid-fifteenth century. He made a sculpture of David in the second half of the 15th century, and this figure of the youthful David is one of the most beloved and famous works of its time (Picture 3). In Verrocchio's David, a strong contrast to Donatello's treatment of the same subject is visible. Although both artists choose to portray David as an adolescent, Verrocchio's brave man "appears somewhat older and excludes pride and self-confidence rather than a dreamy gaze of disbelief" (Fichner-Rathus, 1995). Donatello balanced realistic elements with an idealized Classically inspired torso, whereas Verrocchio's goal was absolutely realism in every detail. "Donatello's graceful pose had been replaced in the Verrocchio, by a jaunty contrapposto that enhances David's image of self-confidence" (Fichner-Rathus 334).

Michelangelo's David

The most famous sculpture of David is the one made by Michelangelo Buonarroti (1475-1564) in the early 16th century (1504) (Picture 4). Michelangelo's reputation as a sculptor was established when he carved his David at the edge of twenty-seven from a single piece of relatively unworkable marble. Unlike the Davids of Donatello and Verrocchio, Michelangelo's David is not shown after conquering his enemy. Instead, he is portrayed as a "most beautiful animal preparing to kill-not by savagery and brute force, but by intellect and skill" (Fichner-Rathus, 1995). Cast over his shoulder is David's sling, and the stone is clutched in his right hand, his veins in chief anticipation of the fight. Michelangelo's David depicts the ideal youth who has just reached manhood and is capable of great physical and intellectual deeds, which is part of the Classical tradition (Fichner-Rathus, 1995).

Picture 4. Michelangelo Buonarroti David 1504

Besides that, the sculpture of David is more than 5 meters tall (517 cm). To anyone who knows the story of David and Goliath, an obvious paradox arises from a statue of David that is as big. The mythical figure of David is supposed to be the giant-killer—yet, in view of his size, Florentines spontaneously called this David the Giant – *Il Gigante.* With that, the whole meaning of David's victory is altered. No longer does he represent a fable whose moral is "the bigger they come, the harder they fall." As Marcel Brion wrote: "Michelangelo's David is like Perseus and Siegfried, whose prowess was the result of their own strength and courage; they would have scorned to appeal for help, even from God" (Brion, 1940). Michelangelo's David is a result of change in the understanding of world and God. He possesses no supernatural powers-neither divine strength nor divine foresight. The Middle Age human, helpless before God and Destiny, who prays for salvation after death, gives place to a self-conciens, Renaissance *hommo faber* – a maker of his own destiny.

A trivia connected to this sculpture is that recent scientific research discovered an anatomical mistake on the sculpture. Michelangelo's David is missing a muscle on the right side of his back, between the spine and the shoulder. A flaw is not a result of a mistake done by the artist, for Michelangelo himself complained (in one of his letters) about the anomaly of the marble which prevented him to mould the muscle (Lorenzi, 2004). Regardless of this imperfection (which is not even a shortcoming, for art is more than just an imitation of nature), this work of art represents a moral strength and dignity expressed by the classical beauty of a vital human body in perfect harmony of physical and spiritual strength.

Baroque presentation of David

Bernini's David

Picture 5. Gian Lorenzo Bernini David. 1624.

The sculpture of David from the early 17th century (1624), made by Gian Lorenzo Bernini (1598-1680) is notably different from those of Donatello, Verrocchio and Michaelangelo. Bernini emulated neither Donatello's triumphant boy victor nor Michaelangelo's posturing adolescent (Picture 5). His hero is full-grown and fully engaged-both physically and psychologically-as he takes aim and twists his tensed, muscular body a split second before slinging the stone, grasped in his left hand. David stands alone, but Goliath is envisioned directly behind the viewer. It is the anticipation of violent action that heightens this confrontation as David's latent power is momentarily arrested (Scribner, 1991). Present in this sculpture are three crucial characteristics of Baroque art: motion, a different way of looking at space (spiral, in opposition to frontal and sideways) and the introduction of the concept of time. Donatello and Verrocchio depicted David at rest after he killed Goliath, Michaelangelo, by contrast, presented David before the battle, with the tension and emotion evident in every vein and muscle. Bernini does not depict David before or after the fight. Instead, he shows him in the process of the fight. This represents the element of time in his work. The viewers are forced to complete the action that David has begun.

Caravaggio's David

Picture 6. Caravaggio David with the Head of Goliath. c.1610.

In the 17th century, renaissance exaltation with the classical idea of human being the centre of the world, gave place to again more spiritual understanding of existence. Caravaggio's David (1610) is neither classically nude, nor classically strong (Picture 6). He is, again, depicted after the battle, but he lacks the satisfaction of the victory.

For all its obvious theatricality (which is very typical for baroque period), the painting is surprisingly muted: David seems to contemplate Goliath with a mixture of sadness and pity. According to contemporary sources, the severed head is a self-portrait, but although the identification can be doubted, the disturbing image communicates a tragic vision. Not long after the David was painted, Caravaggio killed another man in a duel, which forced him to spend the rest of his short life on the run. (Janson)

Conclusion

The idea of strength has changed drastically throughout the history. In a certain period of Ancient Greek civilization the harmony between body and soul was present. That was the concept misunderstood by the Romans, who emphasized the physical strength. The long period of the Middle Ages denies the material existence of this world, and appreciates only the spiritual component. In the period of Renaissance, a classical idea is reborn; ideal is once again found in the harmony between the physical and the spiritual. This aspiration for harmony is once again disturbed by the Reformation and Counter Reformation that put the emphasis on the spirit. The period of Modern Age is marked by slow return of the physical – notably the birth of modern sport in England. Surely the greatest moment of this harmony is the turn of the 20th century with Pierre de Coubertin and the Olympic movement. Today, the harmony is once again disturbed in the way that the physical component prevails in the contemporary society. When studying this evolution, it is clear that the brightest highlights of human civilization are the periods when harmony between physical and spiritual existed and that this harmony should be the inspiration and the aim.

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OLYMPISM IN CROATIA 1894-1912

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Abstract

The paper is about Olympic movement in Croatia from its origins. Period from 1894 to 1912, in Croatia was very turbulent in political, social and cultural way. Therefore, sport was also particular battle field in order to accomplish affirmation of Croatia and Croatian people in the world of sport and Olympic movement. Reports and reviews about foundation of International Olympic Committee were important part of daily, weekly and monthly press. Also we will write something about the role of Croatian sport enthusiasts in modern Olympic movement. The most important person in promoting Olympic movement in Croatia was Franjo Bučar and because of that it is almost impossible to write an article about Olympism in Croatia without mentioning this person.

Key words: *olympic movement, Franjo Bučar, Croatia, olympics*

Introduction

As we know the attempt to revive Olympic Games was very successful. Baron Pierre de Coubertin made his dream come true. International Olympic Committee vas founded in Paris on 23 June 1984 with great support of many Countries of the world including USA, Italy, Spain, France, Greece and Russia. (Platonov and Guskov 1997). In this respect revival of the Olympic Games and foundation of International Olympic Committee was accompanied in Croatia with great attention. The Person who gave the most of information's about these topics was Franjo Bučar.

Picture 1. Franjo Bučar (Zagreb, November 25, 1866 - December 26, 1946) – one of the first promoters of Olympic movement in Croatia

Croatian, historian, sportsman, founder of many sport clubs informed Croatian's about great international meeting, held in Paris about reconditioning of Olympic Games and rules for the Games. Also he writes about discussion on amateurism and professionalism in sport and Olympic Games. This article is published by Croatian journal *Gimnastika* in September 1894. In 1896 there were several articles about Olympic movement, International Olympic Committee and Olympic Games in Croatian press and therefore we can consider this year as the beginning of propaganda of Olympism and Olympic movement in Croatia (Jajčević 2007). Miljenko Stefanović *Gymnastic teacher course* attendant, organized in Zagreb by Franjo Bučar from 1894 to 1896, write an article *Olympic Games before and now* in journal *Šport – Glasilo za sve športske struke.* An article was published in January of 1896 and it had a few parts. As he was attendant of mentioned *Gymnastic teacher course* his wish was to inform in detail other colleagues on course about foundation of International Olympic Committee and preparation for organizing first modern Olympic Games. He noted that many representatives of sport from many countries were in Paris and that only Germans did not participated. His polemics about an article published in *Daily Telegraph* on June 19. 1894 was also a significant indicator that Olympic movement was accepted

with great attention and understanding. Author of article in *Daily Telegraph* was more than skeptic about whole idea on Olympic Games and International Olympic Committee. There were several things that he noted as problems that will lead to extinction of Olympic Games. He writes about problem of amateurism and professionalism and assumes that is hard to decide who professional sportsman is and who is not. Also he thinks that is hard to expect to have athletes as competitors in modern pentathlon due to the fact that most of athletes are specialized for one sport. He considered that there will not be many athletes that would compete only for Olive leafs. Stefanović wrote that this author forgot that other nations have competitors for pentathlon despite to the fact that British are one of the first sport nations. Pessimistic approach that author had been also commented by Stefanović. There were several other articles about this topic. In this way another article was written in sport trade journal *Gimnastika*. Author is unknown but experts assume that article is written by Franjo Bučar editor of that magazine (Jajčević 2007). Article is about difficulties in organizing first Olympic Games in Athens. Different European gymnastic organizations had different views about appearance in the Games. European gymnastic organizations did not get along with the principles of the Olympic Games because of the sport that favor competition and underestimates educational elements of physical activity.

First modern Olympic Games and Olympic congress in Le Havre

Paris Congress in 1894 made a decision that first Olympic Games will be organized in Athens, Greece. So National Olympic Committee of Greece had a task to organize and supervise all preparation of venues for the First Olympiad. They had to finish it within twelve month (Platonov and Guskov 1997). Despite all difficulties that they had First Olympic Games were opened on April 6, 1896 by King George of Greece in presence of 80,000 spectators. This was a great success for International Olympic Committee. Croatian journal *Šport* start to publish a feuilleton *Olympic Games in Athens*. Feuilleton had a few proceedings and it had a lot of interesting information's about First Olympic Games. In the article that is written as third proceeding of feuilleton author writhed "Everything *was finished in the best manner and with lot of joy and International Olympic Committee already started preparations for the next Olympia that is to be held on 1900 in Paris where, so God help us, Croats will attend as competitors".* The author of this article was Franjo Bučar and as we can see he announced appearance of Croatian athletes on Olympic Games 112 years ago (Jajčević 2007).

Success of the first Olympic Games was a great contribution to the popularization of Olympic movement in the world. International Olympic Committee carried on with expansion and foundation of National Olympic Committees and their inclusion to big Olympic family. Main goal of Franjo Bučar's activities was to incorporate Croatia into International Olympic Committee. During his study and many of his trips's Bučar met members of International Olympic Committee: Viktor Balck from Sweden, Jiŕi Guth - Jarkovskỳ from Czech Republic and Aleksej Butovskij from Russia. They informed Bučar about Olympic congress that is to be held on July 23 to august 2 1897 in Le Havre, France and he write a detailed article about this subject. He brought comprehensive report about topics that will be discussed on Olympic congress and write that Mister Jiŕi Guth - Jarkovskỳ from Czech Republic gave him an invitation to this congress. Unfortunately Franjo Bučar did not go to Le Havre because of bad situation in Croatian sport caused by Izidor Kršnjavi withdrawal from the Head of religion and education department. This article was brought by Croatian journal *Šport* (Jajčević 2007). It is very important to know that Jiŕi Guth - Jarkovskỳ gave an opportunity for Croatian athletes that they can join to Czech Republic Olympic Committee so they can go to Olympic Games 1900 in Paris, France.

The Games of second Olympiad

These Games were in coincidence with World exhibition and it was a positive vibe for Olympic Games and Olympic sport in general because Exhibition draws more spectators and promotion of The Games was on higher level. Despite to this fact Olympic Games in Paris did not obtain success as Athens Games in 1896. The truth about Paris Games was that these games went down in history as "The Olympics of chaos". The extension of the Olympiad to last from 20 may till 28 October did nothing good for Olympic Games or Olympic movement in general. Anyway these Games had bright side to. There were 1,225 athletes from 26 countries of the world. First time women took part in this event and there were 19 female athletes. (Platonov and Guskov 1997) Important occurrence from these Games was appearance of Milan Neralić from Slunj, Croatia in fencing tournament. He went on the Olympic Games under the flag of Austria and made a bronze medal (Jajčević 2007).

Activities in the period from 1900 till 1906

One of the most important events in this period was in June 1903. Member of International Olympic Committee Victor Balck from Sweden came to Zagreb for few days and visit sport facilities in Zagreb such as building of Croatian Falcon where he attended a fencing exercise and gymnastic exercise by the rules of Croatian Falcon. On June 20 he had a lecture about physical education and sport in Scandinavian states. The lecture was very well visited by the representatives of government, army and university professors. Furthermore, in this period The Games of Third Olympiad in London were held in 1904. No one of Croatian athletes was in this Games but it is relevant to mention that Olympic Games in St.

Louis were also poorly organized. Failure of second and third Olympiad was a great opportunity for Greeks and their idea that Olympic Games are to be held in Greece every time. They organized in honor of 10-th anniversary of the first modern Olympic Games so called intercalary games. Franjo Bučar was interested in possibility for Croatian athletes to appear in these Games so he sent preliminary application for gymnastics. He attended to send athletes from Croatian Falcon to Athens. First reaction of organizers was positive but after the intervention of Hungarian Olympic Committee they withdraw that decision. During this period Croatia was integral element of Austro-Hungarian state so organizers send out Bučar to Hungarian Olympic Committee. A criterion of allowing to Croatian athletes to go on these Games was that Croatians should join Hungarians and compete in prequalification contests. Croatian sport activists refused to go under these circumstances. Success of these Games was great. Franjo Bučar writes another feuilleton in *Sokol* magazine where he writes that after failures in Paris and St. Louis Olympic Games held in Athens were very well organized and we can expect that every Olympic Games in the future are going to be held in Athens because of good organization and impressive venues that they have (Jajčević 2007).

Appeal of Croatian Falcon Federation

After discussion with Jiři Guth - Jarkovskỳ from Czech Republic Franjo Bučar went to Paris to see Baron Pierre de Coubertin and to see the possibility that representatives of Croatian nation enter big Olympic family. He told him that the "*Croatian fighters*" will have his support. After this conversation Bučar persuade Croatian Falcon Federation to send an appeal to the International Olympic Committee for acceptance as members. Memo was sent on May 23 1909 and International Olympic Committee had a meeting on May 27 1909 in Berlin. Anyway the memo did not arrived on time and Berlin meeting went without discussion about this topic. Despite to promises of Baron de Coubertin this inquiry had not been considering either next year in Luxemburg. In Budapest 1911 was a big discussion about inclusion of nations that did not have their own state. Result of this discussion was that Croatia can not be the member because of their position in Austro-Hungarian alliance (Jajčević 2007).

Conclusion

The period between 1894 and 1912 was very vivacious in the field of sport. Olympic movement and Olympism became more and more popular. Croatian athletes are gathered in two main courses. One is big and strong organization of Croatian Falcon and the other is different Sport disciplines represented in Olympic Games. However Olympic movement was growing and leading experts of sport in Croatia realized an importance of including to International Olympic Committee. First of all there was Franjo Bučar. He was an author of numerous articles about Olympic movement and situation in sport. Beside this he also operates in the field of organization of sport in Croatia. Right to his persistence on September 5 of 1909 Croatian Sport Federation was founded as central department of sport in Croatia. In spite of that Croatia did not had right to perform independently on Olympic Games in this period.

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BOOK COLLECTION FUNDS IN CROATIAN SPORT MUSEUM - CONTRIBUTION TO BIBLIOGRAPHY OF SOKOL MOVEMENT

Dedicated to Nikola Grgić my life pilot, as well as to all good people I have met through their work, regardless of ethnic, racial, religious, educational or political affiliations.

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Abstract

Modern scientific analysis of history, despite the knowledge of laws of social development, is based on the findings and authentic records. Most valuable among them are certainly the material objects and written documents with its direct ant6ion and contribute to the successful lightning of past events. During the 18-th and 19-th century, in the history of exercise and sports appears mass movements that were mutually distinguish by the goals and organizational forms, and become national systems, such as: German (Turner) physical exercise, the Swedish health and physical exercise system of English sport. Promoting the work of cultural categories, such as education, morality and national awareness Sokol had a remarkable publishing activity, which was particularly typical for Croatian Sokol. So far collected and register material we have found to be at the Croatian Sports Museum in holdings Sokol located 826 titles, or with specific number of duplicates 1174 enumerated bibliographic units. We can say that Sokol holdings as part of Book Collections Fund of Croatian Sports Museum is of a priceless value and importance.

Key words: *museum, book collection, Sokol, Croatia*

I.

Museums are institutions in the field of culture that carry out activities of special social interest. In the domain of museum activities they study, collect, handle, keep, protect, published and exhibit museum materials and museum exhibits of the importance for culture, art, science and education, and thus contribute to the cultural rising of introducting them with documents showing cultural, economic, socio-political, technical, historical and other development and progress of society that is a particular community. By its contents and activities, or thematic problems and types of items they collect can be divided into general and special or specialized. In this second category definitely belongs and Croatian Sports Museum.

Modern scientific analysis of history, despite the knowledge of laws of social development, is based on the findings and authentic records. Most valuable among them are certainly the material objects and written documents whith its direct action and contribute to the successful lightning of past events.

Book collection fund of Croatian Sports Museum contains several tens of thousands of books and about two hundredths of various magazines, newspapers and bulletins. This is certainly the biggest historical and scientific library related to physical exercise and sport in Croatia, and beyond. There are nearly all sport books printed on Croatian soil, but also many foreign editions. Book collection fund is classified by thematic branches and other activities related to physical exercise and sports such as: Sokolstvo, Olimpism, sports architecture, medicine, art and other activities. By its purpose Book collection fund is a special, technical and historical intended for a specific category of users, who perform their work in research, profession and other needs of public and media. These are mostly students, research fellows, journalists and professional and scientific workers. It was created thanks to the great effort and efforts of many donors who have collected material for decades, buying up the target of some private collector or by copying a small number of some rare works, which are kept in some other institutions.

Existing state of collected material through a longer period of time required special analysis and preparation followed by inventory and sorting. First of all, times appears of UDK system in the world and with us is a recent date, but that is dated many items from areas of exercise, sports or physical exercise movement. Another task that was supposed to be solved was sorting by professions, fields of Sports; Sports discipline within the same branch, some other related activities as well as some social movements. Further, we had to deal with the impact of other relevant factors, such as state administrative regulations that are regulating these questions and some other factors for example political activities that used sport as instrument to achieve their objectives.

Respecting all previously sed and respecting the principles of library profession and science, after deep analysis and specific consultations we come to the conclusion that the classifications, and cathalogization items must hold following the rules and principles, and these are:

1. That there are RULES OF THE GAME - whether in the general sense, which regulates the possibility of activity or specialized, which regulates all types of activities within the same sport. For example the sport's law as a general rule, and the rules of the profession such as track and field athletic and its disciplines as special rules.
2. That there are ORGANIZATIONAL SHEME OF SPORT - either as a community, institution, movement, club, association, International Federation, etc.
3. That there are COMPETITION - where it is possible to make measurement of results of all activities, whether in a formal sense, where the rules specified professions such as athletic competitions, either as a rivalry that is a different form, and where necessary assessment, for example, artistic skating, or as special forms of activities, mountain climbing, mountaineering, etc. In addition, activities in the form of games, where you can access the fully flexible, such as games for children and adolescents, and the game in the form of offical competition, for example ball games, where the rules of the profession only able to determine which activities are allowed and which are not, for example dribling as invenzive technical means to achieve the basic goal of the game is precisely defined.

Respecting all above, we found a series of many new terms, items and topics of activities, organizational forms and all kinds of regulations and rules that need to be taken in consideration in book classification precess.

So we resolve the basics classification through sport classification and cathalogization for example, Athletics, Boxing, Cycling, etc., and the differences in the sport's branch, specialty or any other form of activity through the signatures, which we marked with the Roman numerals from I onwards where we had to form a completely new table. (Table 1)

Table 1 Proposed signature for sports books

I = ideology and the emergence of activities in all forms,	VII = monographies,
II = history of particular activity,	VIII = Calendars, almanahs;
III = ruls of activity,	IX = periodicals,
IV = competition,	X = buildings,
V = rules of the profession, training, terminology, methodology,	XI = equipment, etc.
VI = biographies,	extensions signaturs is open for future changes

II.

During the 18th and 19th century, in the history of exercise and sports appears a mass movements that were mutually distinguish by the goals and organizational forms, and become national systems, such as: German (Turner) physical exercise, the Swedish health and physical exercise system of English sport. Important factors that have impacted on the emergence of these systems are development of productive relations with its consequences on health of professional injury or deformity, as well as the seismic political-national relations, where physical exercise came from a direct linkage with the military needs and has emerged as a possibility to fight for freedom through such activities and other national gathering of ethnic communities in multiethnic countries. Such views are most typical on the territory of the Austro-Hungarian monarchy where Sokol was born.

Sokol is in fact a joint name for exercise movements that was developed since 1862 in the Austro-Hungarian monarchy between the Slavic nations, except in those areas where there was not enough developed liberal civil society, which was the main bearer of this movement, with the aim of defense national identity. It is also worth noting that there were two most typical directions in their work and action through the historical period, Sokol as a national revival on the basis of filantropizm and liberlizma with the aim of spreading culture and education and raising national identity, where the most significant example is Sokol in Croatia, or Sokol as an instrument for some other goals and especially political, where it is used as an political instrument, the most significant example is Sokol in Kingdom of Yugoslavia (1918-1941). In addition to Sokol movement influenced and other factors, such as: enactment of legal and state institutions, where the physical education was introduced as a obligatory subject in schools, in 1874 in Croatia, appearance of similar movements, in Croatian religious physical exercise movement, educational and exercise organization that was active from 1923 to 1929, and the certain political movements that intervene in Sokol movement. Sokol was definitely influenced and by historical events and a world war, the formation of new states, introduction of dictatorship in Kingdom of Yugoslavia in 1929 when all Sokol organizations with national mark where forbidden and only Yugoslav Sokol was allowed as a tool in the dictatorship hand. Following historical events Sokol in the Kingdom of Yugoslavia, simply disappears 1941.

Promoting the work of cultural categories, such as education, morality and national awearness Sokol had a remarkable publishing activity, which was particulary typical for Croatian Sokol. In the process of reviewing written Sokol items

arising from the earliest days of motion until its end, we had to solve some important questions. First, we share the basic material by mentioned signature which was in a lot of cases insufficient, so we had to add some supplements. Secondly, we have to solve that Sokol is definitely not only a mass movement (by the UDC 796.03) but that Sokol has also a philosophical component, so we add a label 13 (philosophy of the mind) in the same relative value with the exercise, an example 13:796.03.

Table 2. Sokol book collection in Croatian Sports Museum

Type of Sokol movement	Number of books
Croatian Sokol	134
Croatian/Yugoslav Sokol	20
Slovenian Sokol	28
Slovenian/Yugoslav Sokol	74
Yugoslav Sokol	227
Croatia	65
Slovenia	31
Bosnia and Herzegovina	15
Macedonia	2
Autonomous Province of Vojvodina	25
Czech Sokol	190
Poland Sokol	6
Russian Sokol	9
altogether	826

In table 2 is shown complete Sokol books collection fund in Croatian Sports Museum. Commitment to such a classification are primarily written material itself, with its main theme, as well as place of origin and ideas such as for example territorial and state or national affiliation and assertion organizations of author. So far collected and register material we have found to be at the Croatian Sports Museum in holdings Sokol located 826 titles, or with a specific number of duplicates 1174 enumerated bibliographic units.

After all, we can say that Sokol holdings as part of Book Collections Fund of Croatian Sports Museum is of a priceless value and importance, and as such will serve time in the future for deeper and more significant historical research, both in the framework of exercise and sports and beyond.

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Management of Sport

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PART ONE: MANAGEMENT OF SPORT

ANALYSIS OF THE INCOME STRUCTURE OF SPORTS ORGANISATIONS AND THE EXPENDITURE OF THE SLOVENIAN POPULATION FOR SPORT AS A POSSIBLE RESEARCH APPROACH TO ECONOMIC ASPECTS OF SPORT

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Abstract

Sport is becoming progressively more important discipline of the economy in comparison to other social segments; therefore, researching its economic impacts is also becoming more important. The presented research approach to the studying of macroeconomic aspects of sport outside of educational system is a product of several years of experience. Additionally, the article presents the findings of various researches on the topic, including the analysis of the income structure of Slovenian sports organisations on a sample of 8.092 organisations, the expenditure of the population for sport on a representative sample from the Statistical office of the Republic of Slovenia and the public expenditure for sport from the reports about the realisation of the National programme for sport in Slovenia.

The research approach reveals that the total expenditure for sport in the studied year 2005 amounted to 530 mio. EUR or 1.92% of GDP. In the expenditure structure, the largest share with 85% holds private funds (corporations, households), whereas public finances (state, local authorities, lottery money, EU) amount to slightly less than 15%; the latter percentage is slightly lower compared to some neighbouring countries. As a result of the EU structural funds, the increase in the funds for the building of sports facilities has been noticed in the last three years, while the funds for sports activities are falling on both the national and local level. Whereas the relationship between the private and public expenditure has not changed significantly in the last years, the volume of the expenditure is constantly increasing due to the economic growth in Slovenia. Nevertheless, the volume lags behind the increase in the expenditure of population for so-called leisure industry, resulting in sport loosing a marketing share within the industry. The analysis of the expenditure of population reveals that each Slovenian household spends in average 9.7% of family budget for sport, equalling to 500 EUR per year. Two thirds of the money is being spent for sports products and a third for sports services. Households with the highest and medium-high income are responsible for the 70% of all money spent for sport. The analysis of the income structure of sports organisations reveal that progressively more sports services are being offered by a private sector, although the public sports sector created 62% of all income for such services. Within this income it can be noted that the money is being accumulated more in commercial sport, which could have been expected as a result of the evaluated income structure of sports clubs and associations; namely, the majority of income comes from business corporations, which usually expect some kind of return for their investment.

The results point to certain weaknesses of Slovenian sport. First is a small size of Slovenian market, which is resulted in limited sponsorship potential. Second is poor competitiveness of the non-governmental sports organizations within the leisure industry and sport and third is decreased investment of public finances into sports programmes. Left unchallenged, these weaknesses could become a real obstacle for further successful development of sport; therefore, some countermeasures are being presented in the last part of the article.

Key words: *sports management, macroeconomic aspects, public expenditure, private expenditure*

Introduction

The influx of money into sport started to grow in the majority of European countries approximately twenty years ago. As a result, the need for a good organisation of economic data appeared which would allow easier overview of the development of sports market. The 1980s were marked with first efforts in the collection and evaluation of data from the fast developing sports economy, the first countries being Belgium, Denmark, Finland, France, Germany and Great Britain. The first study, led by Michael Collins, was sponsored by the Committee for the development of sport in the European Council (Jones, 1989). The researchers collected the available data; the purpose of the research was to find the first indicators of the economic value of sport in nine European countries. The following study was led by a French working group, which achieved the implementation of more standardized methodology. The French working group mainly

studied the macroeconomic relationship between the sport and economy, particularly focusing on the sources of sports financing on a larger sample of European countries (Andreff, Bourg & Halba, 1994). Since then, the European Council has not financed any similar study, despite the large need for a collection of such data in sport due to the rapid development of all types of sport in Europe, particularly sports events, sports sponsorship, popularisation of sport on television etc. (Andreff, 2000). Therefore, the researchers have to rely on the results acquired in individual countries, although only few use the accepted research approach of French working group, whereas others use their own methodology for researching sports market and economy.

Several research studies were carried out in Slovenia, examining the economic aspects of sport outside the educational system, although two thirds of sports programmes are carried out within the educational system with both the volume of compulsory sports programmes (Hardman, 2002) and the quality of curricular and extracurricular programmes (Jurak et al., 2003; Strel, Kovač & Jurak, 2004) being among the best in Europe. It has been estimated that the economic strength of Slovenian sport, expressed with public and private expenditure for sport, amounts to approximately 2,2-2,3% of GNP (Bednarik, Kolenc & Močnik, 2001a), similarly to developed countries (Watt, 2003; Bartoluci, 2004). The level of development of sport in different parts of Slovenia mainly depends on the economic strength of the area and slightly less on the age structure and the urbanisation level of the population (Bednarik, Petrovič, Potočnik, Simoneti, Šugman & Štrumbelj, 1999). Findings show that the elite sports result in Slovenia has a trading value (Bednarik, Petrović & Nyerges, 1997), the potential for spectators and viewers of sports events is relatively large yet very limited due to the relatively small population of 2 million (Bednarik & Petrovič, 1998; Bednarik, Šugman, Urank & Kovač, 2007). As a result, the potential for the sponsoring of Slovenian sport is small in an absolute sense, whereas relatively speaking the sponsorship potential of sport in Slovenia is large (Bednarik, Simoneti, Petrovič & Štrumbelj, 1998). The most important goals of sponsoring Slovenian sport are: advertising the name and the logo of the corporation, inclusion of a corporation in the social environment and the improvement of the public opinion about the corporation (Jurak, Bednarik, & Kolar, 2008). The priority of sponsorship goals of corporations is similar to what it was a couple of years ago (Bednarik et al., 1998); however, the goals are slightly more focused on the social responsibility of the corporations. These goals are also being listed in the majority of international studies (Copeland, Frisby, & McCarville, 1996; Cornwell & Maignon, 1998; Musante, Milne, & McDonald, 1999; Amis, Slack, & Berrett, 1999). In contrast, some of the goals, such as the increase in the market share and sales increase are according to some studies more important in the international area in comparison to Slovenia (Irwin & Sutton; 1994; Cornwell & Maignon, 1998), indicating that Slovenian sport is not being sponsored for entirely commercial reasons. Nevertheless, the amount of money spent for sponsorship by Slovenian corporations is large in relation to the economic strength of the country. The share of sponsorship money in the total finances is comparable to that in EU (Bednarik, Kovač & Jurak, 2001b). One of the largest financial sources of sport, particularly in the elite sports market, are TV viewers (Lobmeyer, 1992), although some specific characteristics can be noticed in Slovenia due to the small size of the Slovenian market. Namely, Slovenian people mostly watch sport on television and less frequently attend sports events (Bednarik & Petrović, 1998; Jošt et al., 1999); this is reflected in the low expenditure of Slovenian households for the attendance of sports events (Bednarik et al., 2001a). Different sports in Slovenia vary in their attraction for individual TV viewers and spectators of sports events and the structure of spectators and viewers differ for different sports (Bednarik & Kline, 1997; Bednarik et al., 2007). Despite relatively well-saturated market of spectators, the size of the market limits the financial potential of sports events (advertising during the broadcasting) in comparison to other countries, which are larger in population yet less successful in achieving elite sports results. The issue has also a strong negative effect on the financial resources of the elite sport, which is in major part still being financed from the public finances, similarly as is the sport of children and youth (Kolar et al., 2005).

Despite the listed specifics the model of financing the sports organisations in Slovenia is very similar to the model of financing in the EU (Bednarik, Petrović & Šugman, 1998). The majority of financial revenue is secured from the private sources, however, the level of expenditure from public finances on both national and local level in Slovenia is lower to neighbouring and Western Europe countries (Sever, Bednarik & Šugman, 2000; Bednarik et al., 2001b). The important source of financing of Slovenian sport are volunteers. They represent almost 80% of workers in nongovernmental sports organisations (Bednarik et al., 1998, Jurak, 2006). These volunteers perform 65.8% of all work (Jurak, 2006) and the estimate contribution of volunteer work to the income of sports organisations is nearly 15% (Bednarik et al., 2000, 2001a). It is estimated that volunteer work represents 13.5% of economic strength outside the educational system, equalling to 81.2 mio EUR or 0.311% of GDP (Jurak & Bednarik, 2006). The volume of volunteer work lags behind that in the developed European countries (Jurak, 2006), nevertheless, this is expected in relation of volunteer work to the GDP.

The economic aspects of sport are closely related to the proportion of sportingly active population. The increase of sportingly active population is reflected in the increased expenditure of population for sport (sports services and products); as a consequence sport and other related activities (tourism, health, education) are becoming more important branch of economy. Nearly 30 years of continuous monitoring of sports activities of Slovenian population (Petrovič, Ambrožič, Sila & Doupona, 1998; Jošt et al., 1999; Kovač, Starc & Doupona Topič, 2005) show an increase in the proportion of sportingly active people (52.4% of Slovenian population are sportingly active, whereas 37.7% take up sports activities once a week, Kovač et al., 2005). Results are comparable with the western European countries and are higher than in some more developed European countries (http://europa.eu.int/comm/public_opinion/). Important increase can also be

noticed in the proportion of sportingly active women. The results show an emergence of growing mass sports market in Slovenia. Particularly the expenditure points at the size of the sports market and the importance of sport for specific subjects of Slovenian society.

Many aspects of sport legacy have been researched in Slovenia and the presentation of all of them exceeds the framework of the present study, therefore, only the aspect of the financial flow in sport, the methodological approach and its possible use in practice are presented. The research approach used allows the comparison with comparable data in Europe. Such data enables the solution looking for the improvement of the competitiveness of Slovenian sport in the European sports space.

Methodology

The income of sports organisations, the expenditure of population for sport, the public expenditure for sport and the expenditure of corporations for sport have been analysed for the purpose of researching of Slovenia sports market from the financial flow point of view.

The income (from sales, other income, income from financing and transferred earnings) *of sports organisations* is represented with the total income of organisations (sports clubs, sports companies, entrepreneurs, public institutions, private institutions) that provide sports activity outside the educational system (see Table 1). Data were collected from the Agency for public legal records and services in the Republic of Slovenia (AJPES).

Table 1. The structure of sports organisations and their income in 2006

	transfers		suppliers	
	in EUR	%	number	%
Sports clubs and associations	163,873,256	70.6	5,941	73.4
Sports companies	34,342,818	14.8	188	2.3
Public institutions in sport	25,994,362	11.2	34	0.4
Private institutions in sport	1,922,125	0.8	16	0.2
Entrepreneurs in sport	5,967,188	2.6	398	4.9
Private sports workers	-	-	633	7.8
Professional sportsmen	-	-	882	10.9
Total	232,099,749	100.0	8,092	100.0

Source: AJPES, 2007

Private sports workers and professional sportsmen form a specific group; their income has not been presented in Table 1 due to the lack of available data. In the first half of 2007, their number rose to 1,515 according to the AJPES records. The characteristic of this group of sports services is that its members offer their services to sports organisations. When analysing the income and expenditure of other sports organisations they mainly represent the expenditure part of these organisations, yet the total income of all subjects in sport does not increase significantly. In both the number and the income the largest groups are sports clubs and associations, which are for Slovenian sport (beside the educational system) also the most important. As a result, the study focuses mainly on the analysis of the income of public sports organisations. AJPES records reveal merely the bookkeeping review of the income; some other available data were used to evaluate the structure of income from the aspect of sports contents. The structure has been designed on the basis of following information:

- Data from the Annual reports, as given to AJPES by the sports clubs for 2006 financial year as well as from the government budget and other public sources. This is also the only item in the Income statements of sports clubs, explicitly discussing the income from public sources and was therefore the only indicator in estimating the income structure.
- Data obtained from the Statistical office of the Republic of Slovenia (SURS) about the household expenditure in 2005. Data about the expenditure for sports events, sports courses and membership fees were extracted from the total household expenditure.
- The evaluation of the income of sports clubs received from the corporations and other private sources that are based on the difference between the total income of sports clubs, the income of sports clubs from government budget and other public sources and the household expenditure for sports events, sports courses and membership fees.

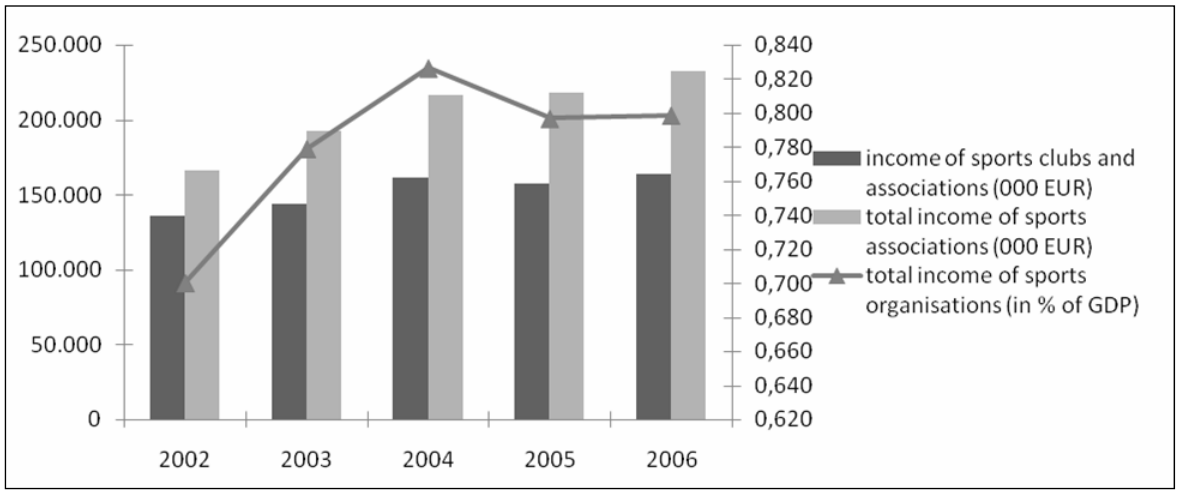
The expenditure of the population for sports events are represented by sports events, training fees for sports activities and the charges for facility hire, sports courses and sports clubs membership fees, sports equipment rental charges and

the ski lift services. The expenditure of the population for sports products is represented with costs of clothing, shoes, bicycles, large equipment for sport and leisure and the equipment for sport, hunting, camping and outdoor recreation. Data about the household expenditure for sports services and products for 2005 were collected from SURS. The sample is representative, meaning it is stratified for regions and the density type of area.

The public expenditure for sport is represented with the expenditure for sports programmes and investments from local authorities, passed on by the local authorities in their annual reports about implementing the National programme for sport, also from the government budget and Foundation for sport (lottery money).

The expenditure of the corporations for sport is represented with an estimate based on the difference between total income of sports clubs and the income from budget and public sources, expenditure of households for sport, courses and membership fees.

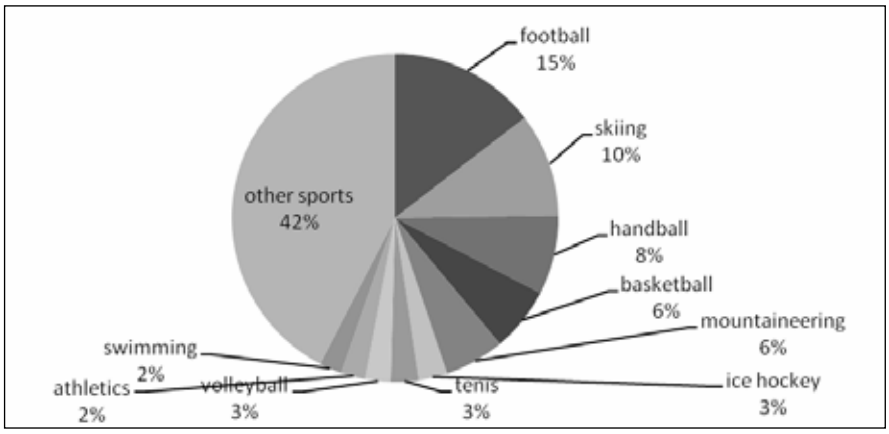
Results and discussion



Source: AJPES, 2007

Figure 1. A comparison of the income of all sports organisations and the income of sports clubs and associations between 2002 and 2006

Total income of all sports organisations have in the last studied year reached 0.79% of a GDP. In the last few years there have been some changes in the tendency of income of sports clubs and associations and the income of all sports organisations (see Figure 1). Whereas the increase of sports clubs and associations have slowed down, the total income is still rising nominally, pointing to the increased volume in private sports segment, which is represented with the income of sports companies and entrepreneurs in sport.



Source: AJPES, 2007

Figure 2. The share of income of sports clubs and associations according to the sports discipline in 2006

Sports clubs and associations from the ten by income largest sports disciplines generate more than a half of total income of sports clubs (see Figure 2) with commercial sports being in front. Football, basketball and handball together generate 29% of total income of sports clubs. These sports are uncompromisingly increasing their share of income. In the last five years, the share of ten by income largest sports disciplines increased by five percentage points and by two percentage points from 2005 to 2006. Annual reduction of the average income per sports clubs and the increase of the share of income in largest sports confirm that the commercialisation of sport in Slovenia occurred on behalf of TV sports; similar conclusions have also been found in some other researches (Lobmeyer, 1992; Bednarik & Petrović, 1998; Jošt et al., 1999).

The following analysis of the expenditure for sport reveals that the population (households) spend the most, yet the evaluation of the income structure of sports clubs and associations reveals that these organisations create the most of their income from corporations with the sales of sponsorship and TV rights (59% of total income), whereas public sources represent only one 19% and population 22% of total income. The increased attention on the expenditure of sponsors, which for sports clubs represent the main source of income, is also a danger for commercially less interesting sports. Namely, commercially more interesting sports create larger share of income from this source, have larger media contact and are therefore more interesting for sponsors. It can be noticed that only 16 sports are generally interesting for sponsors in Slovenia, with football and basketball especially ahead (Jurak et al., 2008). Sports clubs should focus their sports services more into the population expenditure and increase their income from this source and thus decrease the dependency on the income from corporations (sponsors). The longitudinal monitoring of sports activities of Slovenian people (Petrović et al., 1998; Jošt et al., 1999; Kovač et al., 2005) reveals that the proportion of sportingly active people in Slovenia is increasing and with it also the income potential of sports organisations that they can create from population for sports services. On the other side the increase of the population, which participate in sport often yet in unorganised manner (out of sports organisations), has been noticed. It can be concluded that sports organisations only partially utilise their marketing potential.

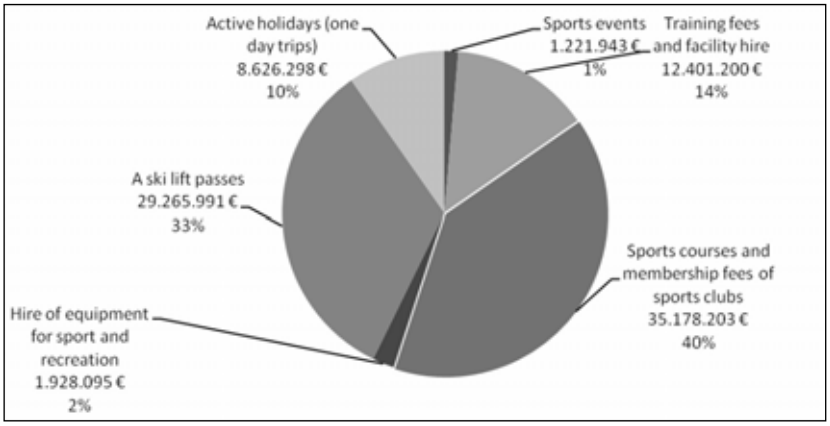
Table 2. The expenditure structure of sport in 2005

Expenditure for sport in 2005	**TOTAL(EUR)**	%	For sports services or programmes (EUR)	%	For investments in sport (EUR)	%	For sports accessories, equipment, clothing, shoes (EUR)	%
TOTAL EXPENDITURE	***530,220,012***	**100.0**	**214,320,055**	**100.0**	**41,818,648**	**100.0**	**274,081,309**	**100.0**
Total public expenditure	***77,716,567***	***14.7***	***41,751,331***	***19.5***	***35,965,236***	***86.0***		
Government budget expenditure	14,738,654	2.8	9,273,172	4.3	5,465,482	13.0		
Local government expenditure	56,361,676	10.6	29,209,581	13.6	27,152,095	65.0		
Lottery money	6,616,237	1.2	3,268,578	1.5	3,347,659	8.0		
Total private expenditure	***452,503,445***	***85.3***	***172,568,724***	***80.5***	***5,853,412***	***14.0***	***274,081,309***	***100.0***
Expenditure of corporations	96,716,192	18.2	92,825,467	43.3	3,890,725	9.0		
Expenditure of population	353,824,566	66.7	79,743,257	37.2			274,081,309	100.0
Expenditure of population for products	274,081,309	51.7					274,081,309	100.0
Expenditure of population for services	79,743,257	15.0	79,743,257					
Expenditure of clubs					1,962,687	5.0		

Source: SURS, MSS, Local authorities, Foundation for sport

The total *expenditure for sport* in 2005 was 530 mio. EUR or 1.92% of GDP. Half of the money in sport was spent on sports products (51.7%), followed by sports programmes (40.4%) and the investment in sports facilities (7.9%). In the structure of expenditure, private expenditure has the largest share with 85%, the share of public expenditure is slightly less than 15%. The proportion between private and public expenditure has not been changing through the years (see: Bednarik et al., 2001b); however, the volume of expenditure dictated by economic growth has been changing. With economic growth the expenditure for sports services has also increased. This trend has stopped in 2005. Future analyses will have to show whether this was a system or an accidental halt in growth.

The total expenditure for sport has been nominally increasing until 2005 and has been falling in relation to the GDP due to larger investments in Slovenia in other social segments, particularly in transportation infrastructure. The share of expenditure for sport has fallen from 2.3% to 1.92% of GDP.



Source: SURS, 2007

Figure 3. The structure of expenditure of the population for sports services in 2005

The expenditure of population for sport shows that in 2005 population spent more than 57 mio. EUR for sports services (sports events, training fees for sports activities and hire charges for sports facilities, sports courses and membership fees for sports clubs, active holidays) in the public sports organisations' market (SURS, see figure 3). Sports clubs had with selling of sports services (sports courses, membership fees for sports clubs) made an estimated 35 mio. EUR and achieved a 62% market share.

Table 2 also reveals that Slovenian people spend most of their money for sports products (sports clothing and shoes, outdoor sports equipment), three times more compared to sports services (sports courses, membership fees for sports clubs, training fees and ski passes, tickets for sports events). In household budget, the expenditure for sport is nearly as high as expenditure for culture (9.7% of family budget is being used for culture and recreation) and is in average as high as that of EU25 members (Eurostat, 2006). Data from SURS (2007) reveal that in 2005 every household spent slightly more than 500 EUR per year (5.6% of average net annual salary in Slovenia) on sport, 370 EUR were used for sports products and 130 EUR for sports services. A detailed analysis shows the following expenditure:

- Sports clothing and shoes 260 EUR
- Sports and hunting equipment, camping and outdoor recreation equipment 80 EUR
- Sports courses and membership fees for sports clubs 40 EUR
- A ski lift passes in ski centres 40 EUR.

Data from the Office for Macroeconomic Analysis about the parity buying strength led to a conclusion that households from the top two income categories (people with highest and medium-high income) amount to 70% of expenditure for recreation.

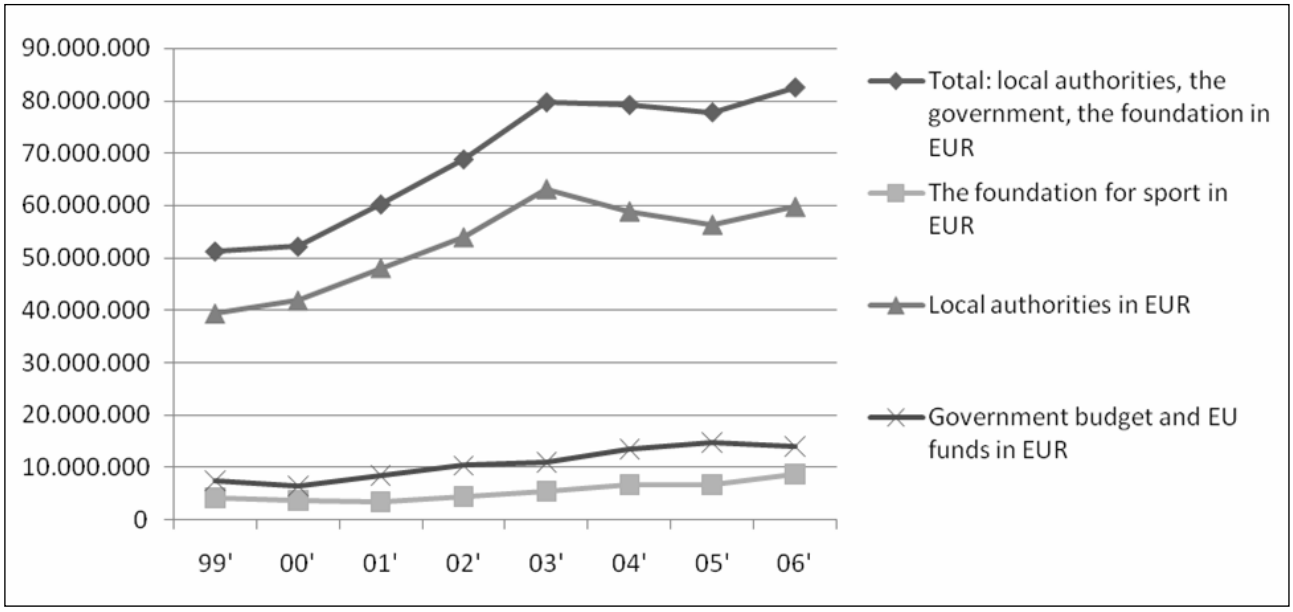
Table 3. The expenditure of population in comparison to the share of expenditure for all leisure activities

Year	2000	2001	2002	2003	2004	2005
The proportion of expenditure for sport in % of the total expenditure of population	3.04	2.87	2.87	2.87	2.92	2.81
The proportion of expenditure for sport in % of the total expenditure for leisure and culture	35.77	32.24	30.23	29.35	29.97	29.72
The proportion of expenditure for leisure and culture in % of the total expenditure of population	8.51	8.89	9.51	9.79	9.74	9.46

Source: SURS

The economic growth in Slovenia also generated higher expenditure of the population in the area of so-called leisure industry (music, film, culture, sport). Slovenia had in the last few years above average economic growth in comparison to the other EU member states. It is estimated that the economic growth will experience a continuing long-term increase, resulting in a consequent expenditure of the population for leisure industry services. Despite the economic growth, sports organisations in past years did not utilise the increased expenditure of the population for leisure industry. The proportion of total expenditure for recreation and culture (including all expenditure for leisure activities: holidays, gardening, music, film, culture, sport etc.) in the total household expenditure has between 2000 and 2005 increased by almost 1%, whereas the proportion of expenditure for sport has in the same period decreased both in comparison to total population expenditure and in the proportion of expenditure for recreation and culture (see Table 3).

Expenditure of corporations for sport represented estimated (see methodology) 17.7% of total expenditure for sport, equalling to 92 mio. EUR or 0.34 % of GDP. In the last few years a change in the negative tendency of expenditure of corporations for sport has been noticed (mainly as a result of sponsorship). It can be concluded that this is due to increased economic climate and faster growth of gross domestic product.



Source: MSS, Foundation for sport

Figure 4. Trend of public expenditure for sport on a national level in EUR

Public expenditure for sport, accomplishing public interest. The state, local authorities, Foundation for sport (lottery money) and the European Union through the National programme for sport provide public finances in order to accomplish public interest and provide suitable conditions for sporting activity of Slovenian people in all types of sport. In other words, fulfilling the public interest facilitate the increase in the use of sports services of both population and corporations. Besides a direct fulfilling of public interest with part financing of programmes and investments in the field of sport, the importance of the state also lies with introducing different regulations (taxes etc.), which can significantly contribute to a demand for sports services. In public expenditure for sport large fluctuations can be noticed (Figure 4, Table 4), which are a result of the investment expenditure for building of sports facilities. A strong positive change is noticed on a national level due to the EU structural funds finances, although the finances for sports programmes are falling on both national and local levels.

Table 4. A proportion of expenditure for sport in % of total government budget for the period 2007 to 2009

	2007	2008	2009
Total expenditure of the government budget (EUR)	7,965,703,000	8,865,216,441	9,112,167,385
Proportion of expenditure for sports programme	0.120	0.114	0.111
Proportion of expenditure for sports investments	0.132	0.217	0.240

One of the main goals in the ten years of running the National programme for sport is that the proportion of public finances in the structure of total expenditure in sport will reach 25%. After five years the proportion was at a level of 15% (see Table 2). From the aspect of income of sports clubs the proportion of income from public finances is at a 19%, whereas in some national sport associations the income from public finances is considerably higher (see table 5). This data confirm previous findings about civil sports organisations lagging behind in the development of their services. Certain sports have been focusing solely on a single segment of the sports service market (e.g. elite sport), which is limiting (for example sponsorship potential, public interest) and can with changes in public financing lead to development limitations or even existential problems.

Table 5. A proportion of public finances in the budget of some national sport associations in 2006

National sport association	in %
Rowing Federation	96.6
Cycling Federation	81.4
Shooting Federation	77.7
Track and Field Federation	75.7
Sailing Federation	75.1
Judo Federation	69.4
Swimming Federation	69.2
Kayaking Federation	66.5
Dancing Federation	59.5
Mountaineering Association	55.7
Gymnastics Federation	54.5
Handball Federation	37.3
Basketball Federation	36.9
Volleyball Federation	35.5
Water Polo Federation	33.5
Tennis Federation	30.9
Ice Hockey Federation	30.3
Skiing Federation	27.0
Football Federation	11.7

Source: AJPES 2007, MSS, Foundation for sport

Conclusion

The used approach for the monitoring of the macroeconomic financial indicators enables the monitoring of financial efficiency of Slovenian sport. The expenditure of the population and corporations for sport demonstrate a demand for sports services, whereas the income of sports organisations show the exploitation of this demand, where public finances are understood as a promoter of the demand for services on a sports market.

The advantages of the research approach:

- Relative ease for comparison, as the data used is collected by competent institutions for public statistic purposes;
- Good representation of samples;
- The possibility to use the SURS sample for comparative economic analysis of sport with other expenditure of population;
- A possibility for comparison with other countries of former Yugoslavia, as the bookkeeping reports have same normative origins.

Weaknesses of the research approach:

- The purpose of data collection (universal data for all subjects regardless of their specifics), the data about the income are limited to common characteristics of legal entities and thus the contents structure of the income from sport (sponsorship, individual public sources, population) allow only estimated expenditure.

The financial effects of sport depend on the successful exchange between the providers of sports services and their potential consumers. Findings of the present research approach exposed some weaknesses, which could become an obstacle in the future development of Slovenian sport, therefore certain measures are being suggested on two levels (sports organisations, national level) in order to neutralise potential obstacles.

One of the specifics of Slovenian market is its small size. This is being reflected in a small sponsorship potential and advertisers during the TV broadcasts and also in the fact that the sales of TV rights in other countries are not large, as Slovenian sports events are not interesting enough. A main question is how to overcome the limitations of the absolute small size of Slovenian elite sports products, which are designed mainly for the passive participants in sport (Chelladurai, 1994)? The number of passive participants is sufficient or even large when considering the proportion of the population; nevertheless, their absolute number is very small. The solution could be found in the internationalisation of sports events – international competitions and also in international league competitions. This process is in Europe in full flow and is being utilised rapidly by Slovenian club sport (Adriatic basketball league, EBEL ice hockey league, volleyball Interleague).

Findings reveal that the income of sports organisations does not follow the increased expenditure of the population for leisure activities. Apparently, the services of sports organisations are less competitive and the sport is loosing a market share in the expenditure of population for leisure activities. A detailed analysis show that particularly a non-governmental sports segment cannot keep up with the development of the society. Sports clubs and their associations should to a greater extent focus on the formation of new services and create new sales pathways and projects for accelerated service sales. New services should target the new groups (e.g. tourists, over age population, people with health problems). Obviously the majority of sports clubs and associations focus their activities on the similar services in the sports market, which is resulted in a limited volume and income structure. Existing services of sports organisations should be used to increase the income through sports events and the changes in ticket sales (the elite sports events are often advertised as being free of charge, also the VIP tickets are given away). In order to carry out marketing activities that exceed a public association (e.g. sales of players, commercial service activities in mass sport), sports clubs and associations should form trade corporations, which would be more business orientated in order to promote the activities.

There are other reasons for the stagnation of the Slovenian public sports segment that cannot be perceived from the macroeconomic point of view. The management of sports organisations is poor due to the non-professional running of the non-governmental sports segment. According to the Slovenian Olympic Committee, the non-governmental sports segment is less competitive due to its inability to claim a volunteer work as service costs, which leads to a less favourable economic position of such organisations in comparison to the professional organisation.

The task of the Slovenian Olympic Committee should be to set up a system for continuous improvement of quality of the management in sports organisations (management quality certificate) and to achieve the volunteer work in sports

clubs to be valued and established as an economic category, presented in the book-keeping records. The improvement of the quality of sports services and the volume of sales should be encouraged on a national level with other measures, one of them being a tax relief for all consumers of sports services and products. Other possibilities are related to the encouragement of the participation of public finances in the setting up of innovative environment in sports organisations, cooperation of sports organisations on both horizontal and vertical level into innovative networks and the cooperation of sports networks with the networks in education, tourism and health. The government could pass suitable legislative solutions for reduction of income taxes from marketing activities of sports clubs and the reduced or waived value added tax for sport services.

In order to develop sports infrastructure the public sources should encourage a construction and renovation of sports facilities, which offer better quality of services. From the aspect of active sports participation this would be reflected in the support for investments, which will plan the use of sports facilities (particularly indoor facilities) for professionally carried out sports programmes. Nowadays a large number of facilities are being hired out for unorganised and unfounded sports activities from the utilisation of space point of view. Furthermore, as a result of momentary political ambitions or circumstances oversized sports facilities are being built; their maintenance reduces the finances for sports programmes and the facilities stay unused. The local authorities should carefully consider the decisions about the construction of sports facilities; the state and local authorities should increase the finances of sports programmes and in this way enable better access to sports programmes and better competitiveness of Slovenian sport. When considering the passive participants in sport (spectators), the improved quality of sports facilities would be manifested in safer and more comfortable (seating area, VIP boxes) infrastructure that would result in a private-public partnership in the supply of additional activities (hospitality, shopping). Particularly in this area should the state and the local authorities reduce the paperwork obstacles and improve the conditions for faster investment of private money in the sports infrastructure.

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EDUCATION OF SPORT MANAGEMENT EXPERTS

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Abstract

The aim of this paper was to present the theory- and practice-based perceptions in sport management and its application on the one hand, and to present various possibilities of education of sport management experts on the other. The survey of the websites of colleges and universities in the world offering education in sport management yielded three models of studying sport management: as a major within a university, as a course within the major in economics or business and as a course within the major in sport. All three models are acceptable; however, some programmes in all three model types need to be complemented by subjects that would contribute to a better overall quality of the study.

Key words: *programme, knowledge, university, sport, management*

Introduction

In sport, management can be defined as the process of organising sport or a sports organisation for the purpose of accomplishing sport-related and other goals with the rational application of limited resources (Bartoluci, 2003, p. 154). Such a definition makes it obvious that the role of management is realised at the global level of sport – at the level of state, region, county, town, or at the micro level – within a sports federation, sports association, sports club, etc. The functions of management and of managers are connected herewith.

According to Humphreys and Maxcy (2007), the first sport management programmes were introduced by physical education or related departments in the 1970s. These authors also quote Laird (2005) and Stier (2001) who wrote that the Ohio University claims to have started the first sport management programme in 1966. The name that deserves the most credit for the development of sport management is Dr. E.F. Zeigler whose efforts and work resulted in setting the outlines of sport management as an academic discipline (see, e.g., Zeigler, 1992, 1987, 1979). Hence, sport management is a very young academic discipline, and debates are still going on among the scholars as regards the future of this discipline, the crucial debate being over the relevance of academic research for sport management practice (e.g. Weese, 1995; Chalip, 2006). There are several reasons for the insecurity of the sport management's field, and the main one is the continuous discussion over "whether the appropriate home for sport management should be a business school or a department specializing in sport studies (e.g., kinesiology)" (Chalip, 2006). Chalip (2006) expresses his opinion that sport management is a hybrid discipline and that in disciplinary terms it matters very little whether sport management is "housed with colleagues who study sportor with colleagues who study management".

For a discipline to become an authentic academic discipline, several preconditions must be fulfilled. First, it must be taught at institutions of higher education; second, philosophy doctorates must be written on the topics that cover the research area of a discipline in question; third, non-profit professional associations must be founded, and finally, journals must be published that deal with the subject matter of a discipline in question. Humphreys and Maxcy (2007) further say that it was in the year 1986, i.e. twenty years after the first sport management programme was started that the *North American Society for Sport Management* (NASSM) was formed, and the year 1987 saw the subsequent publication of NASSM research journal the *Journal of Sport Management.* According to Humphreys and Maxcy (2007), this was the birth of sport management as a *bona fide* academic discipline, and today the NASSM website lists over 200 colleges and universities only in the USA that offer degree programmes – from concentrations within other majors, to undergraduate and graduate majors, to the PhD level - either in this discipline or in sport administration, and forty programmes outside the USA – Australia, New Zealand, Canada and Europe. Apart from the *Journal of Sport Management* there are many other journals that deal with the themes within sport management, e.g. International Journal of Sport Management and Marketing, *International Journal of Sport Management, Sport Management Review, Sport Management Education Journal, European Sport Management Quarterly*, etc. Thus sport management is a fully recognised academic discipline. Still, there are researchers who are of the opinion (see, e.g., Mahony, 2008) that, taking into account the research on dissertation topics (Dittmore, Mahony, Andrew, & Phelps, 2007), most of the research is done in marketing, organisational theory, organisational behaviour, and that very little is done in other areas.

Methods

The aim of this paper was to present the theory- and practice-based perceptions in sport management and its application on the one hand, and to present various possibilities of education of sport management experts on the other. To be able to realise these goals, the survey was done on the Internet to find the websites of colleges and universities in the world offering education in sport management, and subsequently examples were chosen that best illustrated the variety of sport management programmes offered.

Results

The survey yielded the following results. The study of sport management, i.e. the sport management programmes at institutions of higher education fall within one of the following three groups: 1) Sport management can be chosen as a major within a university, 2) Sport management can be chosen as a course within the major in economics or business, and 3) Sport management can be chosen as a course within the major in sport.

Discussion and conclusion

Sport management is today the subject of study at many universities and other institutions of higher education all over the world. Additionally, international conferences and symposia on the theoretical and practical application of sport management have also been held all over the world (Pitts, 2001). In this way, sport management has found its place in the curricula of the institutions of higher education.

In some countries an effort was made to set the basic guidelines for devising sport management curricula in order to ensure that all relevant topics will be incorporated in the study programmes. In the USA, according to the already mentioned authors Humphreys and Maxcy (2007), since 1992 an effort has been made for sport management curricula to be approved – however, not accredited - by the *Sport Management Program Review Council* and for this purpose a set of guidelines was designed as regards the content both of the undergraduate and of the graduate sport management curricula (Table 1). Curricular standards were maintained by the *National Association of Sport and Physical Education* and the *North American Society for Sport Management* in the *Sport Management Program Standards and Review Protocol* (2000, quoted in Cuneen, 2004).

Table 1. Curricular content guidelines of the Sport Management Program Review Council

Undergraduate Curricular Content	Graduate Curricular Content
1. Socio-Cultural Dimensions in Sport	1. Socio-Cultural Dimensions in Sport
2. Management and Leadership in Sport	2. Management and Leadership in Sport
3. Ethics in Sport Management	3. Ethics in Sport Management
4. Marketing in Sport	4. Marketing in Sport
5. Communications in Sport	5. Communications in Sport
6. Budget and Finance in Sport	6. Financial Management in Sport
7. Legal Aspects of Sport	7. Legal Aspects of Sport
8. Economics in Sport	8. Venue and Event Management in Sport
9. Venue and Event Management in Sport	9. Field Experience in Sport Management
10. Governance in Sport	10. Research in Sport
11. Field Experience in Sport Management	

Source: Humphreys, B.R., & Maxcy, J. (2007). The role of sport economics in the sport management curriculum. *Sport Management Review*, 10, 177-189.

The survey of Table 1 shows several points. First, no distinction is made between competitive and recreational sport. Second, none of the contents listed deal with either organisation principles or organisational behaviour in sport. It can be assumed that these two areas are incorporated to one of the guidelines listed. Another interesting aspect missing from the set of guidelines presented in Table 1 is the sport psychology. However, these guidelines are an excellent frame of the crucial areas within sport management that the experts educated at institutions of higher educations should be proficient in.

Sport Management as a major within a university

The Cedarville University in the USA is an excellent example of a university offering sport management as a major. It is not a part either of *management major* or of *business major* (at Cedarville University *Management* is studies within the major in *Economics*). At this university *Sport Management* is major as is *Sport and Exercise Studies.* When describing the sport management major, the Cedarville University draws the attention of prospective students to the fact that the graduates will be able to pursue careers in amateur, collegiate, professional and corporate sport settings, as well as in management to marketing to journalism to law. When compared to the guidelines of curricular contents from Table 1, it

is evident that this university offers their students, together with the subject that are in accordance with the recommended guidelines, subjects such as *Principles of Organization and Management, Organizational Behavior in Sport, Recreation Management Practicum* and *Sport Psychology.*

Sport Management as a course within the major in economics or business

Bond University in Queensland, Australia, offers the study for the degree of the *Bachelor of Sport Management* within the course *Business & Commerce* (other programmes within this course are, for example, Accounting; Advertising; Economics; Entrepreneurship; Finance; International Business; International Relations; Marketing; Public Relations; Hotel, Resort and Tourism Management) at the faculty *Health Sciences & Medicine.*

The Griffith University, Australia, also offers sport management as one of the business study areas and some of the undergraduate programmes are *Bachelor of Business (Hotel/Tourism/Event/Real Estate and Property/Sport)*, *Bachelor of Exercise Science/Bachelor of Business (Sport Management)* and *Bachelor of Journalism.* Some of the postgraduate programmes offered in *Sport Management* at this university are *Graduate Certificate in Sport Management, Graduate Certificate in Sports Coaching, Master of Business* and *Master of Sports Coaching.* The aim of the programme *Graduate Certificate in Sport Management (> Master of Business)* is to provide students with knowledge and skills in business management, and to be able to apply the acquired knowledge in tourism, hospitality, sport and event management organisations. The four core subjects are marketing, strategic management, managing people and managing financial resources, and the graduates may seek careers in government departments, tourism authorities, sporting clubs and associations, event management organisations, sport tourism, food and beverage management, entertainment services, theme parks and attractions and retail travel.

Sport Management as a course within the major in sport

Sporthochschule Köln, Germany, offers the undergraduate programme *Sport Management and Communication in Sport* among other 4-semester scientific sport-related programmes - *Sport and Performance, Sport, Experience and Movement* and *Sport, Health and Prevention*. The graduate programmes *Movement and Sport at Old Age*; *Sport Tourism and Recovery Management*; *Technology in Sport*; *Exercise Science and Coaching*; *Economics of Sport*; *Sport, Media* and *Communication Research* and *Rehabilitation and Health Management.* The graduate programmes incorporate seminars in the English language, reading professional and scientific literature and spending semesters abroad. These programmes are both application- and research-oriented.

Another example of a university at which sport management is a programme within a sport major is the UNITEC, New Zealand. The programmes available for *Sport* are *Bachelor of Sport (Coaching), Bachelor of Sport (Management), Bachelor of Sport (Physical Education)* and *Diploma in Sport and Fitness Education*. According to the programme summary the students will acquire knowledge in sport organisations, application of sport management and marketing principles to all areas of the sport industry (understood as a singular industry including recreational facilities, clubs and service organisations and as an industry that has many contrasting segments such as amateur and professional, school and tertiary, commercial and public) and in managing and running sporting events.

The Faculty of Health and Wellbeing at Sheffield Hallam University, United Kingdom, offers the *Sport and Active Lifestyles Programme* that provides both undergraduate and postgraduate courses. These courses are said to reflect the diverse nature of sports industry. The University offers ten undergraduate courses and some of them are *Exercise Science*, *Physical Education & Youth Sport*, *Sport & Exercise Science*, *Sport & Leisure Management*, *Sport Development with Coaching.* Sport Management is not included into the programme of postgraduate courses at this faculty. At some universities, for example, the Western Michigan University in the USA, sport management is a graduate programme within the Department of Health, Physical Education and Recreation. The students will acquire knowledge in management in general, in financial management, in communication, ethics, marketing, promotion, legal aspects of sport, the role of sport in society, but also the role of management in sport, in planning and management of sports facilities, public relations in sport, ethics in sport, etc.

The previous analysis of sport management programmes has shown that in the world there are three different models of studying sport management at universities: a) as a major within a university (Cedarville University, USA; University of Zagreb, Faculty of Kinesiology, etc.), b) as a course within the major in economics or business (Bond University, Australia; Griffith University, Australia, etc.) and c) as a course within the major in sport (Sporthochschule Köln, Germany; UNITEC, New Zealand, etc.). We are of the opinion that all three models listed are acceptable. However, on the one hand, when sport management is studied within the major in economics/business, those programmes that lack sport-specific subjects such as *Theory of Training* or *Theory of Coaching* should be complemented by these subjects. On the other hand, when sport management is studied within the major in sport and in case that the subjects such as *Financial Management* or *Facilities and Event Management* are not in the programme of study, efforts should be made towards incorporating these subjects into it. Some other subjects such as, for example, sports medicine could also be included into the study of sport management regardless of the model type. Many researchers (see, e.g., Frisby, 2005; Chalip, 2006) have demonstrated that

examination of other academic disciplines can help new developments and ways of thinking that could all contribute value to sport management. Light and Dixon (2007) suggest that recent developments in sport coaching, physical education, contemporary learning theory, etc. may contribute valuable perceptions to sport management education. However, more effort should be put into improving the language fluency (e.g., Walters, 1990; Omrčen, 2008) and cultural understanding (Masteralexis & McDonald, 1997) of sport management experts.

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A COMPARISON OF SPONSORSHIP POTENTIAL OF THE MOST POPULAR SPORTS IN SLOVENIA DURING 1998 AND 2003

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Abstract

The purpose of the study was to examine the changes in the sponsorship potential of particular sports according to the importance in fulfilling the marketing goals of companies. The sample of measured subjects included 494 potential sponsors – managers of Slovenian companies, the questionnaire used was identical to the questionnaire used in the research by Bednarik et al. (1998).

The results show that in general only a small number of sports in Slovenia are interesting for sponsors, with the top sports being basketball, football, alpine skiing, ski jumping and handball. In comparison with the results of earlier research, most noticeable are increased interest for football and smaller interest for alpine skiing.

In order to attract sponsors, sports organisations will have to use more strategic approach in presenting the sponsorship possibilities to companies. They will also have to develop some new products and services, which will manage to fulfil the goals of potential sponsors.

Key words: *sports management, manager, marketing goals of the companies*

Introduction

In 1987, sponsorship money represented 2.5-3.5% of all advertising investments worldwide; the proportion rose to 5.8% by 2001 and is predicted to increase to 8.5% of all advertising costs by 2010 (in Seguin, Teed & O'Reilly, 2005). Sponsorship is an important source of financing also in Slovenian public sports organisations, despite the limitation due to the small size of Slovenian market. It is estimated that sponsorship income and TV rights revenue represent 59% of total income of sports clubs and associations (Bednarik, Jurak, Kolenc & Kolar, 2008). As the total income of Slovenian public sports organisations (Bednarik et. al, 2008) is stagnating, several important questions related to the future development of this particular segment of Slovenian sport are being asked; one of them undoubtedly being What are the future possibilities of sponsoring in sport?

Similar to the rest of the world, Slovenian sport has by far the largest potential among the social activities, which are subjected to sponsoring. From the social development point of view, it is estimated that in competitive sport, with time less sports in Slovenia will receive media attention due to its correlation to the size of economy. Media most interesting and thus the largest sports will become even larger (media interest of sports), the largest companies will acquire even more control over sports services and those with power and suitable infrastructure will exploit the opportunities in given circumstances. Concentration of financial resources in Slovenian sport is already clearly visible. Almost 60% of total revenue of sports clubs is being created by 10 sports disciplines; the largest sports constantly increase the proportion of total income (Bednarik et al., 2008). Such tendency is expected and points to the changes in sponsorship possibilities of particular sports disciplines. Bednarik et al. (1998) found that alpine skiing, basketball and tennis are among the favourite sports for sponsors; according to the total income and the influence of sponsorship it is predicted (Bednarik et al., 2008) that the successes of national sportsmen, global trends in sport and increased marketing approach to sponsorship caused the important shifts in the interest of sponsors. Exposure to marketing rules is particularly important for Slovenian sport. In future, as the government will gradually reduce its hold on the economy, the concentration of capital of Slovenian companies will be even greater. These companies will make some key decisions about sponsoring any of the activities, including sport. The marketing appeal of individual sports disciplines and the ease with which companies fulfil their marketing goals through sport will be particularly important. As a result, the interest of companies for sponsoring the sport needs to be studied; the purpose of the present research is to examine the changes in the sponsorship possibilities of Slovenian sport in comparison to the earlier study.

Methodology

The sample of measured subjects included 494 potential sponsors – managers of Slovenian companies, 75.7% were men and 24.3% women. Sample included 97 managers of large companies, 258 managers of medium size companies and 135 managers of small companies, whereas 4 managers did not specify the size of their company. The data of the variables were collected with the use of a questionnaire, previously also used by Bednarik et al. (1998). For the purpose of examining the changes in the sponsorship potential of sports, a question about the importance of particular sports discipline for the fulfilment of marketing goals of the company was also used.

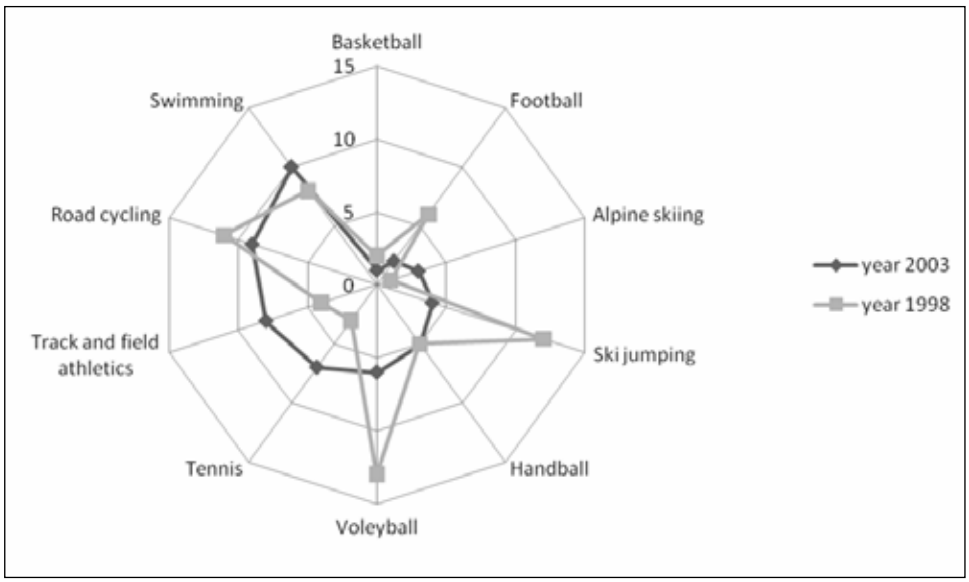
Results

Table 1. The importance of particular sports for the fulfilment of marketing goals of the company

Sport	N	Min	Max	Mean	SD
BASKETBALL	157	1	6	3.293	1.773
FOOTBALL	160	1	6	3.119	1.854
ALPINE SKIING	153	1	6	2.824	1.732
SKI JUMPING	151	1	6	2.808	1.850
HANDBALL	154	1	6	2.779	1.622
VOLLEYBALL	148	1	6	2.615	1.580
TENNIS	147	1	6	2.612	1.572
TRACK AND FIELD ATHLETICS	154	1	6	2.591	1.631
ROAD CYCLING	152	1	6	2.480	1.496
SWIMMING	148	1	6	2.399	1.479
ICE HOCKEY	153	1	6	2.340	1.438
ARTISTIC GYMNASTICS	150	1	6	2.327	1.495
CROSS COUNTRY SKIING	148	1	6	2.324	1.526
ROWING	149	1	6	2.302	1.455
BIATHLON	151	1	6	2.291	1.440
MOUNTAINEERING	148	1	6	2.203	1.457

Sponsors have evaluated the importance of particular sports discipline for the fulfilment of marketing goals of the company with the marks from 1 to 6. The largest average value, which also represents the sport that in opinion of measured subjects is the most interesting for the fulfilment of marketing goals of the company, was noted in basketball (3.292, see Table 1). In addition, football and alpine skiing have also been listed as very interesting for sponsors. The least interesting among the listed sports were go, tae-kwon-do and bridge. The results have to be viewed with care due to the large number of possible answers (76 sports) for the size of the sample.

When sports were ranked according to the number of times companies awarded the highest marks (6), the results in the interest of companies show slightly different ranking. In the first place came football with nineteen companies placing it in the top spot, followed by basketball and ski jumping, which have been awarded the highest mark fourteen times. Both ways of ranking placed sports with a large number of spectators in top places. These sports also receive most media attention.



Picture 1. A comparison of sponsorship interest of first ten sports disciplines between the years 1998 and 2003

A comparison of first ten sports disciplines in the sponsorship interest in the five year period (1998-2003; Bednarik et al., 1998) reveal that changes in the top places occurred in a relatively short time. Namely, the alpine skiing dropped from first to third place and basketball and football progressed to first and second place.

Discussion and conclusion

A decline of interest for alpine skiing is presumably a result of unsuccessful competitive years of Slovenian skiers, who did not achieve significant results at important international competitions, such as World cup, Olympic Games and World Championships. Similarly, increased interest for basketball and football can also be related to the results of these disciplines, particularly those achieved by the national teams on an international level. In football, the most noticeable result was the qualification to the European championships in 2000 and the World cup in 2002, the events that resulted in real football euphoria and an increase in the interest for matches of the national team. The reasons for the increased interest in basketball lie with a continuous solid results in Europe of both the national team and club basketball. The Adriatic league also plays a part in the increased interest of basketball, as it opens the promotional and media recognition in the territory of former Yugoslavia. Undoubtedly, the worldwide popularity and universality of these two sports have an impact on the interest for football and basketball.

In the fourth place is ski jumping, a sport that in 1998 was not yet interesting. It can be assumed that in the earlier research the interviewed subjects did not recognise ski jumping as a part of Nordic skiing, therefore such increase cannot be viewed as unexpected.

The biggest fall among the top ten sports can be noticed in the interest of sponsors for athletics and tennis. During the studied period, a decline of interest for tennis in comparison to other sports is most noticeable. Subsequently, this also resulted in the smaller number of people taking up tennis (Jurak et al., 2003). In athletics, the observed period represents a transition between two specific years: 1998 and 2003. Namely, 1998 represents the end of the golden period of Slovenian athletics (Olympic medal in 1996, medals from the European championships and World University Games), whereas 2003 represents the beginning of the rise of Jolanda Čeplak (bronze medal at the 2004 Olympic Games, silver medal at the 2004 World Indoor Championships in Budapest).

The largest increase in the interest of sponsors in the observed period can be noticed in volleyball, which climbed from the rank number thirteen to rank number six. In the top ten for sponsors most interesting sports in 2003 can also be found handball, cycling and swimming. Handball is the only sport that remained in the same place, followed by cycling and swimming, which managed to stay in the top ten. Car racing, ice hockey and kayaking have dropped from the top ten sports.

The average values of the importance of particular sports for the fulfilment of marketing goals of the companies (see Table 1) lead to the conclusion that during the time of the study sixteen sports (21% of all sport disciplines) were interesting for the sponsors. Nevertheless, the findings do not exclude the possibilities for the sponsorship potential – marketing niche – related to the characteristics of particular sports and/or companies. Furthermore, the general interest of sponsors changes with new products and services of sports organisations, therefore, sports should take more planned approach to sponsorship, use new technologies and develop new products and services in order to fulfil marketing goals of the companies (in Jurak et al., 2007).

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ANALYSIS OF VARIOUS FACTORS IN ESTABLISHING THE E-COMMUNITY IN THE FIELD OF SPORT - SPORTBLOG.SI

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Abstract

The article presents an analysis of various factors, which are important for the establishing of e-community in the field of sport. The setting up of an e-community was based on a theory of e-learning organisation, which uses web logs (blogs). The sample of measured subjects included 53 teachers – mentors and 108 students in the final year at the Faculty of sport. Data indicate that the majority of teachers-mentors and students consider e-learning community as useful for the exchange of experience, knowledge and competencies when working in the field of sport. Teachers-mentors and students have listed text files, video files, presentations and photographs as the most useful types of information. An analysis of "positive and negative" aspects of writing and using of blogs reveals that e-communities are principally "social medium", which allows the exchange of different information, experience, knowledge, skills and competencies. "Sportblog.si" project, intended for all users in sport and accordingly related services, has started on the basis of carried out analyses.

Key words: *sport, factor analysis, learning organisation, e-community, blog, internet 2.0*

Introduction

The circumstances in the society and on the market compel sports organisation to change into knowledge-based organisations. The production and distribution of knowledge are the main sources of capital of such organisations. Modern times are times of knowledge-based economy; the organisations striving for perfection are required to change into learning organisations, which in their working processes include teams that constantly learn. Transfer of knowledge from the individuals to teams is essential for the development of learning organisations, which utilise the opportunities of knowledge-based economy. Apart from the learning individuals, who acquire and distribute knowledge at work, the consumers are equally important for the learning organisation and knowledge-based economy. The knowledge of consumers, acquired whilst using the products, could in future become vital for the development of the products of the organisation. Therefore, organisations in the knowledge-based economy generate competition advantages on the distinctiveness of network connections, created with suppliers, distribution channels and final consumers (Dimovski, et al. 2005).

In order to realise horizontal and vertical association, a suitable information communication technology (ICT) is required, which is becoming the most important supporting environment for the management of knowledge in the learning society. The last version of internet 2.0 is crucial, as it allows cooperation and connection of final consumers, which are not only the users of services, but also active participants. The consumers most often participate in the internet community by using blogs. Blogs operate on the platform of the internet 2.0 and are some kind of personal internet diary, which in the economy of knowledge can establish learning organisations. Individuals can use blogs to publish various contents, such as text files, photographs, pictures, video and audio files, internet connections etc. in a simple manner. Consequently, blogs help the organisations to gain advantages over the competition on the basis of the individuality of social networking, which is created within the organisations, with the suppliers, distribution channels and final consumers. Blogs facilitate and accelerate communication and cooperation between the members of e-society in a way that every individual is involved in recognition and solving of the problems, allowing them to constantly experiment and improve their capabilities.

According to Majerič and Kolenc (2007) numerous sources state that the management of knowledge will be very important as the amount of data and information is increasing rapidly. Management of knowledge will utilise the opportunities, offered by the use of modern technology; the educational institutions around the world are increasingly more aware of this fact and they are setting the e-communities on the basis of various models of learning organisations (e.g. Princeton University, University of Minnesota, Cornell University, University of Massachusetts Lowell, The University of British Columbia). The majority of them use blogs, proving that the model of learning organisation can in this way be transferred into education. The networking of consumers using blogs can be used to set an e-community, which will enable them to acquire, develop and exchange different knowledge and professional competencies (Majerič and Kolenc, ditto)

The experiment of the setting up of an e-community, based on the model of learning organisation, have been carried out between September 2006 and June 2007 at the Faculty of sport, University of Ljubljana. Within the project "A model of practical pedagogical training of the students at Faculty of sport", which has been in part financed by the European social fund of the European Union and the Ministry of Education and Sport of the Republic of Slovenia, a pilot project "Sportfolio.si" has been carried out with the use of 2.0 internet and personal blogs, consequently creating an e-learning society in the field of practical pedagogical training of students. The foundation of the project was an open method of modification, which the European Council in Lisbon (2000) defined as a "way of developing examples of good practice that can be used to fulfil strategic goals in the area of education and training in the EU until 2010" (Education and training in Europe, 2002). In this way, a "new" culture of behaviour with knowledge has been set up in the field of sport, based on the idea that "own knowledge can be developed when shared with others" (Majerič in Kolenc, 2007). The purpose of the project "Sportfolio.si" was to set up an e-learning community of the teachers at the Faculty of sport, mentors in primary, secondary and high schools and students of the final year. The aim of the project was to improve cooperation and connection of "theory and practice" and enable the exchange of knowledge in the area of education, based on the model of learning organisation. Within the e-learning community, participants used blogs in order to exchange "examples of good practice" (different experiences, reflection on realised lessons, teaching materials etc.) and have therefore acquired, developed and exchanged professional competencies in the area of physical education (Majerič and Kolenc, 2007).

The analyses of the pilot project were very encouraging; therefore, an e-community "Sportblog.si" was set up on the basis of these results. "Sportblog.si" started to operate in January 2008, some important factors for the setting up of this e-community are presented below.

Methodology

Sample of measured subjects

The research included 53 primary, secondary and high school teachers-mentors (out of 62 included in the project) and 108 final year students at the Faculty of sport (out of 184 included in the project) that have been undergoing practical pedagogical training in the 2006/2007 academic year.

Sample of variables

A questionnaire, designed by Majerič, Kovač and Kolenc (2006, 2007), has been given to all the included subjects at the start and end of the project. As a result, several factors, important for the working of e-learning community, were analysed. Present article shows the analysis of three variables: 1) an opinion of teachers-mentors and students about the usefulness of an e-learning community for the exchange of experience, knowledge and competencies with the use of blogs, 2) an opinion of teachers-mentors about the most useful type of information found on blogs, and 3) an opinion of teachers-mentors and students about "positive and negative" aspects of writing and using of blogs.

Data collection and data analysis methods

Data were collected within the framework of the project "Model of practical pedagogical training of students at the Faculty of sport" (Majerič et al., 2007). Simple descriptive statistics has been calculated for all the variables (arithmetic mean, standard deviation, minimum and maximum result). Data were analysed using a SPSS for Windows statistical package.

Results

Table 1. Opinion of teachers-mentors and students about the usefulness of an e-learning community for the exchange of experience, knowledge and competencies with the use of blogs

Usefulness of an e-learning community	teachers-mentors				students			
	f	%	SV	SD	f	%	SV	SD
1 (not useful)	1	1,89	2,86	0,65	1	0,93	2,93	0,70
2	11	20,75			27	25,00		
3	31	58,49			57	52,78		
4 (very useful)	6	11,32			22	20,37		
Missing values	4	7,55			1	0,93		
Total	53	100,00			108	100,00		

*4-level measuring scale was used; 1 representing not useful and 4 very useful

Table 1 reveals that the majority (69,81%) of teachers-mentors consider an e-learning community as useful (value 3) or very useful (value 4) for the exchange of experience, knowledge and competencies. The proportion of students is even higher, as 73,15% of all questioned subjects evaluated the usefulness of e-learning community with marks 3 or 4.

Table 2. Opinion of teachers-mentors about the most useful type of information found on blogs

The most useful type of information found on blogs	teachers-mentors		students	
	SV	SD	SV	SD
Text files (word, excel …)	3,24	0,80	3,36	0,65
Presentations (e.g.. PowerPoint)	3,18	0,80	3,09	0,73
Video files (films)	3,16	0,89	3,31	0,75
Pictures other than photos (drawings, graphs…)	2,96	0,87	2,89	0,77
Photos	2,88	0,94	3,13	0,81
Audio files (music, speech …)	2,64	0,94	3,00	0,86

*4-level measuring scale was used; 1 representing not useful and 4 most useful

Table 2 reveals that teachers-mentors consider text files (word, excel…- 3,24), presentation (e.g. PowerPoint – 3,18) and video files (films – 3,16) as top three most useful information found on blogs. Similarly, students have ranked text files (3,36) and video files (3,31) in the first two places, nevertheless, they consider photos more useful (3,13). In comparison, mean values for all variables, except for presentations and pictures other than photos, are higher in students than in teachers-mentors.

Table 3 reveals that in teachers-mentors the values about "positive and negative aspects" of writing and using of blogs are highest (above 3,00) in the following variables: I can use blogs to find out how other people think and what are their personal experiences, knowledge and skills; I can document and share personal experiences via blog; I can share practical knowledge, experiences and skills with others. In this variables there are no significant differences between teachers-mentors and students.

Table 3. Opinion of teachers-mentors and students about "positive and negative" aspects of writing and using of blogs

"Positive and negative" aspects of writing and using of blogs	teachers-mentors		students	
	SV	SD	SV	SD
I can use blogs to find out how other people think and what are their personal experiences, knowledge and skills.	3,25	0,76	3,19	0,71
I can document and share personal experiences via blog.	3,23	0,73	3,16	0,72
I can share practical knowledge, experiences and skills with others.	3,15	0,80	3,24	0,61
I can tell others who I am and what I do.	3,13	0,94	2,85	0,87
Writing blogs takes too much time.	2,96	0,91	2,41	0,83
I can express my own creativity via blogs.	2,79	0,82	2,81	0,84
I can save data and information, which I consider important, on blogs.	2,73	0,90	2,91	0,76
Authorship rights are always questionable on blogs.	2,56	1,03	2,70	0,78
I can motivate myself and others for "action" on blogs.	2,46	0,99	2,40	0,82
I can acquire and maintain contacts with friends and acquaintances.	2,40	0,96	2,28	0,84
I can use blogs to pass various information, related to lessons and schoolwork, onto pupils and their parents.	2,34	0,92	2,87	0,85
I can create personal "networking" and meet new people via blogs.	2,25	0,91	2,33	0,77
Writing new ides and experiences on blogs is "dangerous", as they are easy to steal.	2,00	1,01	2,49	0,87
I can use blogs for fun.	1,96	0,87	2,09	0,82
I can earn extra money via advertising services and knowledge on blogs.	1,72	1,02	1,80	0,77

*4-level measuring scale was used; 1 representing the least and 4 the most suitable answer

Discussion and conclusions

Data indicate that the majority of teachers-mentors and students consider the experimental e-learning community "Sportfolio.si" as useful for the exchange of experiences, knowledge and competencies. Therefore, the set goals have been fulfilled and the first e-community, which uses blogs, has been created in Slovenia in the field of practical pedagogical

training. Teachers-mentors and students consider text files, video files, presentations and photographs as the most useful types of information for publishing on blogs. Findings are similar to those abroad, where lately video files are very popular. An analysis of "positive and negative" aspects of writing and using of blogs in teachers-mentors and students reveal that e-communities are "social media", which enable an exchange of various information, experiences, skills, knowledge and competencies.

An analysis of findings of the pilot project "Sportfolio.si" was used to establish internet application and the e-community in the field of sport "Sportblog.si". Since the creation of "Sportblog.si" in January 2008, the number of users has swiftly increased. Application enables all blog users to publish text and video contents, presentations and photographs in a simple way. "Sportblog.si" enables users to network and exchange various information, knowledge, skills and competencies and is gradually turning into an e-learning organisation in the field of sport. Users consider blogs as more than personal websites; namely, they can be used as personal transmitters of information and knowledge. Within the e-community "Sportblog.si", users can acquire, exchange professional information and knowledge both during the study and at work. Users can also communicate with different types of public and promote sports profession and create own "passport of knowledge and competencies" (CV EUROPASS) and thus create their own trademark, which can be placed on the job market.

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ROLE AND PLACE OF SPORT AS A MEDIUM IN SPORT MANAGEMENT

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Abstract

Role and place of sport as the media of market communication in sport management is mainly possible to perceive in two ways: from the social and from the business aspect. The social aspect implies comprehension of sport as one of generally accepted media and perceiving the sport as attractive medium that can possibly influence the public opinion. Under the business aspect we understand use of sport as a market communicator to achieve the determined business goals through sport management.

Key words: *sport as a medium, contemporary market communicator, sport management*

Introduction

In order to observe the role and place of sport as a medium of market communication in sport management, it is necessary to indicate before taking any conclusions

- Possibility of defining "sport as a medium of market communication",
- Possibility of using "sport as market communicator" with the purpose to realize determined business goals using sport management through the determined indicators.

Perceiving the sport from media attraction point of view, sport can take the position of possible communicator i.e. the "transmitter" or "sender" of a message. Empirically observed, assumptions for the perception of sport as the transmitter or sender of a message – is acceptable. But is there any coherent and real arguments for such conclusion?

Defining the media system

It is well known that "institutionalized media", consequently media that have been recognized as such and that have become a part of everyday life are partitioned inside *arranged systems of media* and that is commonly accepted. Media are usually partitioned on electronic and printed media, as well as through the media mix. *Electronic media* are radio, TV, electronic media such as audiotapes and discs, videotapes and discs, cinema, displays and Internet. In this group it is also possible to include public-address system. *Printed media* are daily newspapers, different magazines, journals, (sales) catalogues, books, leaflets, bulletin, large boards and billboards, posters, brochures, prospectus and other similarly advertising materials. *Media mix* is the regular choice of the single medium or group of media that will transfer the messages to the targeted individuals in a best way.

Defining the term of media

Against the general perception of term "medium" it is possible to define it in two basic ways. Originally, medium is the environment in which something or somebody being, resides or exists, and presents the integrity of those conditions. On the other hand, term medium presents the means of communication or the contemporary means for the information transmission (Anić & Goldestein, 1999:827; Opća enciklopedija, 1979:392; Leksikon, 1974:607). Consequently, does the sport as a medium has attributes of both presented meanings of term "medium"?

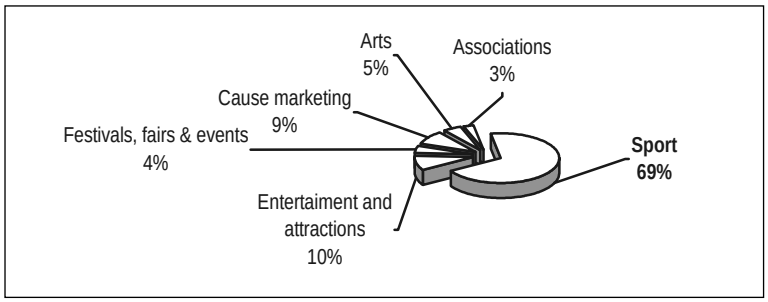
In context of the general perception, "sport as a medium" can be perceived as the "medium" i.e. the environment in which something or somebody being, resides or exists, and presents the integrity of those conditions. Without any special explanation the most realistic example is to imagine some sport event and to place the passive participant in conditions of this spectacle. It is unquestionable that the passive participant (direct spectator) of a sport event finds himself in and resides in certain, even special conditions. Also, on the basis of the stimulus the spectator receives i.e. different information take action in its characteristic manner. Other meaning of the term "medium", which marks the medium as the "mean of communication" or the "contemporary mean for the information transmission" has more significant meaning for this paper. In the context of economy medium is set as the "medium of mass communication" (Baletić, 1995:494; Rocco, 1993: 254, 257, 416; Jurković and others, 1995:315) and it is possible to define it as non-personal communication with an indirect message transmission to certain public. Such definitions and meanings of the term "medium" of mass communication open and give the possibility of considering "sport as the medium and contemporary means of market communication" and a part of institutionalized i.e. the formalized media system.

Defining sport as a medium of market communication

Sport, as physical activity inside the sub-areas, does not challenge equal attention that makes it a medium. Because of that reason, we could be faced with the dilemma of the integral or partial approach to syntagma "sport as the medium" i.e. is it necessary to observe sport generally or every of its segments separately. But, sport also has conceptual integrity and in that context there is no doubt. It is possible to support such point of view with argument that attractiveness of sport to masses and masses affinity to sport, regardless of the sub-area, never has been questionable, no matter whether they are active participants or bystanders (passive participants). If it is a case, it is necessary to observe sport as the medium inside of formalized partition on the basis of coherent and real argument. Such statement is possible only if criteria exist that will show how *sport as the attraction has all attributes of a medium, or even more.* Minimum of criteria that needs to be satisfied is:

- It is able to attract certain public
- It is able to transfer the information
- Demands for such type of services exists
- It is possible to recognize target public to which it is addressed to
- It is possible to communicate in a business-like manner
- It is possible to charge that service of information transfer.

Number of included active participants in some sport event, that are not athletes, number of present spectators, number of present journalists and representatives of different media, as well as the number of present TV and radio stations that broadcast the event, number of readers and spectators that have read or seen the actual journal and other media reports from the sport event scene or have watched live broadcasts, report or taped game - these are main factors that determine the size of audience that has been attracted by a sport event. *In any case, sport attracts certain audience and publicity.* When companies want to improve and/or boost the sales of their products or services, the result of the numerous previously conducted marketing analyses and activities is the specific set of promotional activities. The results are design for the message to wide public. Such results are shown through well-known marketing promotional activities. Companies or other organizations that have interest use media of mass communication for the non-personal communication and indirect message transmission to certain audience. What media they will use depends on number of factors. However, *Graph 1* clearly shows the *exceptional use of sport as a market communicator.*



Source: IEG Sponsorship report, Press Release, January 18, 2008. & Sample issue, p. 4

Graph 1. Projected interrelation of sponsoring shares in USA in 2008

If consequently numerous companies have noticed the comparative advantages of advertising through sponsorship to athletes, clubs, leagues or sport championships, *then there is certainly no doubt that demand for the such type of service - exists.* So, this demand indicates great possibilities of messages transmission that sport offers. Since the transfer of messages is the core of market communication and "condicio sine qua non" in order to define "sport as medium of the contemporary market communication", it is possible to conclude that in relationships to and through athletes, clubs, leagues or sport happenings and championships – *it is possibly to transfer particular message and charge it.*

Role and place of sport as a medium in sport management

As the competition is one of the factors of reinforced investment in publicity, investing in sponsorship packages is larger with the stronger competition. Already long ago the advantage of sponsorship of certain events has been notice compared to usual advertising. The basic advantage that has been noticed is the financial one, less money for bigger and long-lasting advertising. Except for the financial benefits, investment in the sponsorship consumption brings more,

attractiveness of public presentations or psychological moments and excitement etc. All over the world as well as in Croatia, as examples of competition and struggles for the market share encourage more intensive financing of advertising and sponsorship agreements, it is possible to point out the following examples: VIP vs. HT, Coca-cola vs. Pepsi-Cola, EA Sport vs. Play Station, Nike vs. Reebok, Yahoo vs. Amazon.com, McDonalds vs. Burger King, American Express vs. Visa etc. In 1994 4.500 USA companies invested 4,7 billion US sponsoring different events, with the aim of exposure of their own brands or trade marks. 10 years later, for the same needs, in 2003 the sponsorship consumption by North American companies reached the sum of 10,25 billion US$. In 2008 such sponsorship consumption of North-American companies was projected with the growth of 12,6% compared with 2007 ($14,91 billions) i.e. on $16,78 billion. In that amount sports sponsorship spending makes even 69%. So, it is possible to conclude that the large *number of companies has considered the investment* in sport as a medium justified and reasonable investment, because the investment in that activity regularly leads to the increase of trade activities and income through the increased sales.

In Croatia advertising is also increasingly treated key element of business success. Value of advertising market in Croatia is growing every year. In 2001 the value of investments in the communication market reached around 254 millions of € (euros) (Bohutinski, 2002:6), in 2002 it was invested approx. 333 millions € (Čuljat, 2003:8) and in 2006 that expenses were around 500 millions € (Gavranović, 2007). Also, there is no doubt that the significant value of the total income of TV contributes to numerous sport events broadcasting such as summer and winter Olympics, European and World Championships in all popular sports, then different professional leagues like Champions League, Goodyear league, Ski World Cup or numerous other sport spectacles, during which the prices of advertising are mainly higher than in some other terms. Also, during broadcasts of such sport events, because of increasing ratings caused by increasing auditorium, the advertising prices are rising, circulation of daily newspapers increases, as well as special editions of different publications. That fact has influence on the increase of TV and other electronic and printed media income. For example, soccer Championships attracts more and more spectators (in billions), and the promotional cake has been estimated as a growing one. There are a lot of companies ready to spend extra €. In respect to attractive, but very expensive rights for live broadcasting of those ball games, there were expectations that TV Company will achieve largest earnings from promotional spots. By domino effect, high prices for buyoff of broadcasting rights are ready to be paid by advertisers. Under such circumstances, role of attractive sport i.e. those which finds themselves in sport management as organizers of sport shows and events, come into the position when their product (the sport event) becomes interesting to companies and organizations, or in the position when they are able to financially exploit the attraction of theirs product. That "using" generally may be oriented in two directions: to sell sport as product or to exploit it as a message transmitter to certain audience. In the second case, when sport becomes market communicator, organizers of such sport event have entered into certain relations with different subjects whose interest is financial or some other benefit. Entering in such business communication i.e. the business relationship there are different possibilities for that relation (communications), between organizer of the sport event and - marketing agency, - Radio, TV and news agencies, - sponsors, - advertisers and - licensed manufacturers. There are a number of factors (Džeba et. al., 1995; Brooks, 1994) that are influencing general valorization of sport events and their image by wide audience, but also by professional audience. That is, the professional and wide audience, in this case together, makes power that adds up to (financial) successfulness and efficiency of a sport event. For this reason, different factors with various importances come out, and also contribute to the total result. See Table 1.

Table 1. Factors that influence on valorization of sport events and its image

FOR SPORT EVENTS	FOR SPONSORSHIPS
1. Reputation of sport events	1. Quantities of anticipated finances for the promotion
2. The integral form of sport event as spectacle	2. Power of influence
3. TV-genic rate of sport event	3. Magnet companies that attracts other Co.
4. TV station competition	4. Number and quality of present media
5. Compliancy of sport events TV program with needs of TV spectators and advertisers	5. Image of sport in function of company and its image
6. Rating of TV broadcast	6. Evaluation of numerical audience availabilities
7. Rating on largest consumer markets	7. Selling and trading possibilities
8. Assumed competitive success of domestic athletes	8. Climate of competitions

Source: Changed and adjusted according to Brooks, 1994: 235-251; Džeba et. al. 1995:240-248

Factors that influence the valorization of a sport event and its image are significant arguments that have spoken well for the sport as media. Carefully studying those elements from Table 1, it is evident that they crucially influence on the selection of sport as medium and market communicator. From those reasons, in sport is possible to *charge services of transmitting messages and information*, what is the case with the majority of media, thus neither the sport is not exception. Also, just because the rational propaganda of products and services can achieve significant economic effects, costs for that

kind of publicity constantly grow, that has direct effect on sponsoring and sponsorship agreements. Therefore, sponsoring through the sport as a medium of market communication has all characteristics of rational propaganda and significant economic effects arise from it. Otherwise companies worldwide would not invest such finances in missed investments, which is confirmed by presented data. Evidence that has spoken well for is certainly the data that around the world 25,9 billion US$ in 2003 was invested on sponsorship consumption. That same consumption grew up for 8,1% in 2004 i.e. has reached the value of approximately 28 billion US. It has become obvious that "*sport has become marketing medium in and of itself, with the ability to target, segment, promote and cast products and services in heroic light*" (Schlossberg, 1996:6). Therefore, more and more companies, that have no connections with the sport, use the charisma of athletes and clubs to "enhance and embellish their marketing" (Schlossberg, 1996:6). Confrontation between supply and demand in the media market pointed out the outstanding influence of sport management and progress of sport as a medium of market communication. There is a constant demand and growth of that demand for services of "sport as media" present. With that kind of communication it is possible to improve business, boost the sales and correct the bad impression or put a gloss on an image in public.

Conclusion

Role and place of sport as a media of market communication in sport management is possibly perceived from social and business aspect. The social aspect understands sport as one of generally accepted media and perceiving sport as attractive market communicator that can possibly influence the public opinion. Under the business aspect there is the use of sport as communicator for the purpose of realizing certain business goals through the sport management.

This paper is based on presented arguments and accompanied definitions of media. It is undoubtedly shown that in formalized and general accepted partition of media sport can be possibly included, *since sport is a kind of media.* Also, the significance and importance of sport is huge and growing. There are many financial indicators that point out the ever-growing presence of companies in sport. Many companies use sport and sport management for promotional activities, for sale of theirs products and for the correction of bad images of products or brands. Sport management has been proclaimed through sport as necessary tool for companies to attract market communication. Considering a *clear connection* of sport as media of market communication and sport management, an inseparable connection between them is obvious. It is essential that the role of sport as a media has been observed through the objectivity, systematic quality, reliability, preciseness and universality. Since this paper has given *descriptions* that include implementation of different methods, characteristics of usage are possible to summarize in two basic points:

- Exploitation of obtained descriptions (results) has been oriented on the cognition, what means against the generalization i.e. discovering of important and general, common phenomena;
- Collecting and putting data in order, comparison, valuation and interpretation of that data.

On the basis of such access it is undoubtedly possible to conclude that place of "sport as media" in the sport management is determined with growing presence in public and usage of sport as a media, possibility to attract large number of the spectators as possible consumers, attractiveness of events and market communicator, diversity of transfer mode of messages (bill boards, banners, advertisements on training outfits, public-address systems, events, etc.) and possibility of choosing quantity and levels of quality of massage transmission.

Finally, *role of sport as a media* has been defined through the influence on public opinion and achievements of business results that use sport management. *Place of sport as a media* of market communication in the sport management is determined by achieved importance of sport as a media for the contemporary message transfer, and its role in determining the final purpose of sport usage as the market communicator inside the sport management.

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IDENTIFYING STRUCTURE OF ORGANIZATION AND INDIVIDUAL ROLES AT THE EXAMPLE OF SPORT MANAGERS

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Abstract

The purpose of this article is to identify essential elements of the structure of organization and allocations referring to the individuals inside the functional systems and with the example of 40 poll indicators obtained from the sample of 71 top level managers. From the methodology point of view, we are talking about definition of a new model for the analysis of internal developments of real systems giving possibility to collect a complete set of initial data. The results reflected a high degree of correspondence with hypothetical thesis and it resulted in identification of existing levels. The greatest number of hypothetical roles realized by leaders or operatives have been confirmed, too. Transparency on some other situations except sport management is probably very high but it should be confirmed in further research. The results could be applied, for sure, for the purpose of sport management function optimization as well as in some other enough corresponding situations. The value of this research is mostly reflected in its methodological contribution to new technologies.

Key words: *management, human resources, positions, leadership*

Introduction

In the organizational domain of sport, and especially the top one, the potentially high efficacy of the modern technological school processes requests also a high degree of familiarity with positions and relations among individuals incorporated in the organizations dealing with that kind of technology. Most certainly, within the organizational structure of such a kind of sport subjects of different levels, there is a real request for optimization of roles given to individual persons. These roles are not at all a mere coincidence and they have a direct function to preserve the total system for the purpose of realizing as higher general level as possible, which results in production of top results in sport in the end. Naturally, lots of rules from this domain are valid in other fields of management, and not only in sport. There exist numerous theories on internal structure of management and all of them reflect their effort to understand the long-life structures and roles in order to be able to optimize the total influence of sports organization in dynamic conditions. Some approaches start from the position of a leader as the one being important, but expressing doubts mostly in terms of identifying the aim and tasks expected to be realized by management in general (Neinaber & Kakabadse, 2007). However, the greatest number of theories in management have still been defined, to a great extent, in a speculative manner, without a true grounds, except in the part referring anyway to the management and control of dynamic systems. Having in mind that the approaches to the management of these systems have been almost directly copied from technical sciences in the last 20 years, disproportion referring to technical systems and systems with human potentials have appeared with a good reason, resulting in impossibility of having a direct transfer of knowledge. The differences appeared as the result of the level of human independence in relation to the parts of technical systems which can be managed in dynamic conditions of operation being induced with people not only by external factors but also with internal motivation, aims, desires, stimulation, etc., and for that reason, it appears very complicated to describe such a kind of systems and organization in a manner of structure (Méric, 2008). This problem area is especially complex when it is about quantifying quality indicators, being common in management and almost always present (Larsson, et al., 2007). Finally, one of the bigger problems is, for sure, defining the vertical upturn of disposition with human resources, and the descending line in decision making respectively, because it is even dealt with more complex developments than they were retrospectively mentioned here. Most certainly, the act of decision making is found at all levels, but the question is how big its scope and authority for implementation of decisions is. One among important questions is certainly the reflextion of tensions being directed from lower levels towards the top of managment structure, which can result in a number of consequences (Braithwaite et. al., 2008). Out of all these reasons mentioned, as well as out of a number of other mentioned real requests (function optimization, financial efficacy, individual people satisfaction, team work, accomplishing aims), a serious task of defining scientifically acceptable thesis on functions, structure and individual roles in all and also in sport subjects such as for

example, sport clubs, associations, sport board of management, sport education institutions, independent and private sport organizations, etc. has been set up. In this context, the aim of this work is to determine the levels of general internal structure and individual roles being occupied by some individuals in that structure.

Methods

For the purpose of this project, 71 high positioned managers in sport subjects in Bosnia and Herzegovina have been covered by analysis. The data have been collected by poll which included 40 indicators related to managerial sport activities in the largest sense. The data have been analyzed at a few levels. The first level represented the data which was all oriented in a metrical way so that higher result represented a better result in all situations. Then, normalization has been done since it was dealt with non-parametric indicators. The data have been rescaled on the standard scale (1 to 5) in order to determine the parameters easier. Finally, for the purpose of this work, a special procedure generating the necessary parameters for testing the target hypothesis was prepared. In this way, the information on existence and legalization of levels and then also on: the real level of individual consent with the scope of indicators (*positioning*), level of independent activity (*independence*), level of persistence in the scope of management of individuals (*nonmanagment*) and stability in activity (*stability*), have ben obtained. The initial number of levels have been determined in the standard procedure for determination of the number of categories at the level of safety amounting 95% (K=1.69/sqrt(n)). The range of each category was 1.00. The position of each individual was estimated upon its projection at the linear combination of the whole set consisted of 40 indicators, because it was the way to determine to which extent a particular individual was integrated in such a field of range area. A higher value means for sure a higher position or a better disposition of resources being described by indicators. The level of independence of an individual has been expressed as a derived indicator from the multivariant matrix, in other words, as an average value of all the data in the matrix of euclidic distances of each analyzed entity in relation to all other. The logic of this kind of procedure is extremely simple, because it is reasonably hypothesized that the individuals similar to others by the values of indicators are to a smaller extent independent since they share the common area in a larger extent and in that way their mutual activity itself. The level of nonmanagement was estimated by the product resulting from multiplication of positioning and independence, with the logic that an individual having a higher position and a higher level of independence is in his/her substance less managable (and vice versa). Finally, the stability of each individual was estimated as the absolute result of subtraction of positioning and independence because it is certainly true that the individual having ''harmony'' between positioning and independence will not aspire for bigger changes, in other words, he will not put the structure in disorder. In conclusion, if he was at a low position and very independent, he would not make any contribution to the system but he would probably seek his own personal result which would endanger his own and the whole system stability. The same is true for the individual who has a high position and who is very much dependent of all others and therefore he would not be able to make his own decisions. The first three parameters are expressed in the standard range from 1 to 5, and the fourth (stability) was obtained as difference between 0 and 3. This lead to a more precise identification of levels within the same range. A hypothetical model has been set up and it was completely confirmed (Table 1). For the purpose of easier understanding, the data was reduced to one decimal. Before the data was collected, a hypothetic model of the role of an individual, including the possible situations described by the combination of the four hypothesized and analyzed parameters, had been set up. This kind of data have been presented in Table 1 (Hypothesis). The average value of all the standardized and summed up data of these four parameters resulted in real levels and allocations of the individuals on the mentioned levels (Graph 1). For the purpose of an objective comparance, the results were also analyzed with a group of different taxonomic procedures (clustering, polar taxsons, ….), but the data was not in line with any of the procedures, which confirmed the fact that this research dealt with definition of internal levels, internal structure and individual roles and not with taxons.

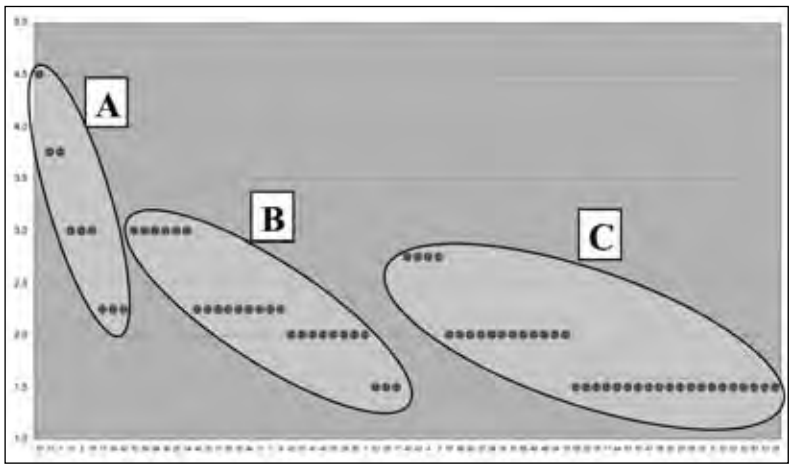
Results

If we suppose that a description of the four offered parameters with five intensities were sufficient to determine the position of an individual, then the first step in that context was the description of potential roles. Although the possible number of roles might seem very big (combination without repetition = 625 possibilities), that is not true, because there is a great similarity among those particular possibilities, and the roles are arranged in real conditions based on different variations of influences, which results in a smaller number of possible roles in the organization in the end. It is also obvious that the roles cannot be arbitrary, because the structure itself is not arbitrary defined and then a great number of the possible-seeming roles is simply unrealistic. These data are safe very much because it was dealt with even 40 indicators covering in large part the scope of activity performed by sport managers. The complete description of indicators can be found in: (Bonacin, Mujkić and Rađo, 2008). In this way, a real leader was hypothetically described as (5,5,5,0), in other words, at a high position, independent, nonmanagable and stable. The subleader was described as (4,4,4,1), in other words, almost as a real leader, but with some less measurable features, though. A manager (5,4,4,1), a counsellor (3,5,3,2), a communication network knot as (5,2,2,2), etc.

Table 1. Hypothetical and empirical indicators and their differences as well (P=positioning, O=Independence, N=nonmanagement, S=Stability, X=Entity, A=Strategy, B=Tactics, C=Executive organs)

		Hypothesis				Results					Differences			
Segment	Role	P	O	N	S	P	O	N	S	X	P	O	N	S
A	Leader	5.0	5.0	5.0	0.0	4.5	4.5	4.5	0.0	1	0.5	0.5	0.5	0.0
A	Subleader	4.0	4.0	4.0	1.0	4.5	3.5	3.5	1.0	2	0.5	0.5	0.5	0.0
A	Manager	5.0	3.0	3.0	1.0	4.5	2.5	2.5	1.0	2	0.5	0.5	0.5	0.0
A	Counsellor	3.0	5.0	3.0	2.0	2.5	4.5	2.5	2.0	1	0.5	0.5	0.5	0.0
A	Network knot	5.0	2.0	2.0	2.0	4.5	1.5	1.5	2.0	3	0.5	0.5	0.5	0.0
B	Supervisor	4.0	3.0	3.0	1.0	3.5	2.5	2.5	1.0	2	0.5	0.5	0.5	0.0
B	Opportunist	3.0	3.0	2.0	1.0	2.5	3.5	2.5	1.0	8	0.5	0.5	0.5	0.0
B	Poser /Accountant	2.0	4.0	2.0	2.0	1.5	3.5	1.5	2.0	5	0.5	0.5	0.5	0.0
B	Confidant	3.0	2.0	1.0	1.0	2.5	1.5	1.0	1.0	8	0.5	0.5	0.0	0.0
B	Partner/Assistant	1.0	3.0	1.0	2.0	1.0	3.0	1.0	2.0	3	0.0	0.0	0.0	0.0
C	Segments maintainer	3.0	3.0	2.0	0.0	2.5	2.5	1.5	0.0	4	0.5	0.5	0.5	0.0
C	Communications channel	2.0	3.0	1.0	1.0	1.5	2.5	1.0	1.0	12	0.5	0.5	0.0	0.0
C	Isolator/disorder	1.0	4.0	1.0	3.0	0.5	3.5	0.5	3.0	4	0.5	0.5	0.5	0.0
C	Univerzal	3.0	1.0	1.0	2.0	2.5	0.5	0.5	2.0	7	0.5	0.5	0.5	0.0
C	Operative	2.0	1.0	1.0	1.0	1.5	0.5	0.5	1.0	9	0.5	0.5	0.5	0.0

A greater number of conceived roles in this way (features) were hypothetically arranged in the strategic, tactical and operative segment of the organization, and finally we came to the number of 15 existing roles. For a certain number of hypothetic roles, it was not known in advance if they could be experimentally determined, which finally happened in the end. Namely, a set of 10 more roles of that kind were expected, but their existance was not confirmed. With an additional inspection of data in the poll questionaries, in rescaled data and with the inspection of final results, it became obvious that such a kind of roles (at least in this sample) were only nonexistent constructions which do not exist at the latent level and they might be synonims for some other roles which in reality exist. In comparance to the number of examinees, the initial number of categories was 5. In fact, the number of 7 levels was identified and all the examinees can be traced in them (Graph 1). Other results of this research are presented in the table. According to the results in the Table 1, it can be seen that the deviations from the hypothesis are minimal, in other words, all the hypothetic roles were pretty well guessed. The hypothetic models obviously turned to be sustainable and credible. The number of entities per a particular role (X) was also found as sustainable and credible.



Graph 1. Identified real levels and allocations of individuals

Within the seven identified levels, and on the basis of the described model of structure and structural roles, it can be seen that hierarchy, according to which the strategic block of management (A) covered the least number of individuals (9) being mostly at high levels, whereas the operative block (C) covered the greatest number of individuals (36) being mostly at the lowest levels, was preserved. It can also be seen that the level of the strategy block is expressed in vertical

and of the operative one in horizontal dimension of structure, which is also one of indicators of results credibility. The tactic segment (B) can be found somewhere between the two, which is also found as expected.

Discussion and conclusions

Identification of levels as well as of structure indicators of the relationships network and individual roles within the structure itself appeared to be a possible and achievable task. The indicators in the Table 1 learly support the fact that the existing roles within the organizational structure are not coincidence at all or found as chaotic, but that it is dealt here with the functions of a big importance by any standards. At this moment, a possible terminology choice disagreement in relation to the recognition of individual roles, is totally unimportant because it is really possible that some of these roles could be given some other terminology name by some other researchers. However, their precise allocation and quantitively determined position on the basis of the well defined parameters, bring the functionality of the system and the whole organization of the analyzed structure to the fore. It is clear that, among 71 managers, the only one real Leader and the only two Subleaders have been obtained. In such a large quantity, there are only two Managers and only one Counselor. This seems to be the very management top itself, which gives ''sound and colour'' to the driving mechanism and it is, together with the Knots, responsible for the strategy of any system in which it can be a structure constituent part. In the hypothetical second line of organization we find the individuals with tactic roles beginning with supervisors (2). However, on the basis of the description of the applied parameters, it can be seen that, even in the mentioned segments, you can find the individuals with the roles being not necessary systematically orientated, but it could be said that they are above all self-oriented. For that reson, the allocated entities were recognized as Opportunists (no less than 8) and Posers (5). But, there are those who can be seen as ones giving the system (organization) a big dose of Credibility, because they are of the same kind and they follow the organizational instructions (no less than 8), and there is also a certain number od Assistants who should be the experts in particular fields (3). In this way, two considerably polarized types of roles meet at this middle level of activity and possibly of decision-making process and they are the following: the roles substantially aiming at the personal promotion (Oportunism, Posing) and the ones following the established global values of the system (Supervision, Credibility; Cooperation). Different implications can be generated out of this tension, depending on how much the whole structure has been successful and how many of the necessary conditions for function operation can be ensured by the segment of strategy. Naturally, the individuals are recruted from this segment into the segment of strategy, which is an additional development rising the whole dynamics. In the operative segment the following are mostly found: Operatives (9), Universals (7), the roles for Communication preservation (12), Maintenance (4) and the roles of Disturbance (4), which show that the organizational operation activities are really settled at this level. So, in this article, with the poll questionaire applied at 71 managers at high levels in Bosnia and Herzegovina, *a new methodology frame of reference for defining the structure of organization* and individuals allocation has been obtained. That frame also includes the definition of existent levels as well as the indicators of confirmation degree referring to the preliminary hypothesis. Quantification of all the indicators was realized by the application of elementary mathematics procedures, but together with the multivariant methods at entities being very much different from taxonomic and cluster procedures. It is suggested to apply the described metodology in all the situations with the totally known set of initial indicators which cover well the aim area referring to the application of identification of organizational elements of any social structure given, as it is here in the case of sports management.

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ARE WOMEN AN OBJECT OR A SUBJECT IN THE DEVELOPMENT OF THE SPORTS MARKETS?

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Abstract

On the historical basis, sport has been conceived by and for men. Women had to win their place within the sport institutions during the 20th century. Today, sport has become a real show industry because of the increasingly important place of the modern media, and women are a strategic communication trump as actresses as well as spectators. The dominating corporal pattern of women changes, and the links between sport and fashion become closer and closer. But what about those links in a cybersport future?

Key words: *sports market, female sports, media*

Introduction

Modern sport was conceived by men for men. The place that Pierre de Coubertin, the creator of the modern Olympics, attributed to women was more than secondary and in keeping with the most traditional views of his era. Even though women were allowed to participate in the Paris Olympic Games of 1900 in a few events such as tennis or golf and, marginally in a few others such as shooting, sailing, croquet, fishing, ball, rescuing, rowing as well as in the scholastic disciplines, Pierre de Coubertin showed clearly his opposition to female practice: The *only real Olympic hero is the individual adult male, consequently neither women nor team sports. A female Olympics would not be aesthetic, would be impractical and improper* he wrote (Stockholm Games). Built upon the model of male sociability, that of the British club, the sports institution became only progressively open to women. The history of women's accession to the world of sport is indeed one of a conquest. A key moment in this process was when in 1921 Alice Milliat organised the "first female Olympics" in Monte-Carlo. The following year, during the first world Games for women held in Paris, de Coubertin confirmed his position in *Sports Pedagogy*, and the journalist Géo André wrote "*The interest of the numerous reporters and cinema operators for the women athletes showed just how curious people were [...] It also seemed to me that too many of the spectators only had eyes for the ladies' naked arms and legs and not for their athletic skills*" (The Sports Mirror, 1922). When in 1928 women were officially admitted by the International Olympic Committee (IOC), here is what the baron Pierre de Coubertin had to say: "*So that's it they are now allowed to do fencing and, what is worse, athletics, which takes place in a stadium…*" The obstacles set up by men to female participation are well known; possible dangers relating to the practice of sport for their social mission of reproduction, moral dangers concerning public exhibition of a certain degree of nudity, the banning of a woman being seen suffering during effort… The long struggle for sexual equality in society and the transformations of the system of sport were to make it possible for women to aim for institutional parity. As an example, whereas women only represented 12% of athletes at the Rome Olympics in 1960, that proportion will reach 48% in Beijing 2008. With the development of sports entertainment, the place of women in sport has evolved enormously. They are present in all competitions, they are appreciated both as athletes and as spectators as well as television viewers of sporting events, special lines in clothing are offered to them, etc.. One can wonder what has changed so much for women to have evolved from a status of people who are just about accepted in an essentially masculine environment to that of being the centre of attention of all those in charge of sport. The question also has to be asked as to whether they are subjects or objects in this evolution, that is to say, are they an object, victims of these changes or are they subjects who have actively participated in the process, actually making the most of the situation.

The role of television in sports entertainment

During the 1960's the arrival of colour on television screens strongly modified the tastes of North American viewers, making them absolutely passionate about sports programmes. Television operators, mostly private, reacted to this demand by diffusing their clients' favourite sports. These were American football, basketball, boxing, ice-hockey, and baseball in particular, all male sports for all male viewers. They also quickly needed to find new types of events to broadcast in order to satisfy advertisers who were not keen to see women, the main people in charge of spending within the family, excluded from their public. Television operators thus tried to diversify the types of sports broadcast, to widen the spectrum. To

do this they used two main solutions; firstly diffuse important sports events which North Americans were good at and secondly create their own sports events. The first part of the strategy led to a clear increase in the broadcasting rights of events such as the Olympic Games, an increase which is still continuing today, but also to a formatting of these events so as they correspond to the needs of the media. A political decision, on the face of it, having nothing to do with sport was very beneficial to the world of sports entertainment in general. When in 1972 Richard Nixon signed a federal law allowing women, like men, to obtain a grant in universities and to get diplomas there whilst envisaging a prestigious career in sport, one aspect of the effects of this action was unknown to him. This form of equality launched high-level female sport in the United States, and made it possible for television to offer variations to the usual sports programmes, which had the effect of greatly increasing the number of female television viewers watching sports broadcasts a few years later.

The second part of the strategy came later. In 1986 CNN, part of the Ted Turner group, created the Goodwill Games, an ersatz for the Olympic Games and in 1995 ESPN, part of the Walt Disney Company, invented the X-Games with its two versions, one summer and the other winter.

A sort of spiral formed, with six actors with convergent interests: the organisers of sports events, television operators, advertisers who use sports as a vehicle for their communication, producers of sports equipment, sportsmen and women in general whatever their level and lastly direct or indirect spectators, the indirect spectator being the one interested in sports entertainment via the media.

To be interested in sportsmen and women is to put the accent on an evolving market. It is necessary to distinguish the active sportswoman, the one who practices sport, from the sports consumer who simply watches sport on the television or at matches and competitions. The latter cannot be forgotten since she represents a real market for the organisers of sports events. In rugby stadiums, during the Rugby World Cup in 2007, one out of three spectators was a woman and they represented 25% of the television viewers. Faced with this recent enthusiasm of women for rugby the producers of equipment decided to make the players more aesthetic by providing them with tight shirts which highlight their muscles and, as a consequence, advertising and women's magazines became very interested in these new icons of masculinity (see the mise en scene of the French player Chabal) and Adidas was very successful with rugby shirts made for women. Furthermore, women, the main financial supervisor in many families, have become a key target for television advertisers who often use a champion, male or female, to show off their product.

The social role of athletes' bodies

Athletes' bodies has for a long time been different, (de)formed for and by the practice of a sport. Even if athletes' muscles can be a source of fantasies, it is not usually the case of athletes themselves who can be too wide shouldered or too well built. The fact is that power is associated with masculinity and is still a criteria of virility. Muscles are male, historically, culturally, and symbolically. How does one show one's strength apart from contracting one's biceps. And the media likes to reinforce a vision conforming to social desirability. The television broadcasts (apart from the Olympic Games) in which sportsmen and women appear put the accent on "grace" (dancing, ice-skating, gymnastics…), where appearances are worked on through clothing and make-up, to put it in a nutshell, where aesthetics are more important than performance. The obligation to be attractive applies to sportswomen as much as to any other women. The example of athletes in the heavy-weights category illustrates the influence of social representations on sexual appearances; whereas men who are in the heavy-weights section are prestigious, women in the same category, in spite of their sporting success, do not reach the status of star since they clash with the norms of female beauty and they are suspected of losing in femininity what they gain in efficiency! Top level female athletes became aware that their femininity and charm were assets: the heavy make-up of the French athlete M.J. Perrec, the hyperbolic nails of the American G. Devers, the sexy clothes of tennis star M. Sharapova, and the waterproof make-up of French swimming icon L. Manaudou… Even if the sportswoman's body can be a useful vehicle for advertisers, the latter never neglect the social context and the evolution of the norms of physical beauty. Based on an analysis of women's magazines, Y Travaillot drew up a panorama of the evolution in recent years of the way in which female beauty is conceived (Travaillot, 1998). He showed that around 1968, a new aesthetic form celebrating the woman as a child, as androgynous (even anorexic) asserted itself (see the model Twiggy, the actrice J. Birkin…) and the ideal of "juvenilisation" made hour-glass curves in the style of Marylyn Monroe a thing of the past. Beauty equals slim was the new rule.

The start of the 1980's hailed a new doctrine; beauty is slim with muscles. The new woman was sporty and muscular. Since the 90's, we have seen something of a return to curves and feminine attributes. Adriana Karembeu, Monica Belluci… launched a new model of aesthetics.

Inspired by this transformation in the way the body was seen, the television series *Bay Watch* (the most watched and the most sold television series with more than one billion viewers) presented to the whole world during the whole of the 1990's coast guards, with not only very athletic but also extremely aesthetic, perfect bodies, both (re)modelled and tanned. Using actors with bodies of sportsmen and women, showing them in activity, the series also took part in diffusing the type of bodies people dream of having. Furthermore, Reebok used the main actress in the series, Pamela Anderson, to promote its products.

The rapprochement of two worlds

One can see that a rapprochement of two different spheres took place at the beginning of the 21st century. The world of sport and that of fashion became closer. To advertise their products, companies seized the values associated with sportsmen and women and producers of sports equipment did everything possible to bring attention to athletic bodies.

In this evolving economic and social context, in a society obsessed with images, the image seen, the image shown and the image of oneself, the tennis player Anna Kournikova probably had a significant impact regarding the rapprochement between sport and fashion, in the same way that Michael Jordan revolutionised merchandising at the beginning of the 1990's in the US, even if the ice-skater Katarina Witt had understood earlier in the 1980's that ice-skating like certain other sports were destined to become shows. With A Kournikova, organisers and producers of equipment understood that between heroism and eroticism there is no great distance and that in numerous sports, it is the sportswomen rather than the sportsmen who attract the spectators and the cameras and hence the advertisers.

To understand the step taken during the 1990's we will take the liberty of playing with the word eroticism. We will firstly spell it *erotisation* to highlight the link between Eros, the God of love, and teasing and hence the fact that the aim is to induce an impulse, to create a choc for the person who receives the image. Eroticism deployed with the help of athletes makes it possible to be more direct. During laboratory experiments, it has been observed that the projection of images with sexual connotations leads to dilating of the pupil, synonymous with increased attention (G. Goetbhebuer, op. cit. A violent scene produces the same effect but is more difficult to manage in advertising). These champions, of both sexes, turned into virtual entities by the media, are enhanced in both senses of the word. Both their sporting feats and their bodies are shown in a very attractive way thanks to the technology used to capture the images. The economic value of the latter is then increased for the benefit of the advertisers, of the athletes and also of the other organisers, since the athlete in question acquires notoriety, admittedly in another domain to that of sport but whatever. This is the very functioning of marketing for the recognition of the product, the "as seen on t.v." shown on certain products as a guarantee of their interest and quality. By selling their image and by promoting all sorts of products athletes have become heralds. They announce an event, they give a message. Here one might write *herautisation*. Because of their aesthetic quality sportsmen and more so sportswomen create an impulse… to buy.

In 1998 Arnon Milchan (the producer of several successful films and director of New Regency Enterprises and also works for Fox Studios) bought the world rights for women's tennis on this basis and transformed press conferences before tournaments into fashion shows and the players into tennis "spice girls" to quote M. Ingis. In four years these broadcasting rights multiplied 7 fold. Today, it is *the slender blondes with pale complexions* (L'Equipe, 2004) who are the centre of attention on the courts. This is because when producers of equipment saw the effect of Kournikova, they went through tennis schools with a fine tooth comb to find young female players, aged about twelve at that time who could be both excellent players and models for their products. It is them that we now see on the tennis circuit, As well as the young Russian girls looking to make their fortune and whose parents could invest in their training by going to live in North America to find coaches able to take them to the top level.

The market for female sport

In recent years the evolution of sports practice has been more significant with women than with men. In the French case, at the beginning of the 1990's approximately 60% of men and 45% of women said that they took part in sport, today the figures are 80% and 71% respectively. Admittedly all disciplines are not concerned to the same level and some are more specifically male and others female, but generally, sport is a very big market for producers and retailers of equipment. Sporting articles for women represented 40% of the total turn over in textiles in 2006 and 30% for sports articles as a whole, with a growth rate of from 7 to 8% per annum compared with 2 to 3% for men. It is not possible to distinguish the volume of sales for active sportsmen and women and non-active persons.

The brands concerned have organized themselves to get the most out of this niche. Adidas surfed the wave of new sports practices with lines of clothing adapted to each activity. The company also employed the famous stylist Stella McCartney to design clothes combining high technology and style. Moreover the products of the line Adidas Y-3 are in the hands of Yahji Yamamoto, while Nike has created Nike women and Reebok called in Scarlett Johanson, reputedly the world's best dressed woman, to create the *Scarlet Hearts Reebok Collection.* Puma is aiming to become a luxury brand and has called in the couturier Alexander Mc Queen as well as Hussein Chalayan, fashion designer, artist and film maker as *Director of Creativity.* Furthermore all luxury brands now have a sport or street wear collection such as Channel Sport, Versace Sport or Burberry Sport.

The strong growth in female sporting practice and the rapprochement which has taken place concurrently between sport and fashion have also led to the creation of brands which deal exclusively in the distribution of sporting articles for women.

The precursor in this field would seem to be the American group Footlocker which created in 1982 its first distribution network dedicated entirely to sportswear for women under the name of Lady Footlocker. Today this brand has more than

six hundred shops in North America alone. This example was followed in 2004 by the British brand Sweaty Betty (24 shops of which 13 in London). It was not until 2006 in France that the brand Attractive was created. This concept was followed by Lily Sportive in 2007 which opened near Euro Disney, hoping in this way to benefit from the flow of visitors to the parks. For its part Nike opened shops in several European capitals, in Italy, Portugal, the Netherlands and Germany. The brand set up its Nike women store in Paris, September 2007, in the most chic district of the capital, offering "a range of sportswear combining casual style with ultra feminine touches".

All these brands are making the most of the same phenomenon; more and more women do sport but the classic retailers only offer them products which are too basic and although many women today are athletes this does not mean that they are not interested in style. This is where many new slogans come from, such as "sport is glamour" (Attractive) or "sportives et so chics" (Lily Sportive).

In this list one must not forget "Wizz", the first sporting complex exclusively for women. 5 themes are developed; Harmony attitude (massage, yoga…), Rhythm attitude (dance), Aqua attitude (aquagym, aquafit, aquaboxing, aquapower...), Performance attitude (running, cardio training) and Fun attitude (golf cross, rugby badminton boxing).

Conclusion

The market which highlights and exploits sportswomen's bodies must not neglect certain signs which herald a cyber society. If homo silicon manages to overthrow homo sportivus, a decisive change will have been made. In a cyber world (see films such as Matrix, Tron…) the real body seems too much, the body's limits and the frontiers of identity are contested. The future producers of sports equipment may well not be Nike, Adidas and Reebok but Nintendo, Sega… in a universe where Lara Croft incarnates the feminine ideal!

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THE RESEARCH ON DESIRABLE SPORT MANAGERS' CHARACTERISTICS

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Abstract

Day-to-day business of sports organisations requires successful management. Persons responsible for that process, among others, are sport managers. In order to successfully conduct their functions sport managers need to possess certain knowledge and skills, as well as various personal characteristics i.e. personality traits. This research aims to determine what are the characteristics needed by successful sport managers. The opinions of the fourth year students of the Faculty of Kinesiology were analysed since they are prospective future employees of such organisations. The top three characteristics identified by the interviewees were business efficiency, resourcefulness and decisiveness. This does not completely match the results of the research on characteristics of managers in Croatia. It is therefore possible to conclude that the results of this type of research are usually dependent on factors such as: who the interviewees are (subordinates or superiors, i.e. managers), in which the surrounding (country) and in which field of activity the research is conducted. Also, the results of the research do not support the thesis that good managers are born since the interviewees believe that for successful completion of all management tasks adequate education, as well as experience are necessary.

Key words: *sport managers, knowledge and skills, sport managers' characteristics*

Introduction

The business of all organisations, sports organisations as well, needs to be managed on day-to-day basis. Responsible for this process are managers at all organisational levels, and the process of management consists of conducting all management functions. It is therefore clear that the success of organisational management depends on managers, that is to say their knowledge and skills as well as various personal characteristics i.e. personality traits. The question of what the characteristics needed to be a successful manager are has drawn the attention of the researchers in various fields for a long time. Since no such research in the field of sport management exists in Croatia, this paper presents a sort of an introduction to further research on the topic of knowledge and characteristics needed by successful sport managers in Croatia. It is an introduction to further research, namely, because the findings presented in this paper were aimed at determining desirable characteristics, but not knowledge areas. Also, this study researched into the opinions of the fourth (last) year students of the Faculty of Kinesiology since they are the future employees of sport organisations (either as the part of management team or as subordinates). The continuation of the research should be concerned with determining the fields of knowledge necessary for a successful sport management process, as well as researching into the opinions of sport managers and not only subordinates on this matter.

Defining a sport manager and the knowledge and characteristics needed by sport managers

A manager is a person responsible for all the tasks needed to enable maximum contribution of each individual to group tasks. This holds true for "small and large organisations, profit and non-profit, as well as production and service rendering companies." (Weihrich & Koontz, 1998:5) Regardless of the type of activities they work in, the activities of managers are usually studied through five basic management functions: planning, organising, human resource management, leading and controlling (Weihrich & Koontz, 1998:20-22). Therefore, a manager needs to be a person with exceptional knowledge, organisational abilities, decision-making skills and responsibility. According to Katz (quoted in Weihrich & Koontz, 1998:6) there are three types of skills (knowledge) needed by the managers: **technical skills** (knowledge and ability in methods, processes and actions), **human skills** (ability to work with other people), **conceptual skills** (ability to see the "big picture"). And finally, added to the list are **design skills** (the ability to solve problems in a way that the company will benefit from). All knowledge is not equally important to all management levels, that is to say "the relative importance of these skills can be different on various levels of organisational hierarchy." (Weihrich & Koontz, 1998:6)

The representative of a different approach to studying management activities is Mintzberg. He concluded that the manager's job can be described in terms of management roles which are common for all managers, and consist of three areas: interpersonal, informational (control function, information transfer and the mediator function), and decisional (Peterson & Van Fleet, 2004) roles. The majority of mentioned knowledge is acquired through education or work experience.

The same approach is used when defining the term sport manager. He is regarded as "an organiser, person who manages a sport organisation whose goal is to achieve certain sport-related and business results." (Bartoluci, 2003:155) When talking about the knowledge these managers need to posses, their specifics are that besides having knowledge necessary for conducting management functions they should be familiar with the characteristics of the sport they manage. Namely, their everyday tasks depending on their position (top, middle or lower management) can be clustered into "general management tasks, organisation management, information management, and exercise and sport science." (Parks et.al. quoted in Parks, Zanger, Quarterman, 1998:4). Research has shown that "the rational management functions were not sufficient to describe the activities of sport managers. Interpersonal communication, information tasks and external representation as well as social tasks are central components of their activity." (Horch & Schütte, 2003:73) According to the same authors their required competencies are determined primarily by the centre of activities, secondarily by the type and thirdly by the size of the organisation (2003:82) and can be summarized as follows: "a sports manager must therefore dispose of a basic knowledge about the sports of his/her organisation, but beyond that, special knowledge in Physical Education was not reckoned to be needed, and, in accordance with the US studies communicational skills in the area of public relations have a central importance. From the sphere of business administration, financing (specifically sponsorship) and budgeting are very important." (2003:75-76)

According to official data, there were about 11,070 workers engaged in sports (13% women) in 2006 in Croatia, and 17,942 public workers (see Table 1) as persons leading Croatian sport. However, only 11.4% of sport workers and 1.4% of public workers do their job as professionals, and the others are volunteers. At the same time the share of qualified personnel, those who have some necessary knowledge for their job attained by education is 62.1%.

Table 1. Sport workers in 2006

	Workers engaged in sports						Persons in charge	
	Total	By working time			By qualifications		Volunteers	Professionals
		Volunteers	Professional workers		Qualified	Unqualified		
			Full time	Less then full time				
Sport associations	11,070	9,804	841	425	6,874	4,196	17,686	256
-women	1,455	1,252	138	65	906	549	1,462	54

Source: CBOS (2007). First release "Sport, 2006", http://www.dzs.hr/Hrv/publication/2007/8-3-7_1h2007.htm, retrieved on 5/10/2007

However, besides the necessary knowledge or the knowledge regulated by law that managers have to possess in order to do their jobs successfully regardless of the organisational level they are in, on behaviour of managers as well as the successful completion of their activities, personal characteristics also have their influence. "This question is connected with management theory on characteristics or "personality traits", which assumes that some individual traits are decisive for the success of managers. Some people have those traits, and others do not, which implies the thesis that successful managers are born, and not educated for that function." (Sikavica & Bahtijarević-Šiber, 2004:259) Although researchers have not been successful in identifying key characteristics that managers need to possess in order to be successful, the question of managers' characteristics is still considered important in the management theory and represents "not only an assumption of managers' success, but often even a contradiction for doing managers' jobs. It is therefore simply unimaginable that someone without self confidence and decisiveness becomes a good manager. Another characteristic more and more demanded from managers is enthusiasm." (Sikavica & Bahtijarević-Šiber, 2004:259) Moreover, according to research of DeSensi et.al. (1990:37) communication skills and personality were considered to be important criteria for hiring by five of the six professional settings (college/university intramural/sport clubs, private sport clubs, college/university athletics, professional sport, local government agencies, and voluntary agencies). Also there were no great differences among researched professional settings in the importance of this characteristic (personality) for "on the job success" (see DeSensi et.al., 1990:38). In Sikavica and Bahtijarević-Šiber research (2004:267) the rank of the importance of desired characteristics of managers is as follows: decisiveness, honesty, business efficiency, objectiveness, independence, resourcefulness, culture, enthusiasm, criticism, and courage.

Results and discussion

The research analysed the opinions of prospective future employees of sport organisations on the importance of personal characteristics necessary for successful managers. The author has conducted this research with the last 3 generations of fourth year students at the Faculty of Kinesiology. Since only the questionnaire for the last generation taking the subject *Economics and management of sport* was for possible result comparison adjusted with the part of the aforementioned research from Sikavica and Bahtijarević-Šiber, in this paper only the results of 85 collected questionnaires from students in the academic year 2007/2008 are presented.

Table 2. The rank of characteristics of sport managers (1 - the highest rank, 10 - the lowest rank)

Characteristics	Mode of the rank	Frequency of the mode
Business efficiency	1	25
Resourcefulness	2	18
Decisiveness	4	18
Independence	5	17
Enthusiasm	6	14
Objectiveness	6	17
Courage	7	14
Criticism	8	17
Culture	10	16
Honesty	10	19

As can be seen from Table 2 almost 30% of interviewees find the characteristic business efficiency to be the most important for the success of sport managers. Besides business efficiency the other most important characteristics were resourcefulness and decisiveness, whereas culture and honesty were chosen as the least important. These opinions differ from the opinions of Croatian managers, namely with the characteristic *honesty.* However, it should be mentioned that the Spearman's coefficient of correlation among the chosen characteristics, calculated the highest statistically significant negative correlation between resourcefulness and honesty (-0.53). In other words, those who ranked resourcefulness high did the opposite with honesty, and the other way round. It can be said that this is mostly due to perceiving these two characteristics in a way that the presence of one excludes the other. Since this is the topic of psychological researches, this paper will not go into detail concerning this matter.

It is possible to conclude that the results of these types of research depend on various factors. For example, the field of activity research is conducted in, the choice of interviewees (the paper showed differences in opinions among managers and students), as well as the area (country) in which the research is conducted in. In that sense, for example, the subordinates in the USA listed honesty, ability and long-sightedness as the three most desirable characteristics (see Srića, 1992:144).

At the same time the results of Mann-Whitney's U-Test do not show statistically significant differences among the opinions of male and female students as was perhaps expected. 87% of the interviewees find that the success of the sport managers is defined by education and experience. That is to say, they do not support the thesis that good managers are born, because for the successful completion of their tasks adequate education as well as experience is needed.

Conclusion

For the successful completion of all managerial functions adequate knowledge and skills, usually gained by education, and experience are needed. The specific of managers working in the field of sports is that they need to possess necessary knowledge on all managerial functions, as well as the knowledge on characteristics of sport they manage. The required competencies of managers are determined primarily by the centre of activities, secondarily by the type and thirdly by the size of the organisation. However, besides these acquired skills, their other personal characteristics are also important for their success. These characteristics affect their behaviour as well as the behaviour of the entire organisation. As the most important characteristics of managers listed in Croatia are decisiveness, honesty and business efficiency. However, the opinions of fourth year students at the Faculty of Kinesiology that took *Economics and management of sport* differ for the area of sport management since they find business efficiency, resourcefulness and decisiveness as the most important characteristics for the success of sport managers. It can be concluded that the results of this type of research are dependent on the factors such as who the interviewee (subordinates or superiors, i.e. managers) are as well as in which area the research is conducted. The results of this analysis also show that the students do not support the thesis that good managers are born, but for the successful completion of all managerial tasks adequate education and experience are necessary.

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PART TWO: TOURISM AND SPORT

TOURISM AND SPORT: MANAGEMENT OF EVENT OPERATIONS

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Abstract

Today, events represent a centrepiece of tourism, tourism strategy and marketing. Tourists want, need and expect that something is constantly happening during their stay in the destination of their choice, within and beyond the hotel. Events attract tourists and motivate them to select a place where they can spend pleasant holidays or to revisit a place. The objective of this paper is to define an event management model that can ensure optimum results, and this means achieving tourist satisfaction and economic results. In particular, the paper focuses on sport events to which the same management model and methodology can be applied, but with certain adjustments to the specific characteristics of sports. The paper comprises several sections. First, events, the events industry, types of events, and event management are defined, followed by an overview of the operations that make up the event management model. The starting point and source are modern world theory and best practises of event operations management. The purpose of the paper is to underline the need to professionalise and standardise event management in Croatia and to point out the huge impact of event management on tourism development and tourism effects.

Key words: *event, management, quality, customer, operations*

Events industry

What is an event? An event is a happening or occurrence of some kind that has been organised for the purpose of attracting people's attention and bringing customers and tourists to a specific place at a specific time. Tourists wish to experience an event in its entirety; they want to watch, listen and participate, and to experience joy and satisfaction. The event industry involves companies that specialise in staging events, creative turn-outs (parties), theme events and various types of shows. This is an industry that brings together many product and service producers, bankers, the media, carriers, hotels and other supporting industries. There are many types of events, which can be classified into several major groups:

Table 1. Groups of events

Leisure events (leisure, sport, recreation)
Cultural events (ceremonial, sacred, heritage, art, folklore)
Organizational events (commercial, political, charitable, sales)
Personal events (weddings, birthdays, anniversaries)

Source: Tum, et al. (2006). *Management of Event Operations*. Oxford: Elsevier Butteworth Heinemann, p. 10

The list of types of events is neither conclusive nor restricted. It is an open list to which new types of events are constantly being added depending on change on the market and in demand (scientific gatherings, educational events, etc.). It should be noted that there are for-profit events and non-profit events (charity events). What is, nevertheless, common to all types of events is that they must be exceptional, unique and special, because only these types of events are capable of attracting attention and bringing results. Events are characterised by: the different magnitude of events (size and volume of output), the diversity of types of services and products offered to customers, uncertainty with regard to number of people expected to attend, different event times and technical requirements, and interaction with customers.

Table 2. Types of events per group

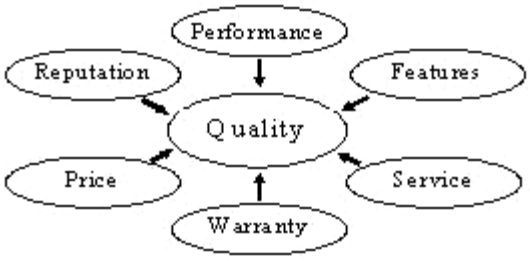
Cultural celebrations: - festivals - carnivals - religious events - parades - heritage - commemorations	**Educational and scientific:** - seminars, workshops - congresses - interpretive events
Art/entertainment: - concerts - other performances - exhibits - award ceremonies	**Recreational:** - games and sports - amusement events
Business/trade: - fairs, markets, sales - consumer and trade shows - expositions - meetings/conferences - publicity events - fundraise events	**Political/state:** - inaugurations - investitures - VIP visits - rallies
Sport competitions: - professional - amateur	**Private events** **Personal celebrations:** - anniversaries - family holidays - rites of passage **Social events:** - parties - reunions

Source: Tum, et al. (2006). *Management of Event Operations*. Oxford: Elsevier Butteworth Heinemann, p. 11

Every event is specific and requires a special management approach and management procedures. The principles of excellence and uniqueness should be applied to events. Interestingly, sports competitions can be either professional or amateur.

Event management

Total Quality Management (TQM) provides a framework for event management. TQM begins with the customer, that is, with what a customer wants, seeks and expects, and ends with customer satisfaction. TQM is entirely customer focused, because only this type of market quality model can yield economic effects. The customer determines what quality is, and it is the task of management to organise employees – quality providers – to deliver this quality. (Avelini Holjevac, 2002). Customer perception of quality is defined by several elements.



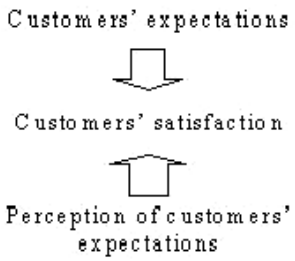
Source: Besterfield, et al. (1999). *Total Quality Management* (2nd ed.). Upper Saddle River: Prentice Hall, p. 51

Figure 1. Customer Perception of Quality

Ranking of factors by importance to the customer:

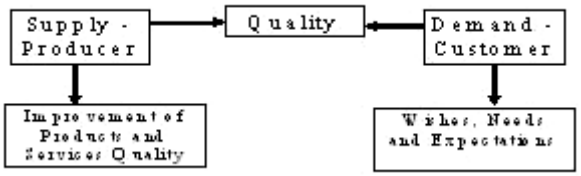
1. Performance
2. Features
3. Service
4. Warranty
5. Price
6. Reputation.

Although price is not ranked first by importance, it should be consistent with the value of services and products.



Source: Avelini Holjevac (2007). *Marketing and Quality Management – The Keys of Competitive Advantage.* Opatija, p. 8

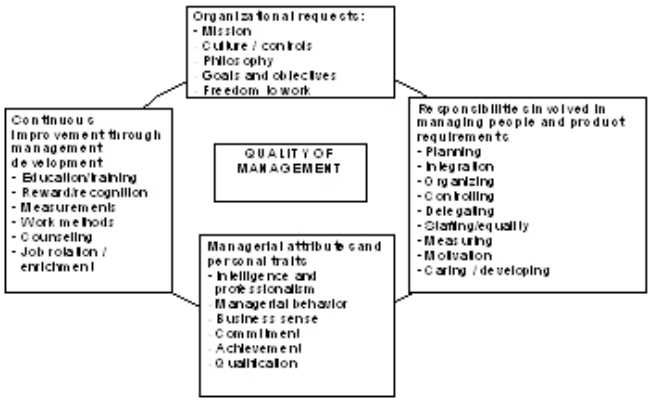
Figure 2. Customers' expectations and satisfaction



Source: Avelini Holjevac (2007). *Marketing and Quality Management – The Keys of Competitive Advantage.* Opatija, p. 11

Figure 3. Creating products and services quality

The quality of products and services is a double-edged sword: one side represents the production; the other represents the customer. How can the quality of management be increased? The platforms for this are the elements of quality of management, and the requirements are many (see Figure 4).



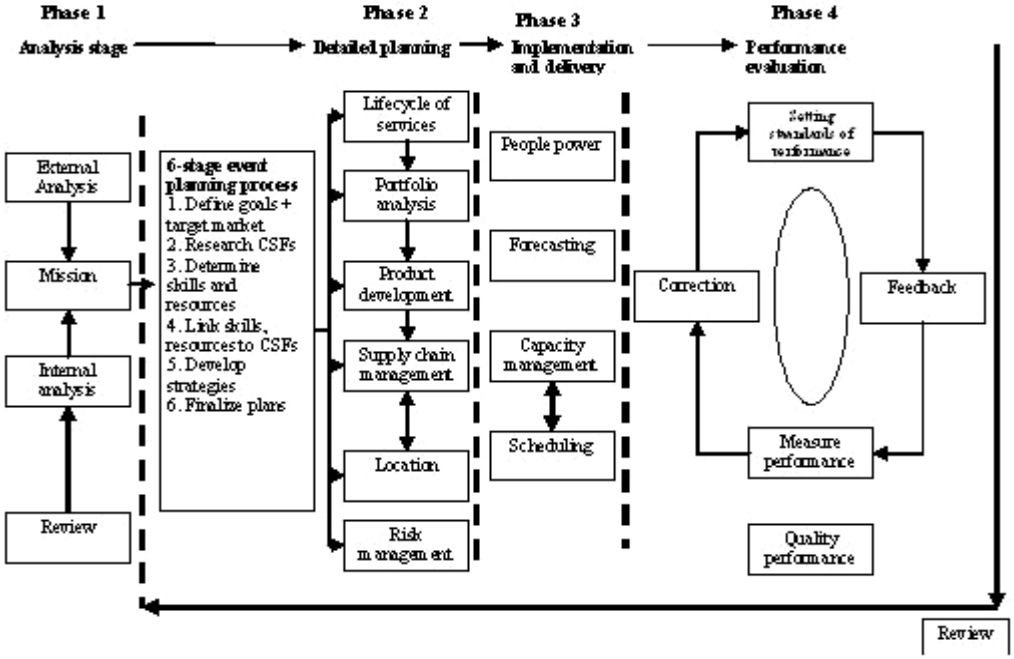
Source: Edosomwan (1993). *Customer and Market-Driven Quality Management.* Milwaukee: ASQC Quality Press, p. 159

Figure 4. Elements in Improving Quality of Management

Each element of quality is complex and important in its own way in achieving the quality of managers and management. The overall successful of any activity largely depends on the quality of managers, and this applies to events management as well. Management quality and excellence can only be obtained through the continuous improvement of all requirements.

Event operations management model

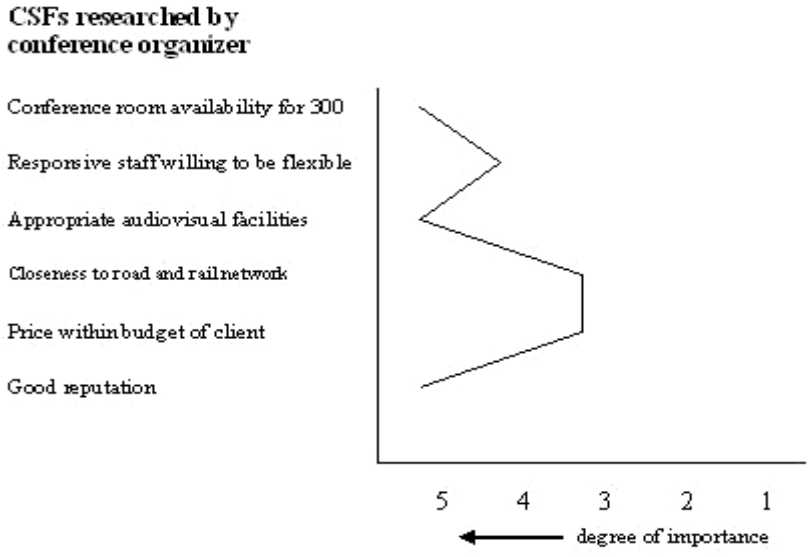
This is a highly complex model because it comprises all management activities: external and internal analysis, detailed planning, implementation, and delivering and evaluating performance. The model involves all general functions of any management: planning, organisation, staffing, leading and controlling.



Source: Tum, et al. (2006). *Management of Event Operations*. Oxford: Elsevier Butteworth Heinemann, p. 90

Figure 5. Event Operations Management Model

This model is entirely market focused, a fact that is evident in each individual phase. In the performance evaluation phase, the indicators of quality achieved are especially monitored. The narrower the gap between what costumers/ tourists want, need and expect, and what they actual get, the greater the efficiency of event management. The service – event – must meet customer expectations. Below is an example of event Critical Success Factors (CSFs) relating to the organisation of a conference event.



Source: Tum, et al. (2006). *Management of Event Operations.* Oxford: Elsevier Butteworth Heinemann, p. 57

Figure 6. Identification of the relative importance of critical success factors demanded of a venue by conference delegates

A total of six critical factors have been listed that determine the success of a conference. These factors have different ratings by importance: the most important factors include the size of the conference hall, the appropriate audiovisual facilities, and good reputation (a rating of 5), followed by flexible and responsible staff (a rating of 4), and last but not least accessibility (transportation) and a price that suits the client (a rating of 3).

Conference CSFs may also be specified in greater detail as requirements for well-organized coffee and lunch breaks, friendly and well-presented reception staff, useful and meaningful signage, well-organized meal service, a clean and tidy car park, and a high level of customer care. An event manager must take care to ensure the highest standards are achieved for each CSF, because standards are the basis of quality of any activity.

For sports events, CSF include: place, time, sports grounds and areas adapted to specific sports, sports facilities, sports staff, facilities for athletes and spectators (accommodation facilities, catering facilities), accessibility (transportation), safety and security, volunteers and other additional services (shopping, souvenirs, etc.), the hospitality of resident and sponsors. Sports grounds, facilities and equipment are rated the highest on the scale of importance.

As a success factor, volunteers are a specific feature of events, in particular, sports events. Their characteristics are (Tum et al., 2006):

- They are usually very enthusiastic about the event itself
- They may lack experience and need training
- Many want to have fun
- Many prefer short-term responsibilities, especially at the event itself
- They may be more artistically creative than technically creative
- They may be full of good intentions but leave things to chance, or expect others to do the work.

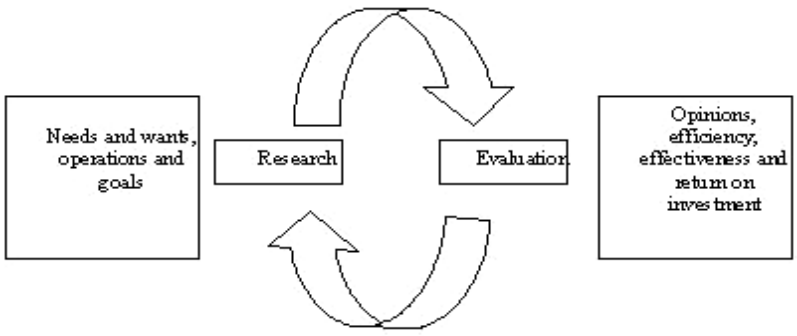
Sports tourism is linked to health tourism and eco-tourism, and these are the three most important trends in travel motivations with steadily growing tourist numbers. In particular, mention should be made of adventure and extreme sports as events that increasingly growing in demand, as they contain elements of sports, health and a return to nature.

Performance evaluation

The final phase in the event operations model deserves special attention, as it involves measuring and evaluating the extent to which the goals of staging an event have been accomplished and the efficiency of management (the controlling function of management).

Focused on tourism, in particular, on accommodation and caterings services, events generate profits and help to increase employment rates. They lead to an increase in occupancy rates and a higher living standard for employees, cause related services to grow and raise the social responsibility of all participants. To achieve this, the strategy of management must focus on increasing revenue by improving the standards and quality of services and especially the level of health, hygiene and safety standards. This entails continuously improving the knowledge and competencies of managers and each individual employee. A learning organisation involves all its employees and becomes a platform for continuous quality improvement and for increasing competitiveness and profits. Best-practise examples confirm this. Controlling and analysing event performance involves the activities of the PDCA model:

- Plan what you intend to do
- Measure what has been done
- Compare achievements with the blueprint
- Take action to correct anything that is not as it should be.



Source: Tum, et al. (2006). *Management of Event Operations.* Oxford: Elsevier Butteworth Heinemann., p. 254

Figure 7. Continuous event-performance evaluation model

Other performance evaluation models that may be used include the EFQM Excellence Model, the Balanced Scorecard, with specific indicators for each event in accordance with the IQM Model (Integrated Quality Management). For detailed event scheduling, planning techniques such as a Gantt chart and network planning can be used. Special attention is attached to evaluating event quality, and the techniques that can be applied include the statistical model SERVQUAL, various surveys and interviews, comments, expert opinions, spectator opinions, remarks from staff and volunteers, the opinions of sponsors, financial reports, reported problems in transport, security, etc.

Conclusion

Event operations management needs to be standardised and professionalised, as only in this way can it yield optimum economic, as well as non-economic, results. This calls for the application of the theoretical frameworks of modern event management together with best practices, and would lead to a considerable increase in tourist arrivals and earnings from tourism in Croatia.

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WATER FACILITY TOURISM OFFER MANAGEMENT

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Abstract

Tourism offer in its structure is very complicated, and it has to derive from the core of tourism demand, and that is to please the tourist. Tourist offer for sport and recreation facilities is defined by the motives that make the tourist choose a certain tourist destination, since water sport facilities are of significant importance for the choice of the destination.

Model of the research are all tourist destinations on Croatian Adriatic Coast. Source of data is the DZS - State Statistics Institute, results of THOMAS survey and other Croatian and foreign references. It is expected that the results will be applicable for the increase of recreational and sports facilities, all in favour or increasing tourist offer and the increase of the motives of tourists' arrivals to potential tourist destinations.

Key words: *recreation, sports offer, water facilities*

Introduction

Contemporariness of the topic is visible in the search for the potentials of tourist consumption increase. The aim is to explore the laws of tourist offer of water sports and recreational facilities and to find out how much do the tourists spend on certain segments of tourism offer. Basic motive for tourists' arrival on Adriatic coast is the experience of sea and facilities connected to sea and water. Author's task is a try to prove how much are the tourists willing to spend on entertainment, food and beverages, cultural heritage, trade products, sports and recreation, as well as facilities connected with sea and water, and how much does the price increase effect the demand.

Methods

From the aspect of tourism offer and demand, all tourist programs can be divided to:

a) offered program,

b) possible program,

c) free program.

It can be assumed that the offered program will be the most attractive for the tour travelling organizer. In average, this is a pre-paid and pre-planned tourist demand which can be easily shaped, but is not necessarily the insurance of largest profit. In practice, these are the all-inclusive arrangements, all inclusive hotels and other similar programs.

Possible programs are those which take place when the tourist comes to a destination, and if it has been carefully created, it has a possibility of earning high profit. Free programs are those the tourist chooses freely, at the destination, and if the management is active, higher income can be obtained.

Management of sport and recreational tourism offer is the most important system of tourism offer since it forms the greatest part of guests' satisfaction and motives that make the tourist choose a certain destination. Starting from the basic fact that almost 86,0% tourists come to Adriatic coast because of the basic motive, and that is the sea and sea-swimming experiences, a question emerges: to which extent do the sport and recreational facilities connected to sea and water influence the tourists' complete experience and satisfaction? (Cerović, 2008)

Management strives to maximize profits, and it should fulfil these two basic conditions which determine the management success:

- Stimulating the facilities and objects development, which would fulfil the motives and experiences which have led the tourist to the destination;
- Using management knowledge, skills and competences to materialize the planned tourist consumption per each facility, program and object. Tourist consumption ensures success of a manager as a result of satisfaction of those guests who have used some of the offered facilities.

Tourist offer of water sport and recreational facilities is a set of all services, objects, equipment and information which is offered to tourists in the place of sojourn, to please the guests' needs and motives. Aim of management in a tourist destination is to create tourist offer which would please the needs and motives as a prerequisite of tourist consumption, and one of the possible facilities are sport and recreational facilities. That management constantly stimulates the total tourists' consumption increase, and while doing so, the main task is to discover the main motives which have lead the tourist to a destination and the motives which can increase the overall guests' satisfaction with the facilities.

Results

Motives of travelling and guests' satisfaction are shown in table 1, and from the listed 24 possible activities, those which have been represented the mostly are activities of sport and recreation, but not also concerning the intensity. Conclusion that 86,5% of tourists activities are swimming and bathing should urge us to analyze the tourists' consumption structure more into details, of course, within the specific Croatian tourism offer.

Table 1. Motives that make the tourist choose Croatian Adriatic destinations

Activities	%
Swimming/bathing	**86,5**
Restaurants	50,5
Walks in nature	50,0
Relaxation	38,3
Private excursions	36,2
Sightseeing	32,7
Boat rides	**24,0**
Dancing / Disco	22,1
Shopping	20,9
Tennis	20,8
Bike rides	19,2
Local festivities	19,2
Organized excursions	18,2
Diving	**15,8**
Fishing	**12,5**
Museums and exhibitions	11,5
Hiking	8,2
Concerts	7,9
Surfing	**6,9**
Waterskiing	**6,8**
Sailing	**3,8**
Health and recreation	**3,6**
Horse riding	3,4
Theatres and festivities	2,8

Source: Institute for Tourism (2007)

Table 1 shows that the accent has been put on water activities: swimming, boat rides, diving, sailing, surfing, water skiing; this proves relatively low activities of potential tourist demand and it results in a low degree of tourist consumption, which is the aim of the following research.

Relatively poor structure of tourist demand leads to the need of a comparison between tourist consumption in Croatia and other competitive tourist countries. It is interesting to see how Croatia changes when compared to other countries.

Table 2. Structure of tourism consumption in Croatia, Italy, Spain and France in 2007 in €

	Croatia	Italy	Spain	France
Accommodation (Hotel, camp, private rooms)	29	34	33	36
Hospitality services (food, beverages)	7	9	8	10
Trade services (shopping), fuel	5	12	15	11
Entertainment, recreation, sport, other	6	14	12	14
Total	**47**	**69**	**68**	**71**

Source: WTO (2007)

Structure of tourist offer shows that in the field of accommodation, Croatia reaches the prices of other competitive countries. However, in the field of non-accommodation offer and consumption, this is not the case. Objects and facilities of sport, recreation, trade merchandize, entertainment and other, are of a lower quality and number, so it can be concluded that hospitality offer of food and beverages, shopping, sports, entertainment, recreation and other tourism services, are not a significant stimulus of tourist consumption increase, although then do influence the motivation of the arrival.

Potential large number of facilities and possible motives of arrival to a destination could lead to a conclusion that tourist consumption should be high; but it can be clearly seen that the core of tourism offer is quite the opposite. Tourists find the motive of arrival in recreation and sports on water, but still spend little for these expenses, i.e. facilities.

Relations between the guests' number in the period from 1997-2007 (a ten-year period) have been put in the correlation, tourist consumption and accommodation expenses, out-of accommodation expenses in hospitality objects, merchandize, fuel, sport and recreation water and sea facilities are to me measured.

For that purpose, a 6-dimensional model has been created.

y = possible increase of tourists' number, if the price of accommodation and other services increases

x_o = unchangeable parameter in the model

x_1 = consumption in accommodation

x_2 = consumption in hospitality services

x_3 = merchandize, fuel expenses

x_4 = other tourism services

x_5 = sport and recreation on water

x_6 = entertainment and other

$y = x_0 + x_1 + x_2 + x_3 + x_4 + x_5 + x_6$

Testing of the graded values of individual parameters has been underdone and the results showed that some hospitality services (variable x_2), does not belong to the model described. The same result applies to other variables, but no measurements have been carried out.

It has been explained that variable x_2 does not belong to the model "that the guests did not come to Croatia for variable x_2, i.e. hospitality services."

And since in this model variable x_2 does not belong to the model, a new model had to be used:

6-dimensional model which, on one hand takes into account the number of tourists who have visited Croatian destinations in 2007, 6.789.000 tourists, and on the other hand the consumption in accommodation services and non-accommodation services, i.e., merchandize, shopping and sport and recreation services.

Mathematical-statistical research, which had included the co-dependence of tourists' number and demand for different services, had been undertaken.

Stated correlation can be presented as:

$$y = 210.655\ x_0 + 29{,}604\ x_1 - 8{,}934\ x_2 - 5{,}715\ x_3 - 6{,}136\ x_4 - 7{,}136\ x_5 - 12{,}136\ x_6$$

Shown multiple-linear correlation can be explained as follows:

"Number or stays (dependant variable y) can be significantly changed (in our example by 210.655 visitors, i.e. tourists, by 3,3 % even though the price increased by 10%) if the accommodation price increases by 3 euros". It means that he accommodation price can be changes, but under the condition that the service also increased.

In the presented multiple-linear correlation, the case is, that coefficient x_2, and x_3 are negative i.e. "-8,934 x_2", "-5,715 x_3", - 6,136 x_4, - 7,136 x_5, - 12,136 x_6. This can be interpreted as:

"Tourists consumption of hospitality services: x_3 = merchandize, fuel expenses, x_4 = expenses for other services, x5 = sport and recreation on water, x6 = entertainment and other, are not a motive of tourists' arrivals to Croatia.

This result can be interpreted as:

Number of visitors (tourists in Croatian destinations) can be expected to increase in 2008 by 210.655, or be planned as 6.999.655, which means a 3,0% growth, but with the possibility of raising the prices by 10%, which also includes the increase of quality at all fields and levels.

Discussion and conclusions

Management of tourist offer of sports recreational facilities on water continuously stimulates the increase of overall tourists' consumption in a certain destination, and the main task is to discover the motives that make the guest choose a certain destination. Croatian tourism offer, facilities, entertainment and other services are of a lower quality and less numerous and they do not attract the tourists' attention since the visitors have a much higher services quality, standard and habits in their domicile countries.

Task of the management is to increase tourists' demand for Croatian destinations and all included facilities. It is surely possible to increase the tourists' number, and even raise the prices, but only under the condition of enlarging the number of facilities offered, as well as their quality. Croatian facilities connected to entertainment, sports and recreation and programs connected to sea and water are not the basic motive of the arrivals, but the tourists are prepared to come to Croatia and use the tourist facilities if they met their expectations and higher quality.

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PUBLIC RELATIONS MANAGEMENT IN SPORT AND TOURISM

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Abstract

This work explores co-dependency of PR and competitive advantage based on numerous interviews with 60 managers of small hotels with sports facilities in Croatia. Aim of this research is to recognize the connection and relations between the implementation of PR in tourism and sports on one hand, and competitive advantages on the other hand, which gives the opportunity of adapting to changes and needs of modern market. Using a descriptive statistical data analysis, paper proofs the theory of a strong connection between PR and competitive advantages, and especially the creativity, strong strategy and market promotion, and offer variety. The research has shown that the management of PR adds to the mastering of processes of creating specific strategies and shaping business politics to improve the competitive advantages in business objects in the market conditions.

Key words: *small hotels, sports facilities, competitive advantages, creativity, strong strategy*

Introduction

This work explores relations between organizations and their public, or more detailed, between small entrepreneurs in hospitality and their public. Special accent is put on small entrepreneurs who connect their business to a special kind of objects – hotels, and especially to those hotels which, as a part of their offer, have sport facilities.

Constant changes have been supported by social, economic, political, market and other changes and they demand an imperative of taking competitive advantages to a higher level of competitiveness, not only at the level of a tourist destination, but as well as the level of management subjects.

Key role in strategic positioning in Croatian tourism belongs to small hospitality enterprises. One of the key commands, which as their aim, have the increase of enterprises' competitiveness are innovations in the field of quality of tourist product, quality of service and marketing.

Management of these enterprises, as the carrier of public relations, has been analyzed within the context of new surroundings, especially demands set in the conditions of management openness and competitiveness. Demand which is put in front of management is its ability to guide the changes and creation of such interrelationships which will enable marketing break on more and more demanding markets.

Problem of research is focused on research of creating and maintaining relationships with public and their influence on increase of enlargement of competitive advantages of small entrepreneurs in tourism and sports.

Methods

This paper will show a part of the research results of management in tourism. It is a descriptive research, carried out on a once occurring, on purpose chosen sample. Target groups in this research are managers/owners of small hospitality companies. The results were obtained through interview method, on a sample of 60 managers/owners of small hospitality companies, on a model of Republic of Croatia.

Data was collected by a specially structured questionnaire. Basic group was defined using the database of Ministry of sea, tourism, traffic and development (www.mmtpv.hr/kategorizacija).

Criterion which was set while forming the sample is based on the remarks on *Trade law* and *Accounting law* which define the criteria for ***small companies*** which, in Croatia, are companies that do not exceed two of three following criteria:

- Income in 12 months before balance 16 mil. kn (2,2 mil.€)
- Sum of balance after the loss deduction shown in active 8. mil kn (1,1 mil.€)
- Average number of employees in a year 50

Elements were taken out from the database within each of the counties separately, to obtain the best possible global proportionate picture on a national level of Republic of Croatia. The number of elements in the sample obtained in the described manner was n=60. The SPSS package version 11.0 was used to analyze the data.

Reliability was assessed using Cronbach's alpha coefficient, which represents a measure of the internal consistency.

PR in tourism and sports

Many definitions try to capture the essence of public relations trying to list main activities which make up practice. Concept development and attempt to describe practice mostly lead to the definition of public relations as a function of guidance which creates and maintains useful relationships between the organization and different public to which its success or failure is depended on (Cutlip et.al., 2003).

It is important to notice that the concept of public relations is quite often mixed with component parts and activities of public relations themselves, such as: publicity, advertising, lobbing etc.

Separate field of PR, *Relations with media* gets more and more attention. Besides they create public opinion, media transfer information to potential guests. Therefore, development and maintenance of quality relations with the media becomes one of the most important segments of organization's strategic planning. Free presence in the media emerges, total expenses decrease and a good promotion for the company is created. Kotler defines publicity as non paid message about the business of the company or their products (services) delivered through one of the mass media (Skoko, 2003).

Business subjects in tourism and sports should accept media as a good opportunity to promote themselves with no cost. But first, a company should have an interesting and attractive message which would ensure the attention of both media and the target groups whom the message should reach.

Basic purpose of PR is to increase awareness of potential users of spending vacation in small family hotels with sports facilities which should shift towards different segments of guests (third age guests, sportspersons, children, businessman, young couples, and groups of friends). Programmed active vacation and other all-inclusive arrangements form a complex integrated sports product because they comprise a vast chain of actions which benefit the basic motive (Bartoluci, 2003).

Strategy of portfolio offer should be based on those products which have the largest potential for development. Their grade is defined by estimating the ability of being competitive, together with the estimation of attractiveness of a single product. The most significant products are those with high attractiveness and high competitiveness in a tourism-sports market, such as health and beauty, sports facilities, facilities for children, bike rides, trekking and other.

Results

Statistic data elaboration encompasses two basis aims:

- Recognising descriptive characteristics of Competitive advantages scale and
- Recognizing connections and relations between the implementation of PR and competitive advantages on a chosen model.

a) Competitive advantages scale characteristics

Scale of competitive advantages, with the aim of obtaining the Competitive advantages index for all business subjects in the research, has been created. Scale has been created using a combination of theoretical and empirical approach.

Certain number of theoretically designed competitive advantages has been widened for specific competitive advantages obtained through the research.

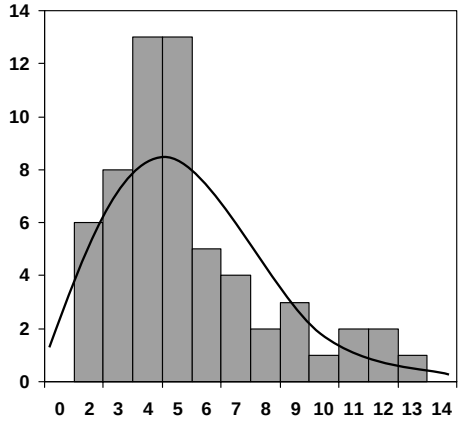

Figure 1. Results' distribution on a Competitive advantages scale

Data on certain competitive advantages has been gathered for each small hotel with sports facilities. In that way, a list of 14 competitive advantages has been formed, and therefore a 'theoretical minimum' has been created, which on a scale has 0 points and a 'theoretical maximum' with 14 points.

Table 1. Descriptive advantages of Competitive advantages scale (Scale reliability Cronbach alpha coefficient α=0.72)

Competitive advantages	N	Min	Max	X	st. dev.	symmetric	kurtosis
	60	2	14	5,38	2,72	1,13	0,75

Scale has a satisfactory reliability coefficient, inner consistency type. Results' symmetric index and picture 1 show that the results are positively asymmetric to the grouping of results in lower values and smaller number of high scores on a scale.

All stated shows that only a small number of business subjects from the sample hold a high index of competitive advantages.

b) Connection between public relations and competitive advantages

Competitive advantages index in small hotels with sport facilities encompass a chain of different competitive advantages. In order to accomplish the planned basic aim of the research, a chain of special statistical analysis has been undertaken. Taking into account the fact that implementation of PR and specific competitive advantages in small hotels with sport facilities, presented by using nominal, dichotomous scales, χ^2 analysis have been used, while for determining the connection measure, contingency coefficient has been used (Rosnow et.al, 2000).

Table 2. Analysis of connection between competitive advantages with the usage of PR

Competitive advantages	χ^2 (1)	Coefficient of contingency
Offer diversity (products and services)	5,19	0,28
Special labels usage (for special services)	4,90	0,28
Creativity	8,00	0,34
Strong strategy	6,40	0,31
Strong market promotion	6,50	0,31

It is clearly visible that using PR in small hotels with sport facilities is greatly connected to creativity. Business subjects who are using PR statistically significantly more emphasize creativity as a competitive advantage in their business.

Implementation on public relations in small hotels with sports facilities is just slightly less connected to strong strategy and strong market promotion. Therefore, hotels which are using PR statistically significantly emphasize strong strategy and strong market promotion as their own competitive advantages, compared to small hotels which are not using PR in their business.

PR is the weakest, but still statistically significantly connected to offer and services variety in tourism and sport. Business subjects who use PR in their business statistically significantly more emphasize offer variety as competitive advantage.

Discussion and conclusions

Role of management in creating and maintaining PR contributes to competitive advantages increase of small business subjects, and therefore, the competitiveness of tourism and hospitality of Republic of Croatia.

Role of management is seen through creating value added by forming and maintaining PR by which it adds to small business subjects' competitive advantages increase, and it that way, competitiveness of tourism and hospitality of Croatia.

Focus of the offer towards guests' target segment, especially sportspersons, as well as tourists which more and more show an interest for active vacation ("activity break"), understands constant creation of added facilities (bike tours, adventure programs etc.). Weaker competitiveness of small business subjects in sports segment should be transformed into high competitiveness and in a way that the sports facilities' offer completely meets guests' demands and expectations.

Results of empirical research show strong connection between PR and competitive advantages of small entrepreneurship in tourism and sports. They are especially relevant for mastering processes of choosing certain strategies and forming business policy for competitive advantages improvement in business objects which act under market conditions.

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SPORTS AND RECREATION ACTIVITIES IN PROTECTED AREAS

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Abstract

Protected areas are the most attractive natural spaces, which is why a wide range of sports and recreation activities take place in them. In their efforts to protect those spaces from devastation which can be caused by uncontrolled activities, governments are undertaking various measures, mostly legislative ones. Starting with the thesis that limited sports and recreation activities can bring necessary revenues to national parks without the area being devastated, this paper analyses the legal framework for sports and recreation activities in the national parks, the most frequent sports and recreation activities in Croatia's national parks, as well as their benefits and downsides.

Key words: *tourism, protected area, national park, nature protection, sports and recreation activities*

Introduction

Tourism takes place in a particular area. The intensity and attractiveness of a tourism resource as well as the potential to develop various activities that satisfy the needs of tourists depend on the characteristics of such areas. The areas that have rare natural or social qualities have been increasingly valued economically through the development of tourism. In the last few decades, sports and recreation have been an important part of the tourist stay. An active vacation is a synonym for a tourist holiday that comprises sports facilities, including many activities in an attractive natural environment (Andrijašević, 2007:94). Protected areas are the most attractive spaces in the nature, which is why a range of sports and recreation activities take place in them. If tourism impacts in these areas are not properly managed, negative wildlife impacts will follow (McDonald, et al., 2003:437). Thus, unique natural resource characteristics are often in the public domain in order to protect them from major transformational development (Gartner, 1996:354). Having in mind the protection of such areas from potential devastation caused by their uncontrolled (economic) use, governments take various measures. The aim of this paper is to show, using Croatia's national parks as an example, that only by implementing appropriate protection measures in attractive protected areas can various sports and recreational activities take place in them, without devastating parts of those areas by over-intensive development of those activities.

Legal framework for sports and recreational activities in protected areas

The protection of nature (total biological and landscape diversity) as part of environmental protection (man's environment, i.e. natural surroundings and the social modification (influence) of nature by man and society; (Bilen, Bučar, 2004:86) is nowadays given special attention worldwide. Since tourism makes intensive use of space, numerous national and international documents aimed at environment protection pay special attention to the protection of the environment and nature from tourism over-development. Croatia joined the world trends in nature protection relatively early, and the first regulations attempting to protect certain natural phenomena were adopted as early as the end of the 19th century (Klarić, Gatti, 2006:154). In Croatia today, the provisions regarding nature protection are contained in the Constitution of the Republic of Croatia as well as numerous regulations, the most important of which are the Environmental Protection Act (NN /the Official Gazette of the Republic of Croatia/, 110/07; hereinafter EPA;), the Nature Protection Act (NN, 70/05; hereinafter NPA) and their implementing regulations. The subject matter has also been partly regulated by the regulations on waters, forests, fish and game, cattle, viticulture, veterinary medicine, cadastral and spatial planning, construction, roads etc. In nature protection, special attention is given to protected resources of nature. The NPA is the basic act regulating their use. The protected natural resources are as follows:

- Protected areas: strict nature reserve, national park, special nature reserve, nature park, regional park, nature monument, significant landscape, park-forest and park architecture monument. Every uncontrolled visit to the protected area can cause devastation in one part of it.
- Protected species (microorganisms, fungi, plants and animals): highly protected wild species, protected wild species and protected regional domesticated species. The strongest negative impacts on protected species can be caused by uncontrolled hunting, fishing, and plant and mushroom picking.
- Protected minerals, cave structures and fossils. They may be particularly negative affected by uncontrolled mountain-climbing, alpinist and speleological activities.

Due to their wide spaces and attractiveness for the development of tourism and sports and recreational activities, national parks and parks of nature are particularly suitable for those activities. The NPA prohibits, among other things, actions and activities (including business activities) that may endanger those areas. That is why the economic use of natural resources is prohibited, and the activities that do not endanger the nature in its original state are allowed, including tourist - catering and recreational activities, as well as the pursuit of agriculture, fishing and crafts in the traditional forms (Article 11, Paragraphs 2-6 of the NPA). Various features of national parks determine various measures of protection that need to be taken within them. Therefore, a special management plan is developed for each of them, as well as internal regulations, spatial planning and other acts. These acts lay down protection measures such as: permitted activities and their respective zones, maximum number of visitors per day and per year, supervision of activities, and possible sanctions for those undertaking them in spite of prohibitions in effect. However, when adopting such measures, due to the desire to generate maximum revenues, protected areas can give approval for too many visitors and/or activities (such as, for instance, in the National Park Plitvička jezera), or for activities for which the space needs to be significantly altered (e.g. the golf courses in the Brijuni National Park). This can eventually lead to the disturbance of the balance of nature. Regardless of the length of stay in a protected area, going there is a regular tourist journey during which visitors use services of various service providers. Those service providers have to provide services according to the regulations that lay down the manner and conditions in which such activities are to take place. The organization and undertaking of sports and recreational activities is regulated by the Sports Act (NN, 71/06) and its implementing regulations. These regulations, however, are insufficient in regulating those sports and recreational activities that tourists take part in. This is especially true for adventure tourism which poses increased risks to the health and life of participants, and which is particularly connected to the protected areas (Pešutić, 2007:173). The Act on Provision of Services in Tourism (NN, 8/07) fills this loophole, since it lays downs the conditions for providing tourist services that include sports and recreational or adventure activities (services to be provided by experts; compulsory participant insurance; limitations for minors etc). The Act on Provision of Services in Tourism and its implementing regulations also stipulate the manner and conditions of providing other services commonly used by visitors of protected areas, such as organization of excursions to protected areas, mediation in acquisition of entry passes, various permits (for hunting and fishing) etc. The provision of catering services – food and drink, and accommodation services has also been regulated by the Catering Activities Act (NN, 138/06) and its implementing regulations. According to the aforementioned acts, public institutions that manage national parks and parks of nature can provide services in tourism, under the conditions prescribed for the performance of those activities (Article 3, Paragraph 2 of the Act on Provision of Services in Tourism and Article 3 of the Catering Activities Act). The rulebooks on internal order establish who, and under what circumstances, can undertake economic activities. Depending on the number and structure of their employees, public institutions provide certain services themselves, while they entrust providing other services to businesses for a compensation. The first solution is better, due to the fact that public institutions can and will undertake such activities in a way that is the least detrimental to nature. The undertaking of sports and recreational activities and the provision of tourist and catering services is permitted in all national parks under the prescribed conditions in Croatia.

Sports and recreational activities in national parks in Croatia

In the year 2007, protected areas covered 8.69% of the total territory of Croatia (www.dzzp.hr/zpodrucja_zpodrucjarh.html). The largest protected area, with almost 27% of the total protected territory in Croatia, is in Velebit, where the Nature Park Velebit, and the National Parks Sjeverni Velebit and Paklenica were founded. The figure of 2,136,096 visitors in national parks (8 of them: Plitvička jezera, Risnjak, Brijuni, Sjeverni Velebit, Paklenica, Krka, Kornati, Mljet) in Croatia in 2007 demonstrates that those protected parts of nature are extremely attractive to tourists. The most visited park in the year 2007 was the National Park Plitvička jezera (43% of the total number of visitors in the national parks of Croatia), and the smallest number of visits was recorded in the national parks Risnjak and Sjeverni Velebit (www.dzs.hr). That year, the foreign visitors comprised 83% of the total number of visitors in the national parks of Croatia. Tourists are drawn to the national parks in such large numbers by their remarkable natural beauty, as well as the fact that national parks, to attract as many tourists as possible, organize various sports and recreation activities within their protected area. Considering the fact that five of the national parks in Croatia are in the coastal tourist region of Primorje, two on the crossing from that region to the Mountain tourist region, and one in the Mountain tourist region, parks, depending on their features, organize various sports and recreational activities. The most common one is hiking, for which special trails have been organized and marked which provide tourists with sightseeing opportunities within the park as well as physical activity. Such trails are organized in all national parks except in the National Park Kornati, which also has the option of hiking, but the trails are not organized due to the fact that the park is situated entirely on the islands, which are, moreover, largely privately owned. Among other sports and recreational activities available in the national parks in Croatia are:

Mountaineering – Paklenica, Risnjak, Sjeverni Velebit, Mljet, Plitvička jezera

Swimming – Brijuni, Kornati, Krka, Mljet

Spelunking – Paklenica, Risnjak

Diving – Kornati, Mljet

Nautical tourism – Kornati, Mljet

Biking – Risnjak, Sjeverni Velebit, Plitvička jezera, Paklenica

Bird Watching – Paklenica

Fishing – Risnjak, Kornati, Krka

Golf – Brijuni

Tennis – Brijuni

Apart from these activities, national parks organize others, such as archery and team building programmes in Brijuni, and rowing in Plitvička jezera.

Positive and negative aspects of sport-recreational activities in the national parks

By organizing various sports and recreational activities, national parks are trying to attract larger numbers of tourists, prolong their stay and achieve visits all year long, thereby also increasing revenues and distributing their visits equally all year long. The national parks try to provide sports and recreational activities in such a way that they affect the environment in the least possible way. To achieve that, trails are clearly marked, and signs explain which activities are permitted. One example of a well organized activity is climbing in the national park Paklenica. The first alpinist routes were set up in the park in 1983, and today, the park area holds 400 marked trails. Any climbing outside the marked trails is prohibited, and the directions have been prepared which each climber receives when buying a ticket to enter the National park. The sale of tickets, apart from its purpose to provide income for the park, also helps to keep track of the number of climbers in the park area. This way, it is ensured that there are never too many climbers in the park at once to cause imbalance to the natural order of things. Moreover, it makes it easier to care for the safety of climbers, which is a good example of sustainable development within this park. Problems arise when activities are very difficult to control due to the natural features of the park space. Such a problem is present within the Kornati National Park, which spreads over 220 square kilometres, including a total of 89 islands, islets and reefs. The land mass of the park comprises less then a quarter of the total area, while the remaining part is a sea eco-system within which nautical tourism is allowed. This national park recorded 94,605 visits in 2007 (www.dzs.hr), and the only way to visit this park is by sea. One part of the tourists came by way of organized one-day tourist boat visits, while the rest were individual yachters. It is exactly the individual visits that pose the biggest problem, due to the fact that anchorage and overnight stay is allowed in over 16 inlets. Due to the size of the park, it is very hard to monitor the arrival of the ships and the activities of those sailing them. Sailors very frequently, due to their ignorance, cause damage to nature by disposing of their waste in an improper manner or by making anchor in an amateur fashion, which destroys the undersea wildlife. Divers on the other hand, knowing the difficulties arising from the monitoring of this area, wilfully engage in illegal activities and devastate the extremely attractive sea floor. To reduce that sort of behaviour to the minimum, it is necessary to establish further restrictions to the activities in the park and employ much larger numbers of supervisors.

Conclusion

The protection of nature, as part of environmental protection, is nowadays given special attention worldwide. Numerous regulations and other legal acts have been passed to that effect in Croatia, which comprise the legal framework for sports and recreational activities in the protected areas. When establishing protection measures, one must take into account not only the capacity of the area, but also the ability to efficiently monitor the enforcement of these regulations with the aim of preventing prohibited visitor behaviour. That is the only way to pursue activities along the principles of sustainable development. Sports and recreational activities are permitted in all the national parks and parks of nature in Croatia. The most frequent sports and recreational activities that take place in the parks are: hiking, climbing, swimming, spelunking, diving, nautical tourism, biking, bird watching, recreational fishing, golf and tennis. In spite of the fact that the organization of sports and recreational activities has been regulated by numerous legal rules and regulations, certain protected areas suffer an overly intensive development of activities, which is detrimental to nature in them.

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KVARNER TOURISM OFFER AND MANAGEMENT OF SPORT

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Abstract

Sport is an important element of tourism offer of the Kvarner region (Croatia). Satisfaction of tourist with the present sport facilities and events has been examined and the main findings of the survey are presented in the paper. The evaluation of sport facilities and events are compared with the guests' satisfaction with other elements of tourism offer. Expectations of tourists have also been described and evaluated.

Key words: *sport facilities, sport events, tourism development*

Introduction

Kvarner region is one of the best-developed tourist destinations in Croatia. Although this region is quite developed, it is currently at the turning point of its development. Becoming competitive would mean introducing numerous new activities and investments. Beautiful landscapes, rich cultural heritage, pleasant climate and the hospitality of local residents are not sufficient for a successful tourism development in future. Findings of a complex survey on tourists attitudes, local residents and tourism management regarding the tourist offer of the Kvarner region is presented in the paper (2005/07). Special stress has been put on the tourists' attitude towards sport as a part of tourism offer.

Evaluation of the Kvarner tourist offer: attitudes of tourists

The accommodation capacities and facilities of the Kvarner region are inadequate. The hotels make up a relatively small proportion of accommodation capacities since a large number of capacities are camps (where the tourist traffic is very seasonal) and private accommodation (rooms or apartments in private houses). Although Kvarner offers a variety of different activities, tourist flow is of a seasonal rate and that is one of the region's biggest problems. All activities and marketing actions are focused on one of the most important economic goals achievement: minimizing the seasonality of the tourist traffic and activating all resources available since Kvarner can offer much more than "sun & sea". Approximately 80% of the tourists who are visiting Kvarner come from foreign countries, mostly from Germany, Italy, Austria, Slovenia and Hungary. Share of domestic tourists is on a rather low level; therefore, domestic market is marked as an important market which needs to be developed in future.

The basis of the analysis of the Kvarner tourist's offer is the result of the study "An Assessment of the Tourist Offer of the Kvarner Region". The survey was done in 2003 and again in years 2005 and 2006. This paper presents the results from 2005 and 2006. Based on the model of the Kvarner region as a tourist destination, these findings serve to determine the criteria for shaping the tourist product of this region.

The aim of the study "An Assessment of the Tourist Offer of the Kvarner Region" was to determine the extent to which the current tourism offers of the Kvarner and other more local destinations have adapted to the demands of the world market which is firmly focused on the consumers' preferences. (Blažević, et al., 2004; Blažević, et al., 2007) Shifting due to rapid changes in technology, culture and economy, these preferences impact the socio-cultural, natural, economic and environmental transformation of the tourist destination itself. Hence, research was focused on the interaction of these factors at the level of the Kvarner tourist destination.

A stratified random sample was used in the study. Data on tourist traffic (number of tourist arrivals) in the County of Primorsko-goranska based on monthly reports of the Central Bureau of Statistics of Croatia were used as a framework in selecting the sample. Stratification was carried out according to destinations, types of accommodation facilities, and country odd tourists' origin. The sample comprised four types of accommodation facilities (hotels, tourist complexes, motor-camps, and accommodation in private homes), which accounted almost 95 per cent of the tourist traffic of the County of Primorsko-goranska. Sample consists of 1925 survey respondents, of which 1828 questionnaires were filled out properly, representing a 95 per cent response rate. A scale from 1 to 7 has been used (1 – very dissatisfied, 7 – very satisfied). (Blažević, et al., 2007)

The principle travel motivation of tourists to the destination involves leisure and relaxation (67,7 per cent). On the rank list of travel motivations, this is followed by a group of almost equally attractive motivations: fun, entertainment

and new experiences (14,4 per cent); and scenic spots and beautiful landscapes (10,6 per cent). The study shows that sport is the motivation of a very small number of tourists who visit Kvarner. It should be pointed out that the respondents had to choose just one, primary motivation. Considering the situation in reality it could be expected that if they had had an opportunity to choose two or more motivations from the questionnaire, sport as a motivation would have had a greater share. When compared to TOMAS 2007, a survey made by the Institute of Tourism, city of Zagreb showed that sports and recreation as a motivation of travel to Kvarner destination is 8, 1%, but the respondents had an opportunity to choose more than just one response (Tomas ljeto, 2007).

Table 1. Motivations of tourists

Motive	%
Leisure and relaxation	67,7
Fun, entertainment and new experiences	14,4
Scenic spots and beautiful landscapes	10,6
Culture	0,4
Sport	0,3
Health	0,9
Business, conferences	1,7
Hobby	1,4
Visiting relatives or friends	1,9
Gastronomy	0,7
TOTAL	*100,0*

Source: Blažević, B. et al. (2007) Ocjena turističke ponude Kvarnera, Tourism and Hospitality Management, 13 (1), Fakultet za turistički i hotelski menadžment Opatija, WIFI Osterreich, Wien, T.E.I. Greece

A large portion of tourists (51,9%) were first-time visitors to Kvarner region and 48,1% have already visited the region.

The majority of tourists (61,5%) intend to visit the destination again, and this testifies the loyalty of a particular segment of tourists. 32,1% of tourists are indecisive regarding a repeated visit, whereas 6,4% do not intend to visit the destination again.

To obtain a clearer picture of tourists traveling to the destination, an analysis on means of transportation used for reaching the destination was made. Cars seam to be the prevailing mean of transportation used for reaching Kvarner region. The majority of tourists (76,4%) arrive to the destination in private cars. Tourists also favor bus transportation (15,6%) for traveling to the destination and the smallest number of tourists uses trains, ships, boats, airplanes, motorcycles or bicycles.

The vast majority of tourists (79,4%) prefer making traveling and accommodation arrangements independently, i.e. on their own. Only about 20,6% prefer to leave all the arrangements to travel agencies.

As expected, tourists who make their own traveling arrangements tend to arrive to the destination by private cars, while those using the services of tourist agencies usually reach the destination by bus.

In the second part of the questionnaire tourists, residents and tourist managers were asked to rate the various elements of the tourist offer. An attempt was made to determine whether these groups perceive individual elements in the same way or not. The opinions of each group of stakeholders were also rated with regard to issues of special interest to the group in question. For this purpose, the elements of the tourist offer were divided into categories: (a) area, resources, environment, (b) resident employees, (c) identifiability, security, information, (d) destination management, (e) contents. For the purpose of this paper the attitudes of the tourists (research 2005/06) will be pointed out.

Respondents were asked to rate their degree of satisfaction with 37 elements of the tourism offer of the Kvarner region and its destinations involved in the survey, on a scale from 1 to 7 (1 – very dissatisfied, 7 – very satisfied)

Table 2. Tourist satisfaction with the elements of the Kvarner tourism offer: top +/- 10

10 elements of the tourism offer resulting in the highest tourist satisfaction			*10 elements of the tourism offer resulting in the lowest tourist satisfaction*		
1.	Beautiful landscapes	5,70	**1.**	Congresses and meetings	3,53
2.	Quality of the sea	5,61	**2.**	Available parking space	4,07
3.	Hospitable catering staff	5,39	**3.**	Health tourism facilities	4,17
4.	Parks and green areas	5,38	**4.**	Organization of local traffic Sports facilities and events	4,40
5.	Promenades Friendly and hospitable residents	5,37	**5.**	Facilities and events for children	4,50
6.	Preserved environment Local gastronomy	5,28	**6.**	Facilities for nautical tourism	4,54
7.	Working hours of the catering services	5,25	**7.**	Events	4,59
8.	Cleanliness and maintenance of the destination Cleanliness and maintenance of the beaches	5,23	**8.**	Entertainment opportunities	4,62
9.	Healthy climate Foreign language skills of the catering staff	5,22	**9.**	Cultural tourism offer	4,69
10.	Accommodation facilities	5,20	**10.**	Beaches - overcrowding	4,74

Source: Blažević, B. et al. (2007) Ocjena turističke ponude Kvarnera, Tourism and Hospitality Management, 13 (1), Fakultet za turistički i hotelski menadžment Opatija, WIFI Osterreich, Wien, T.E.I. Greece

Table 2 illustrates the elements that contribute the most and the least to tourist satisfaction. Tourists are the most satisfied with the beautiful landscapes and the quality of the sea. It should be noted that tourists are especially satisfied with the staff. In addition, it should be pointed out that all of the ten elements received rating mark higher than five, indicating the extent of tourist satisfaction with these aspects of the tourism offer.

Tourists have expressed their dissatisfaction with elements regarding destination accessibility, parking space, sports, entertainment and health tourism offer.

If we compare the ratings obtained by the tourist survey with the ratings provided by the local residents, we can see that the latter are more critical in evaluating the Kvarner tourism offer. This can be explained by the greater awareness of residents and renters when describing the weaknesses of the destination and current tourism development issues.

The grade for congresses and meetings is the lowest one, but it has to be pointed out that there is a big difference between various local municipalities/cities regarding this type of offer.

This complex survey analyzed not just the satisfaction of tourist, but also the expectations of the tourists. Comparing the satisfaction and expectations makes it obvious that in each of the 37 evaluated elements of tourist offer, the expectations were (a little bit) higher than the satisfaction itself.

Evaluation of sport as part of Kvarner tourism offer – attitudes of tourists

Generally, it has to be pointed out that Kvarner sport offer has been graded with a relatively bad mark, it has even been selected as one of ten weakest parts of the tourist offer of the region (among 37 evaluated elements). Tourist evaluated sport facilities and events 4,40 (scale 1-7). The average evaluation score of Kvarner tourism offer, taking into account all the 37 elements of tourist offer, was 4,93. Tourist have also been asked to rate their expectations before coming to their destination Kvarner, and the estimation of their expectations regarding sport facilities and events was 4,79, which would mean that it is higher than their attitudes.

Table 3. Kvarner - expectations and attitudes of tourists toward sport facilities and events

Tourism offer EXPECTATIONS	N	Arithmetical mean	Standard deviation	Rank (1-37)
Sports facilities and events	1775	4,79	1,31	32
Tourism offer ATTITUDES				
Sports facilities and events	1713	4,40	1,29	34

Source: Blažević, B. et al. (2007) Ocjena turističke ponude Kvarnera, Tourism and Hospitality Management, 13 (1), Fakultet za turistički i hotelski menadžment Opatija, WIFI Osterreich, Wien, T.E.I. Greece

Comparing the results from a similar survey made in year 2003, a very small positive improvement has been made regarding sport facilities and events.

The following towns/municipalities showed significantly higher evaluations of sport facilities and events: Rab - 5,20, Selce - 5,06, Cres - 4,89, Lopar 4,85, Krk - 4,77 and Baška - 4,53.

Kvarner tourism offer of sport should be improved because the economic effects of sport on tourism can be evaluated as a direct economic effects (realized in tourism or sport businesses on the basis of selling the sports physical recreation services) and indirect economic effects which is manifested through the motivation for selecting a particular tourism destination, prolonging the tourist season, overcoming the seasonal character of tourism, increasing extra spending, improvement of the diversity and quality of the tourism offer and other (Bartoluci, Čavlek, 2007).

Conclusion

The quality of sport facilities and events in Kvarner region is not on a satisfactory level. Therefore, new investments in improving the quality of the existing facilities and building the new facilities for sport and recreation is a must, in order to be competitive on the tourist market. In order to implement those investments, different forms of partnerships are necessary (public-private partnership, private-private partnership and pubic-public partnership).

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TOURISM AND RECREATION

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Abstract

Both tourism and recreation have their own particularities, as any other social phenomena. They have their own subjects, but comprise several common features as well. These common features form the base of my lecture. Tourism, as a recreational possibility, can serve our healthy lifestyle. Health is a very important value. This statement is well known for everybody, yet people in Hungary do so little, to recreate, to keep with it healthy. In connection with health protection and free time activities, a special attention is paid to recreation, sport and tourism. When comparing these three social activities, we can find several common elements, which can also realise in sport tourism, as a possible means of recreation. In my study I concentrate on sport activities pursued during tourism, which I compare with the results of my own surveys carried out on sport tourism in two special Hungarian touristic area.

Key words: *free-time, recreation, sport, sport tourism, offer, demand*

Military Kinesiology

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DIFFERENCES BETWEEN ARMY RECRUITS AND PROFESSIONAL SOLDIERS IN STRENGTH ENDURANCE

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Abstract

The goal of this research was to determine differences between Croatian army recruits and professional soldiers in strength endurance tests. Male recruits of various military services (N=323, body mass=76.16 kg, body height=179.67 cm) and professional soldiers also of various military services (N=172, body mass=83.54 kg, body height=178.82 cm) participated in this study. The examinees were tested with two minutes push-up, two minutes sit-up test, and one minute squat test. The task was to execute as many repetitions in given time period. The results show statistical difference in strength endurance of upper body (assessed by two minutes push–up test and two minutes sit-up test) between army recruits and professional soldiers. Obtained results confirmed, as expected, that professional soldiers are physically better prepared than recruits but, when compared with Croatian military standards (Jukić, 2007) also suggest that improvement in physical conditioning of professional troops must be made in the future. The original test results show that obtained differences between groups tested are not as big as expected and necessary.

Key words: *physical conditioning, push-ups, sit-ups, professional troops, military standards*

Introduction

Members of Army Forces, whether they are recruits or professional soldiers, must be physically well prepared. Physically better prepared soldier will be more competent to carry out the assignments that are appointed to him. One of the most important motor ability of a soldier is strength endurance, defined as an ability of a person to suppress outer load in a long period of time. Body weight, army gear and weapons are the loads which every soldier has to be capable of carrying while performing special military duties and operations. In order to well perform the particular movements of running, crawling, throwing and jumping with heavy military gear and weapons a soldier has to be extremely well prepared in terms of strength endurance. Only a high level of strength endurance will allow him to conduct intensive repetitive movements and remain focused on the mission.

The aim of this research was to determine and compare the status of strength endurance of Croatian army recruits and professional soldiers. The presumption is that professional soldiers have higher level of strength endurance, due to the longer period of military service, more strenuous physical activities and finally the necessity for strength endurance in order to execute high demanding military missions throughout the entire career.

The assessment of anthropological status of soldiers has been carried out in many researches. Kožulj (1993) in his paper introduces data that show better strength indicators within special soldiers comparing to army recruits. Author also deals with the problem of optimal physical conditioning programme necessary to maintain the high level of preparedness.

In another research, Lunt (2007) investigates the influence of physical preparedness of navy soldiers on predisposition to injuries and proves a great relation between low physical fitness and tendency to injuries in military population.

Methods

Male recruits (N=323, body mass=76.16 kg, body height=179.67 cm) and professional soldiers (N=172, body mass= 83.54 kg, body height=178.82 cm) were tested with three strength endurance tests. Upper body strength endurance was tested with two minutes push-up test, strength endurance of torso was tested with two minutes sit-up test, while lower body strength endurance was tested with one minute squat test (Jukić, 2007). Each test was executed only once, and the goal was to perform as much repetitions in given time.

Statistica 5.0 was used for data processing. To determine the central and disperse parameters for each variable a descriptive statistic was used. Differences between army recruits and professional soldiers were assessed with t-test for independent samples.

Results

The basic descriptive parameters (arithmetic mean and standard deviation) of army recruits are shown in table 1.

Table 1. Arithmetic mean and standard deviation of recruits

Recruits	AM	SD
MRSSKL2	28,54	14,32
MRPT2	53,87	15,43
MRSCUC1	45,91	11,59

MRSSKL2-push-ups in two minutes, MRPT2-sit-ups in two minutes, MRSCUC1-squats in one minute

The basic descriptive parameters (arithmetic mean and standard deviation) of professional soldiers are shown in table 2.

Table 2. Arithmetic mean and standard deviation of professional soldiers

Specialist	AM	SD
MRSSKL 2’	42,03	17,60
MRPT 2’	57,19	19,73
MRSCUC 1’	45,42	10,58

MRSSKL2-push-ups in two minutes, MRPT2-sit-ups in two minutes, MRSCUC1-squats in one minute

T-test for independent samples was conducted in order to determine the difference significance in mentioned tests between army recruits and professional soldiers (table 3).

Table 3. Results of t – test for independent samples

Test	t - value	df	p
MRSSKL2	**- 9, 23638**	**496**	**,000000**
MRPT2	**- 2,08185**	**499**	**,037865**
MRSCUC1	0, 469273	494	,639082

Professional soldiers obtained significantly better results in two minutes push-up test and two minutes sit-up test, while significant difference between examinees in one minute squat test was not found.

Discussion and conclusions

The goal of this research was to determine the strength endurance status of army recruits and professional soldiers in Croatia and to compare their tests results. The tests results prove that the level of strength endurance in both groups tested is somewhat low.

Compared to Croatian military standards (Jukić, 2007) the result in two minutes push-up test is evaluated as poor (level 3 out of 10) for army recruits and average (level 5 out of 10) for professional soldiers. Although the difference between examinees in this test appeared to be the most significant one, the level of strength endurance of upper limb in both groups tested is under expected. Due to its importance in performing military duties, the strength endurance of upper limbs must be improved in the population of both groups tested.

Although found statistically significant, the difference between examinees in two minutes sit-up test was not so expressed. The results of both groups were evaluated as average (level 5 out of 10) (Jukić, 2007). It was expected that the difference of tests results would be somewhat greater. Obviously, the physical conditioning programme of professional soldiers did not further improve their strength endurance status comparing to army recruits. In another words, professional soldiers do not differ in strength endurance of torso from the population whose military service lasts for six months. Those findings are alarming, when considering the severity of military tasks appointed to professional soldiers.

Significant difference in one minute squat test was not found and the results of both groups were evaluated as good (level 6 out of 10). Better strength endurance in lower limbs is probably due to greater engagement of legs in overall

military physical activities. However, although the results in this test were registered as the best among performed ones, according to standards, the necessity for future improvement is large.

Summarizing the results of all three tests it can be concluded that the strength endurance state of both groups, army recruits and professional soldiers, are below expected and necessary. Those results are especially defeating for professional soldiers who, in such physical condition, cannot react properly on heavy and dangerous demands encountered in military missions. Furthermore, although the difference in push-up and sit-up tests was found statistically significant, an insight in the original values when compared with the military standards, suggests that these difference should be much bigger.

Based on the results assessed in this research, an improvement of physical conditioning programme is recommended in the future. It is necessary to find out and define exact physical preparation improvement programmes which would help in enhancing the actual status of anthropological characteristics. Those programmes must be constructed as to guaranty the highest level of physical preparation in all times and to make distinction between army recruits and professional soldiers in the terms of basic physical preparedness. Only physically prepared soldier is capable of fulfilling his missions in combat and therefore, to make the most of its human resources and potentials, Armed Forces should invest in finding the best ways to create physically superior army.

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DIFFERENCES BETWEEN ARMY RECRUITS AND PROFESSIONAL SOLDIERS IN FUNCTIONAL AND MORPHOLOGICAL CHARACTERISTICS

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Abstract

This research was conducted on a sample of 506 examinees, out of which 325 were Croatian army recruits and 181 were Croatian professional soldiers. Croatian army recruits group was consisted of infantry soldiers, navy soldiers and military police while the Croatian professional soldiers group was consisted of infantry soldiers and soldiers with special duties. The examinees were tested with 11 tests with a purpose of determining their morphological status and functional abilities. The main goal of this research was to determine the morphological and functional status of army recruits and professional soldiers and to compare their tests results in order to investigate the difference between those two groups of examinees. Statistical significance of difference in arithmetic means between the two groups of examinees was tested with t-test for independent samples. Professional soldiers obtained significantly better results in running on 3200 meters, body weight, upper arm circumference, forearm circumference and lower leg circumference. They also had significantly smaller lower leg skinfold. The army recruits are taller and they had smaller suprailiocristal skinfold but those differences were not found statistically significant. The results of the tests executed show that members of Croatian special military units are heavier than recruits and have less body fat. They also have better aerobic capacity. The differences can be attributed to the longer period of military service and more vigorous military duties.

Key words: *army, recruits, professional soldiers, morphological and functional characteristics*

Introduction

A professional solider is an employee of the Croatian Ministry of defence, selected in the professional military units based on his health status, physical abilities, psychological characteristics and military skills. A professional solider must engage in many physically demanding activities thus he has to be on the highest level of physical readiness in all times. Soldiers' morphological and functional status for that reason is very important.

An army recruit in Croatia is a person engaged in military service for a period of 6 months during which he or she attends basic military training and gain basic military skills. Military service was obligatory in Croatia in time when this experiment was carried out. Due to very short period of military service, an anthropological status of army recruits is sometimes on a very low level.

The aim of this research was to determine and compare the status of some morphological and functional characteristics of army recruits and professional soldiers in Croatia. The assessment of anthropological status of soldiers has been carried out in many researches, among which the following should be pointed out:

O'Connor and others (1990) conducted the research in which they assessed the physical readiness of 5 346 men and 676 women soldiers. They concluded that a lot of soldiers, especially young ones, do not content the assigned level of readiness.

Knapik and others (2001) conducted the research on a sample of 438 English and Wellsh army recruits in which they assessed the maximal oxygen uptake and body volume with four skinfold measurements. They determined that there is no difference in the results of those tests between recruits from England, Norway and USA.

Thomas and others (2004) assessed the level of physical readiness of 43 army cadets (30 male and 13 female cadets). All results were better or similar to the standard results.

Methods

This research was conducted on a sample of 506 examinees, out of which 325 were Croatian army recruits and 181 were Croatian professional soldiers (members of special military units). The assessment of morphological characteristics was conducted on a sample of 506 examinees while the 3200 meters running test executed 259 recruits and 156 professional soldiers.

Functional characteristics: F3200 – 3200 meters running, test for aerobic capacity assessment

Anthropometric (morphological) characteristics: ALTV – body height, ATT – body weight, ATSZ – pelvis span, AVON – upper arm circumference, AVOP – forearm circumference, AVOPK – lower leg circumference, ANL – back skinfold, ANSIK – suprailiocristal skinfold, ANNK – upper leg skinfold, ANPK – lower leg skinfold

To determine the central and disperse parameters for each variable a descriptive statistics was used. Differences between army recruits and professional soldiers were assessed with t-test for independent samples.

Results

Professional soldiers obtained better results in the F3200 – 3200 meters running test, used for aerobic capacity assessment, and in the following variables used for assessment of morphological characteristics: ATŠZ – pelvis span, ATT – body weight, AVON – upper arm circumference, AVOP – forearm circumference, AVOPK – lower leg circumference, ANL – back skinfold, ANNK – upper leg skinfold and ANPK – lower leg skinfold. The statistic significance was found in the 3200 meters running test, body weight, upper arm circumference, forearm circumference, lower leg circumference and lower leg skinfold. The army recruits obtained better results in ALTV – body height and ANSIK – suprailiocristal skinfold but no statistic significance was found in those differences.

Table 1. Results of difference testing between Croatian army recruits and Croatian professional soldiers

Test	ARMY RECRUITS		PROFESSIONAL SOLDIERS		t-test	p-value
	Mean	SD	Mean	SD		
F3200	1041.927	170.314	966.006	120.6719	4.877785	0.000002
ALTV	179.7800	6.616594	178.8238	6.260195	1.588273	0.112852
ATŠZ	29.00369	1.628276	29.16630	1.735038	1.05162	0.293480
ATT	76.14865	10.26018	83.54309	9.36069	8.01426	0.000000
AVON	30.44385	2.689886	33.66851	2.272261	13.6423	0.000000
AVOP	27.63354	1.793063	28.93867	1.616012	8.12524	0.000000
AVOPK	38.10985	2.592444	39.20497	2.855468	4.39061	0.000014
ANL	14.23889	5.481489	13.72320	4.794790	1.059289	0.289977
ANSIK	11.85538	6.135120	12.01326	4.978034	0.296109	0.767269
ANNK	16.52523	6.608443	16.51602	5.978640	0.0155	0.987610
ANPK	10.03815	4.344184	8.45801	3.526787	4.1849	0.000034

Legend: Mean-arithmetic mean; SD-standard deviation; t-test-results of the t-test for independent samples

Discussion and conclusions

3200 meters running test (2 miles) is a standard military test which is being used in Croatian Army Forces for aerobic capacity assessment (Jukić, 2007). Professional soldiers obtained significantly better result in this test comparing to army recruits and those differences can be explained by longer period of military service during which they were constantly put through physically demanding and more arduous trainings then recruits. Form the obtained results it can be seen that functional abilities of professional soldiers are on the good level (level 6 out of 10) whilst the functional capacities of army recruits are evaluated as average (level 5 out of 10), (Jukić, 2007). Professional soldiers' functional capacity is very important anthropologic characteristic which has to be on a high level in order for a solider to be capable of fulfilling his professional duties. Demands on the physical readiness of professional soldiers force one to stay in good shape throughout his entire military career. On the other hand, military recruits units are comprised of civilians, sometimes mostly physically non-active men who during their military service might experience physical training for the first time in life. Although the state of functional abilities among professional soldiers was marked as good, a certain improvement must be made in the future and the difference between them and army recruits has to be even more emphasised.

The results of skinfold measurement are somewhat similar for both groups. Significant difference was found only in lower leg skinfold in which the professional soldiers had smaller values. Based on the results presented we can conclude that professional soldiers and army recruits have approximately the same amount of body fat.

From the results of anthropometric measurements can also be seen that army recruits and professional soldiers have the same body height but significantly different body weight. Regarding the fact that body fat is similar for both groups, it can be concluded that the difference in body weight is due to the lean body mass which is larger in professional soldiers. Everyday physical activity and constant strength training in special military units is probably the reason why the professional soldiers have higher body weight.

Greater circumference values were obtained on professional soldiers. Regarding to smaller body skinfolds it can be concluded that greater body circumferences were obtained as a result of larger muscular tissue. When taking into account the amount of extremely arduous and strength demanding activities conducted daily in professional military service, it is expected of a professional soldier to gain great lean body mass as a result of constant physical strain.

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THE QUALITY OF ADOPTING NEW MOTOR ABILITIES AND THE INFLUENCE OF MARTIAL ARTS LEARNING ON THE POLICE OFFICERS' STRENGTH ENDURANCE DEVELOPMENT

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Abstract

A four-week long kinesiologic treatment has been conducted on the sample of 44 police officers of the Bjelovar-Bilogora Police Department. The aim of the research was to explore the dynamics of readopting motor abilities of martial arts which have a greater situational applicability in urgent situations connected with the police activities, and the dynamics of the development of strength endurance of police officers under the influence of the programmed kinesiologic treatment. Two kinds of measuring instruments were used for collecting the research data, in order to assess the effects of the experimental kinesiologic treatment. The first group of measuring instruments was used to measure strength endurance, while the other was used to estimate martial arts skills. The analysis of the collected data has been made using the selection of appropriate statistical methods which enabled to estimate the arithmetic mean difference between the first, second, third and fourth measurements for small paired samples. The effects of kinesiologic treatment, watching the dynamics of readopting motor abilities of martial arts, could be already seen after the first week, and statistically important differences (p=0,05) could be seen in the following two measuring points as well, compared to all the previous ones. The dynamics of development of strength endurance of the examinees manifested its importance after two weeks of training. The obtained results have confirmed the positive value of the analysed model of kinesiologic activities.

Key words: *readopting motor abilities, martial arts, strength endurance, police officers, programmed treatment, t-test, differences*

Introduction

There are certain specific activities connected with the law enforcement jobs. The primary mission is the protection of life, then the protection of personal security and property, locating and apprehending criminals, bringing them to the competent authorities, maintaining public order, and other specific police duties stipulated by the Internal Affairs Law. Implementation and effectiveness of these activities is based on the stability of the psychosomatic status of police officers, with the pronounced need for the high level of motor and functional abilities, and the high applicability of various motor skills, specifically those connected with martial arts. The level of adopting martial arts skills is in the function of solving possible urgent situations for police officers. That is why it is necessary to pay special attention to the preparation and implementation of existing kinesiologic programmes for police officers, but also to examine and verify new kinesiologic methods which might prove more efficient and applicable in everyday activities. Rubeša (Rubeša et al., 1999) has conducted a five-week long kinesiologic treatment (120 minutes, 3 times a week) using the sample of 38 police officers. The results have shown statistically important changes in the strength tests (strength endurance, explosive and static strength), mobility, agility and coordination of movements. The results have also indicated a positive influence of the manner of conducting the treatment on readopting martial arts skills and abilities of the programme participants. The basis of the research was the assumption that the frequency of two 120-minute trainings a week could be coordinated with the daily activities of police officers and that the complete treatment would probably have a positive influence on the change of physical abilities (strength endurance) and enlarge martial arts skills.

The aim of the paper was to assess the influence of the kinesiologic treatment on:

- strength endurance change;
- higher situational applicability of those martial arts skills and abilities characteristic for urgent situations in the law enforcement activities

Methods

The sample of subjects for this study is defined as a sample of police employees of the uniformed and the detective branch of the Bjelovar-Bilogora Police Department. The experimental treatment was conducted from February 26 to April 20, 2008, and the following kinesiologic contents were analyzed in the research:

- adopting and resumption of martial arts skills and abilities synthesized into the complete solving of urgent situations connected with the police activities.

There were two parallel groups preceding the treatment; one of them conducted the programme on Monday and Wednesday, and the other on Tuesday and Thursday. In order to collect the research data, and to estimate the effects of the experimental kinesiologic treatment, there were four measuring instruments used for assessing the strength endurance: overgrasp pull-ups on the horizontal bar (ZGINAD), sit-ups laying on the back in one minute (MFETRB), push-ups in one minute (MFESKL) and squats in one minute (MFECUC). In order to evaluate martial arts skills and abilities, a five-element scale was defined: 1. front elbow key lock including lowering to the floor, binding, lifting and leading away; 2. back elbow key lock including lowering to the floor, binding, lifting and leading away; 3.bending the arm backward with binding in the standing posture; 4. overcoming the passive resistance lying on the stomach and 5. overcoming the passive resistance lying on the back. The final result was calculated using the simple summation method. The analysis of obtained results has been made using the selection of appropriate statistical methods which enabled to estimate the difference in arithmetic means difference between the first, second, third and fourth measurements for small paired samples.

Results

Analyzing the obtained results after the conducted motoric tests, the foremost conclusion is that the applied kinesiologic treatment has exerted a positive influence in all motoric variables on the change of values. This can be seen in the results of statistically important changes in all the strength endurance tests which were perceived after two weeks of training, i.e. after four kinesiologic treatments only. Of course, at the end of the treatment, after four weeks of kinesiologic treatment (eight trainings), a statistically significant difference between the arithmetic means in all the variables assessing the strength endurance, compared with the initial state of the subjects, could be seen.

Table 1. Results of motoric tests

	TEST	Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.
	ZGINAD_1 - 2	-,182	44	,922	,139	-1,308	43	,198
*	**ZGINAD_1 - 3**	**-,295**	**44**	**,823**	**,124**	**-2,380**	**43**	**,022**
*	**ZGINAD_1 - 4**	**-,545**	**44**	**,901**	**,136**	**-4,016**	**43**	**,000**
	MFETRB_1 - 2	,761	44	7,085	1,068	,713	43	,480
*	**MFETRB_1 - 3**	**-1,739**	**44**	**5,715**	**,862**	**-2,018**	**43**	**,050**
*	**MFETRB_1 - 4**	**-3,648**	**44**	**5,898**	**,889**	**-4,102**	**43**	**,000**
	MFESKL_1 - 2	-1,068	44	4,123	,621	-1,719	43	,093
*	**MFESKL_1 - 3**	-2,909	44	4,247	,640	-4,543	43	,000
*	**MFESKL_1 - 4**	**-4,727**	**44**	**4,592**	**,692**	**-6,829**	**43**	**,000**
	MFECUC_1 – 2	-,955	44	5,247	,791	-1,207	43	,234
*	**MFECUC_1 - 3**	**-2,977**	**44**	**6,297**	**,949**	**-3,136**	**43**	**,003**
*	**MFECUC_1 - 4**	**-5,864**	**44**	**5,492**	**,828**	**-7,082**	**43**	**,000**

* - statistically significant difference (margin of error p= 0,05).

Calculations: 1 – 2 - difference between the results of the first and the second measurement; 1 - 3 - difference between the results of the first and the third measurement; 1 – 4 - difference between the results of the first and the fourth measurement. The obtained results principally lead to the final conclusion about the positive influence of the manner of treatment implementation on readopting martial arts skills and abilities of the participants. Looking at the final results of the assessments obtained in the initial, and afterwards every seven days, in two transitive states and at last in the final measurement, it is possible to perceive a difference in adopting the conducted programme as a consequence of the martial arts training programme, which can also be seen in assessments in all the measuring points at different time intervals.

Table 2. Assessments and significant difference tests between the overall assessments of the initial (1), transitive (2 and 3) and final states (4)

	TEST	Mean	N	Std. Deviation	Std. Error Mean	t	df	Sig.
1	UKUPNAOC_1	2,5364	44	,76069	,11468			
2	UKUPNAOC_2	3,0182	44	,65673	,09901			
*	**UKUPNAOC_1-2**	**-,48182**	**44**	**,47899**	**,07221**	**-6,672**	**43**	**,000**
2	UKUPNAOC_2	3,0182	44	,65673	,09901			
3	UKUPNAOC_3	3,6682	44	,59914	,09032			
*	**UKUPNAOC_2-3**	**-,65000**	**44**	**,46780**	**,07052**	**-9,217**	**43**	**,000**
3	UKUPNAOC_3	3,6682	44	,59914	,09032			
4	UKUPNAOC_4	4,2591	44	,39256	,05918			
*	**UKUPNAOC_3-4**	**-,59091**	**44**	**,43069**	**,06493**	**-9,101**	**43**	**,000**

- statistically significant difference (margin of error p= 0,01).
UKUPNAOC – final assessment obtained by the simple summation of results of all five tests

Discussion and conclusions

One of the main results of this experiment was a statistically significant development of the level of strength endurance of the treatment participants in all the topological body regions. Similar results were obtained in the analysis by Rubeša and associates (1999), after a similarly conceived study based on a smaller sample of subjects (38), but with a higher weekly training frequency (120 minutes three times a week). The kinesiologic treatment hasn't influenced the change of the body mass, which is probably the result of the smaller level of the overall energy consumption, as well as the short time-span of the treatment. Observing the dynamics of readopting motor abilities (readopted because they were adopted to a certain level in their previous education), a great weekly development has been achieved taking into account the level of adoption and ability of motor interpretation of the synthesized martial arts elements. A synthesized learning approach has been well embraced during the implementation process, which is an excellent precondition for a higher motivation of participants in their work as well as a higher engagement for the wholesome adoption of the programme. The general conclusion of this study, as well as similar previous studies, and theoretical and empirical knowledge on the applicability of stereotypes of motor martial arts skills, is that the quality mastering of motor martial arts skills, which are called dynamic movement stereotypes in the area of applied kinesiology, reflecting the state of performing movement without deviating from ideal trajectories, and the efficient solving of urgent situations in daily police activities, can be based only on frequent weekly trainings, and not only trainings of martial arts skills in separate courses. A four-week long experimental kinesiological treatment has been conducted on the sample of 44 subjects – police officers from the Bjelovar-Bilogora Police Department. Based on all the collected data and the statistical analysis of the obtained results it is possible to conclude:

1. The applied kinesiological treatment has exerted a positive influence on the change of strength endurance of all the treatment participants.
2. The conducted programme has exerted positive influence on adopting acyclic motor skills, which has enhanced the situational applicability of the martial arts skills of police officers.

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DIFFERENCES OF THE MORPHOLOGICAL CHARACTERISTICS OF THE MEMBERS OF THE CROATIAN ARMED FORCES

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Abstract

The research was conducted on 302 male CAF members, aged between 18 and 40, and divided into four groups: conscript (n=98), guardsmen (n=101), Special Forces (n=53), and employees of the various directorates of the General Staff (n=50). The research was conducted with the purpose of defining differences between the sub-samples in the morphological space and the significance of those differences. The differences between groups and the significance of the said differences are defined through the canon discriminate analysis in the manifest and the latent area of the morphological variables. In the morphological manifest area, three significant discriminatory functions were obtained at the level of significance of 0.01 ($p<0.01$), and in the morphological latent area, two significant discriminatory functions on the same level were obtained. According to the significant statistical differences in their morphological characteristics between the groups we defined their particular anthropometrical features through which we first defined the desirable and the undesirable body shape. Morphological features of the Special Forces and the conscripts present the desirable body structure, while the unfavorable body shape characterizes the guardsmen and the officers of the directorates.

Key words: *Armed Forces, General Staff, morphology, manifest, latent, discriminatory functions, desirable body shape, unfavorable body shape*

Introduction

The anthropometrical features of soldiers have always been the starting point for defining the ideal measures, and proportions of an "ideal soldier" throughout history have always had dominant morphological features.

A taller, heavier, more muscular and healthy soldier was more successful and ultimately more desirable for the unit. During selection process for recruits in the armed forces all over the world, the selection teams designed tests to separate strong, active, well-proportioned and healthy recruits from the ones who are undesirable to the military units. Anthropometrical measuring and designing anthropometrical tables for certain referential values as well as setting various norms and regulations applied to assign a soldier to a certain duty of position within a service, branch or specialty, are widely used in all the armed forces in the world. Inter-population variables caused each country or region to have different norms and values, calculated and defined on the basis of research on the population of the same region. The importance of the relation of the morphological features to the soldiers' health and their physical fitness has also always been an area of extensive research in the armed forces. The results of these researches are used for various anthropometrical standards of selection and keeping the personnel in service (Friedl, 1992). The relations of the anthropometrical features to the health of the soldiers confirm the research by Hubert and his coworkers (1983), Wei and coworkers (1998) and Aračić (2003) "Determining desirable and undesirable body built as a component of the physical fitness of the members of the Croatian Armed Forces" (Aračić, 2005 and 2007).

Methods

The subject sample for this research comprises 302 male members of the Croatian Armed Forces aged between 18 and 40. The research included 98 conscripts aged 18 to 23 from the Conscript Training Center in Koprivnica and the Sailor Training Center in Split; 101 soldiers and NCOs form the 2nd and 3rd Guards Brigades from Petrinja and Vinkovci aged between 30 and 38; 53 soldiers and NCOs of the Special Forces Battalion from Delnice; and 50 officers and NCOs from the directorates of the General Staff. Members of the Special Forces and directorates were aged between 28 and 40. All the subjects were Croatian citizens and most of them participated in the Homeland War, except the conscripts, and all of them healthy (War Invalids were not included in the research).

This research uses 20 anthropometrical variables to define anthropometrical features of the subjects. According to a hypothetical model of four factor in the morphological area, as stated by Miomirović et al. (1969), the 20 anthropometrical variables estimated the hypothetical factors in the following way: the longitudinal dimension of the skeleton was measured by VIST (the body height), DULN (leg length), DULR (arm length) and SIRR (shoulder width – biacromial span);

transversal dimension of the skeleton was measured by DIJL (elbow diameter), DIJK (knee diameter) and SIRZ (pelvic width – bicrystal span); circular dimension of the skeleton (body mass and volume) was measured by MAST (body mass), OPNK (upper leg span), OPPK (lower leg span), OPND (upper arm span), OPGR (chest span), OPTR (belly span) and OPKU (hip span); the last hypothetical factor, the subcutaneous fat tissue, was measured by KNND (upper arm skin crease), KNPD (lower arm skin crease), KNPK (lower leg skin crease), KNLE (back skin crease), KNGR (chest skin crease) and KNZD (pelvic skin crease).

In measuring the anthropometrical variables, chosen from the International biological Program (IBP) list and Eurofit recommended tests (variable OPKU – hip span), all the basic principles of the anthropometrical measuring were maintained: same time, same instruments, same measurer of the variables and always the same technique. All the anthropometrical measuring was conducted at the same time of the day, in the morning, under same weather conditions, in accordance with the International Biological Program (IBP). Eight members of the Croatian Armed Forces, graduates from the Kinesiology Faculty of the University of Zagreb, who have undergone a 30 hours preparation course of measuring different subjects, conducted the measuring. The basic anthropometrical instruments were used to measure the anthropometrical variables in this research. Description according to Mišigoj – Duraković et al. (1995).

The central and disperse parameter were calculated for all the variables: arithmetic mean (mean), standard deviation (Std. Dev.), minimum (min), maximum (max), asymmetry of result distribution coefficient (Skew), curve of result distribution coefficient (Kurt), and the result distribution norm was calculated by Kolmogorov-Smirnoff test (MaxD). Canon discriminate analysis was used to perform discrimination of anthropometrical variables, especially in the manifest and latent area between conscripts, professional soldiers in the Special Forces, guardsmen and officers and NCOs of the General Staff. The following values were calculated for the purpose of comparison and statistic differentiating in morphological features of the subjects: number of discriminating functions (DF), characteristic value (λ), canon correction (Rc), Wilks lambda (W λ), x^2 – test, number of degrees of freedom (df) and level of significance (p).

Results

Three significant canon discriminating functions differentiating between the groups of subject on the level of significance of 0.01 ($p<0.01$) were obtained.

Table 1. Results of the discriminating analysis of the manifest morphological area

DF	λ	Rc	W λ	X²	df	p
1	0,94	0,70	0,21	448,12	60	0,00
2	0,70	0,64	0,41	256,76	38	0,00
3	0,43	0,55	0,70	102,76	18	0,00

On the basis of the structure of the first discriminating function we can state that the variable is bipolar and that the groups of subjects differ most in SIRZ, DIJL and OPND. The structure of the second discriminating function points at the conclusion that the groups of subjects differ in KNPK, OPGR, OPKU and MAST. The second variable is mono-polar. The third discriminating function is bipolar and implies that the subjects differ most in the measures of skin crease and spans: OPTR, KNPD, KNZD, OPGR, OPND, KNLE, OPKU, MAST and KNGR on the negative pole, and the variable DULR is on the positive pole.

Table 2. Structure of the discriminating functions of the manifest area

	DF1	DF2	DF3
VIST	-0.15	-0.15	0.09
MAST	-0.24	**-0.31**	**-0.39**
DULN	-0.15	0.05	0.03
DULR	-0.10	-0.18	0.34
SIRR	-0.16	-0.10	-0.17
DIJL	**-0.31**	-0.25	-0.25
DIJK	-0.09	-0.01	-0.14
SIRZ	**0.36**	0.00	-0.23
OPNK	-0.19	-0.26	-0.20
OPPK	-0.05	-0.25	-0.12
OPND	**-0.30**	-0.29	**-0,44**
OPRG	-0.03	**-0.36**	**-0.46**
OPTR	-0.10	-0.26	**-0.58**
OPKU	-0.23	**-0.30**	**-0.41**
KNND	0.01	-0.05	-0.30
KNPD	***0.25***	-0.16	**-0.55**
KNPK	***0.25***	**-0.48**	-0.29
KNLE	-0.01	-0.23	**-0.42**
KNGR	-0.14	-0.22	-0.39
KNZD	0.01	-0.24	**-0.52**

Table 3. The centroids of the manifest morphological area groups

	DF1	DF2	DF3
conscripts	**0.45**	**0.26**	**0.86**
guardsmen	**0.14**	**0.80**	**-0.66**
CAF GS	**0.96**	**-1.58**	**-0.43**
SF	**-2.00**	**-0.51**	**0.08**

In the table of the centroids of the groups showing the distance of one group from the others in the first discriminating function, the SF, with –2, is farthest away from the General Staff members, with 0.96. In the second discriminating function, the greatest distance between the members of the General Staff, with –1.58, and the guardsmen, with 0.80, on the other pole. The third discriminating function is also bipolar. SFs and the conscripts are on the positive pole, and the guardsmen and GS members are on the negative pole.

Table 4. The results of the discriminating analysis of the latent morphological area

DF	λ	Rc	W λ	x^2	df	p
1	**0.41**	**0.54**	**0.60**	**153.60**	**9**	**0.00**
2	**0.18**	**0.39**	**0.84**	**51.05**	**4**	**0.00**
3	**0.01**	**0.09**	**0.99**	**2.41**	**1**	**0.12**

Table 4 leads to conclusion that the members of the Croatian Armed Forces divided into four groups significantly differ in two canon discriminating functions at the level of significance of 0.01.

Table 5. The structure of the discriminating function of the latent morphological area

	DF1	DF2	DF3
PMT	0.40	-0.90	-0.16
VMT	-0.88	-0.47	-0.04
DSK	-0.03	0.13	-0.99

The first discriminating function is saturated by the diameters and spans (on the negative pole of the function) confirming that the SFs have the athletic build (narrow hips and spans filled with muscular tissue with the smallest skin crease among subjects, on the positive pole of the function). Small skin creases characterize the anthropometrical features of the conscripts, too. Members of the General Staff have the most fatty subcutaneous tissue.

The second discriminating function is saturated with spans showing that the members of the General Staff have widest spans and the most subcutaneous fatty tissue; they are followed by the guardsmen with the same characteristics, and the lowest values of the subcutaneous fatty tissue belong to conscripts and SFs.

Table 6. The centroids of the groups of the latent morphological area

	DF1	DF2	DF3
conscripts	0.47	0.47	-0.05
guardsmen	0.16	-0.17	0.12
GSCAF	0.20	-0.74	-0.12
SF	-1.35	0.16	-0.02

In Table 6, the centroids of the groups showing distances of one group from the others in the first discriminating function, SFs, with –1.35, are farthest away from the guardsmen at 0.16. In the second discriminating function, the greatest distances are between the General Staff members at –0.74, and the conscripts at 0.47 on the other pole.

Discussion and conclusions

After conducting discriminating analyses in the manifest and latent morphological area of the members of the Croatian Armed Forces, we can conclude that in the manifest area of the anthropometrical variables three discriminating functions, which differentiate the anthropometrical characteristics at the level of 0.01 ($p<0.01$), that is, statistically significantly, are defined. The latent area of the anthropometrical variables is defined by two significant discriminating functions at the same level as in the manifestation area ($p<0.01$).

The morphological characteristics of the entities in the research, after establishing their sizes and distribution, and the differences between them, marked two groups (guardsmen and members of the GS) as having *undesirable body build.* The undesirable body build is characterized by the oversized body mass, big spans and high level of the subcutaneous fatty tissue which shows that mass and spans are not the result of the increased muscular mass (which is the case with the SFs). The norms for the desirable morphological characteristics of the members of the Croatian Armed Forces are defined in the Regulations on the Evaluation of Health of the Candidate for Commission in the Active Service and Regulations on Monitoring the Health of the Active Military Personnel during Service.

The cause of the increased body mass and undesirable body build of the members of the General Staff and guardsmen is probably in the decreased physical activity, but the reason can also be in the big quantity and poor quality of the food in the Armed Forces.

In the abovementioned researches on influences of the anthropometrical characteristics on the health of the members of the Armed Forces (Hubert et al. 1983, Wei et al. 1998, Harwood et al. 1998, Aračić M. 2003 and 2007) the increased body mass influences the increase in the number of light and heavy injuries during training and performing everyday duties, increased diabetes risk, increase of the blood pressure and, what causes most concern, growth in mortality rate due to the increased body mass. In the Framingfan Study (according to Maleš, 2004), there is a positive correlation between the death rate and increased body mass. This positive correlation between the death rate and the increased body mass is corroborated by the research of Štuka, K. and S. Heimer (1974).

To conclude, the results of the morphological characteristics of the guardsmen and members of the General Staff, besides undesirable body build, can also indicate an increased health risk of the subjects belonging to these two groups,

which should be the concern of the Medical Department of the Ministry of Defense when drafting the preventive and curative programs for health care, as well when designing the menus.

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DIFFERENCES IN THE MOTOR CAPABILITIES OF THE MEMBERS OF THE CROATIAN ARMED FORCES

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Abstract

The research was conducted on 302 male members of the Croatian Armed Forces, aged between 18 and 40, and divided into four groups: conscript (n=98), guardsmen (n=101), Special Forces (n=53), and employees of the various directorates of the General Staff (n=50). The research was conducted with the purpose of defining differences between the sub-samples in the motoric area and the significance of those differences. The differences between groups and the significance of the said differences are defined through the canon discriminating analysis in the manifest and the latent area of the motoric variables. In the motoric manifest area, three significant discriminatory functions were obtained at the level of significance of 0,01 ($p<0,01$), and in the motoric latent area, two significant discriminatory functions on the same level ($p<0.01$), and one on a smaller level of 0.05 ($p<0.05$) were obtained. According to the significant statistical differences in their motoric characteristics between the groups we defined their particular motoric capabilities through which we first defined the level of condition preparedness of the subjects. The best in this area were the Special Forces, followed by the guardsmen and the conscripts in the third place, and the worst results were obtained from the members of the General Staff of the Croatian Armed Forces.

Key words: *Armed Forces, General Staff, motoric area, manifest, latent, discriminating functions, condition, preparedness, physical capability*

Introduction

The psychosomatic status of a man, according to the theoreticians of Kinesiology, consists of morphological, functional, motoric, cognitive and conative latent dimensions, which, through their particular and common characteristics, enable manifestations and projections of the said dimensions within the framework of the human labor interacting with the environment. The motoric dimensions are definitely an area of exceptional interest for kinesiology and other anthropological sciences. The research of motoric capabilities and their influence on the planned and unplanned activities of the members of the Croatian Armed Forces and military associations is extremely interesting in a number of researches planned and conducted on this topic in various armed forces. Researches of the motoric area of the members of the armed forces were based on the researches of the functional-motoric capabilities, relations and mutual connections with the morphological area of the subjects as well as the influence of the kinesiological treatments on the morphological characteristics and functional-motoric capabilities. In the Croatian Armed Forces, a great number of papers on this topic were published by Boris Maleš, Sc. D., whose works, cited in the bibliography, were used in the interpretation of the results and conclusions of this research. The status of the condition preparedness, as one of the most important components of the physical capabilities of the members of the CAF, thereby the basis of the battle readiness of the CAF, and the characteristics of the motoric area of certain units are both very interesting and important areas of interest and research of the kinesiologists in the kinesiological system. The aim of this paper is to define the existing differences in the motoric capabilities of the four sub-groups of the CAF members and to determine their significance.

Methods

The subject sample for this research comprises 302 male members of the Croatian Armed Forces aged between 18 and 40. The research included 98 conscripts aged 18 to 23 from the Conscript Training Center in Koprivnica and the Sailor Training Center in Split; 101 soldiers and NCOs form the 2nd and 3rd Guards Brigades from Petrinja and Vinkovci aged between 30 and 38; 53 soldiers and NCOs of the Special Forces Battalion from Delnice; and 50 officers and NCOs from the directorates of the General Staff. Members of the Special Forces and directorates were aged between 28 and 40. All the subjects were Croatian citizens and most of them participated in the Homeland War, except the conscripts, and all of them healthy (War Invalids were not included in the research).

For the purpose of this research, a battery of 15 tests for the evaluation of coordination, agility, frequency of movement, explosive power, repetitive power, speed and anaerobic endurance were used: POLN – training track backwards; PRPS – squeezing through and jumping over; KUST – steps sidewise; TAPR – hand tapping; TAPN – foot tapping; ISKP – turn

with bat; PRKL – forward bend on the bench; SKUD – long jump; BMDL – throwing medicine ball from lying position; BBUD – throwing bomb; ZGPP – pull-ups; SK2M – push ups in 2 minutes; PR2M – forward bends in 2 minutes; T100 – 100 meters run and TR2M – two miles run.

Choice of variables: *TR2M – two miles run, SK2M – push ups in two minutes and PR2M – forward bends in 2 minutes* were taken from the battery of tests for the evaluation of the fitness of the members of the Croatian Armed Forces, and *BBUD – throwing bomb* was taken from the conscript training in the CAF.

The research was conducted in May and June 2004 in the abovementioned units of the Croatian Armed Forces. All the testings were conducted under identical conditions by educated evaluators: kinesiologists of the Armed Forces, graduates from the Faculty of Kinesiology of the University of Zagreb.

The central and disperse parameter were calculated for all the variables: arithmetic mean (mean), standard deviation (Std. Dev.), minimum (min), maximum (max), asymmetry of result distribution coefficient (Skew), curve of result distribution coefficient (Kurt), and the result distribution norm was calculated by Kolmogorov-Smirnoff test (MaxD). Canon discriminating analysis was used to perform discrimination of motoric variables, especially in the manifest and latent area between conscripts, professional soldiers in the Special Forces, guardsmen and officers and NCOs of the General Staff. The following values were calculated for the purpose of comparison and statistic differentiating in morphological features of the subjects: number of discriminating functions (DF), characteristic value (λ), canon correction (Rc), Wilks lambda (W λ), x^2 – test, number of degrees of freedom (df) and level of significance (p).

Results

On the basis of the canon discriminating analysis, we can conclude that the conscripts, guardsmen, SFs and members of the General Staff significantly differ in the motoric area in three canon discriminaing functions at the level of significance of 0.01.

Table 1. Results of the discriminating analysis of the manifest motoric area

DF	λ	Rc	W λ	x²	df	p
1	0.96	0.70	0.24	413.96	45	0.00
2	0.60	0.61	0.47	217.19	28	0.00
3	0.32	0.49	0.76	80.56	13	0.00

Table 2. Structure of the discriminating functions of the manifest area

	DF1	DF2	DF3
PRPS	**0.53**	-0.22	-0.38
KUST	-0.11	**-0.60**	0.04
POLN	0.31	-0.22	-0.12
TAPR	0.09	**0.54**	0.11
TAPN	-0.03	**0.35**	0.02
ISKP	0.02	0.13	0.01
PRKL	-0.07	0.07	0.20
BMDL	-0.27	0.30	**0.55**
SKUD	-0.12	**0.42**	**0.31**
BBUD	**-0.39**	0.20	0.11
ZGPP	-0.31	0.21	0.21
SK2M	**-0.40**	0.34	-0.06
PR2M	**-0.55**	0.32	-0.04
T100	**0.49**	-0.38	**0.33**
TR2M	**0.43**	0.18	0.06

The first discriminating variable can be defined as physical fitness, since the discriminating variable is defined by the motoric variables PR2M, PRPS, T100, TR2M, SK2M and BBUD. The second discriminating variable in the motoric area is defined by the variables KUST, TAPR and TAPN which, relatively speaking, encompasses the speed of performing (agility), the speed of simple hand movement and the participation of the manifestation of the explosive power in the performing of the motoric task (SKUD). The factor of the movement speed is responsible for the success in these variables. The third discriminating variable is determined by the numbers of the motoric variables of the explosive power BMDL, T100 and SKUD. This discriminating variable will be called the explosive power factor.

Table 3. The centroids of the manifest motoric area groups

	DF1	DF2	DF3
conscripts	0.06	0.02	-0.81
guardsmen	-0.36	-0.92	0.37
GSCAF	1.95	0.51	0.44
SF	-1.26	1.23	0.38

In the first discriminating variable, the best results were obtained by the SFs, much weaker, but still better than the remaining two groups – General Staff members and conscripts, results were obtained by the guardsmen. Conscripts were the third in physical fitness and the results of the members of the General Staff were undoubtedly the weakest. In the second discriminating variable, the SFs had the best results again, weaker, but still second in rang, were the results of the General Staff members. Third place was taken by the conscripts again, and easily the last were the guardsmen. The third discriminating variable in the motoric area put all the centroids of the General Staff members, SFs and guardsmen, with the conscripts far behind.

Table 4. The results of the discriminating analysis of the latent motoric area

DF	λ	Rc	W λ	X²	df	p
1	0.53	0.59	0.47	226.75	12	0.00
2	0.37	0.52	0.71	100.81	6	0.00
3	0.02	0.15	0.98	7.22	2	0.03

It is evident from the *Table 4* that the two obtained canon discriminating functions in the latent motoric area significantly differentiate the groups of subjects at the level of significance 0.01 ($p<0.01$), and the third one at the level of 0.05 ($p<0.05$).

Table 5. The structure of the discriminating function of the latent motoric area

	DF1	DF2	DF3
TSPO	**-0.86**	0.16	-0.08
BPOK	0.20	**0.96**	-0.19
EKSN	-0.04	-0.12	**-0.97**
KORD	0.31	-0.15	-0.20

On the basis of the correlations of the latent factors and the first discriminating variable, or its structure, the first discriminating variable can be defined as physical fitness, since the size and projection of the centroids (table 4) distributed almost in the same way as in the first discriminating variable in the manifest area. The second discriminating variable was defined, just like in the manifest area, as the speed of movement because the projections and signs of the centroids were again almost the same as in tables 2 and 3. The third discriminating variable, also defined in the discriminating analysis of the manifest area, was called the explosive power factor.

Table 6. The centroids of the groups of the latent motoric area

	DF1	DF2	DF3
Conscripts	0.02	-0.13	0.22
Guardsmen	-0.27	-0.64	-0.13
GS CAF	1.46	0.45	-0.10
SFs	-0.91	1.04	-0.07

In the first discriminating variable titled physical fitness, the best results were obtained by the SFs; much weaker results, but still better than the remaining two groups – the GSCAF members and conscripts, were obtained by the guardsmen. The conscripts held the third place and the GSCAF members had the worst results. The second discriminating variable, the speed of movement, discriminated the subject in the same was as it did in the manifest area. In the third discriminating variable of the centroid values, the members of GS, SF and the guardsmen had very close results, while the conscripts' results fell far behind. The difference from the discriminating analysis of the manifest area is only in SF and GS exchanging places.

Discussion and conclusions

After conducting discriminating analyses in the manifest and latent motoric area of the members of the Croatian Armed Forces, we can conclude that there are significant differences between the sub-samples of this research. In the manifest area of the motoric variables, three discriminating functions, which differentiate the motoric characteristics at the level of 0.01 ($p<0.01$), that is, statistically significantly, were defined. The latent area of the motoric variables was defined by two significant discriminating functions at the same level as in the manifestation area ($p<0.01$), as well as one discriminating function at the level lower than 0.05 ($p<0.05$). Both areas are complementary and confirm the information on the motoric capabilities and differences in the capabilities of the members of the Croatian Armed Forces.

On the basis of the obtained results, we can conclude that the best results in the area of the functional motoric capabilities were obtained by the SFs, followed by the guardsmen and the conscripts in the third place, while the members of the General Staff's results were the worst. The information obtained is logical and in accordance with the overall kinesiological involvement of individual groups, namely everyday military routine. In other words, the SFs are a selected group of individuals who perform physically challenging tasks on a daily basis as part of their everyday training routine, and the guardsmen, while performing physically challenging tasks as part of their everyday training, still face tasks which are much less physically challenging than those performed by the SFs but are more demanding than those performed by the remaining two groups. The conscripts enhanced their motoric capabilities due to their challenging basic training. The members of the General Staff Directorates show the worst results because of the sedate nature of their work in the offices and failure to take the opportunity to exercise regularly, 90 minutes at least three times a week during working hours, which they are requested to do. The bad results of the condition preparedness indicate a change in the body build and degradation of the motoric status, which can even now have a negative impact on their health.

We can conclude that there are very different groups in the Armed Forces, whose anthropological characteristics have significantly different structure. The differences in the structure of the anthropological characteristics are stipulated by belonging to a certain unit, but also by the kinesiological involvement of each individual which depends on his or her attitude towards the given tasks and the subjective desire to reach the highest possible level of psycho-physical capabilities.

However, the results indicate that, except the Special Forces Battalion, none of the remaining groups has the level of the anthropological characteristics required for their tasks. The conscripts have the characteristics indicating that the secondary education system, as well as the teenager way of life, brings about the inadequate development of the anthropological characteristics necessary for performing the military duty. Regarding the active military personnel included in this research, it should be mentioned that they are people who, for the most part, participated in the Homeland War and are not the product of the system as is the case in most Western militaries. It should also be mentioned that they have reached the age when it is difficult to change habits and attitudes. By opening the system of the Croatian Armed Forces to the younger generations, it is to be assumed that this picture will greatly change in the future.

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PREDICTING THE ACHIEVEMENT IN THE MILITARY OBSTACLE COURSE - METHODOLOGY AND SOME PRACTICAL REPERCUSSIONS

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Abstract

The aim of the present study was to evaluate the influence of regularly measured motor-endurance variables (predictors) on the military obstacle course (OC) achievement. The subjects were 25 males, sampled from the Croatian Navy Special Units (mean age 22 years). During the course of the study subjects performed 18-week physical fitness training program (PFT). The predictors consisted of 8 motor – endurance variables. The criterion was the OC. Using the factor analysis we identified three predictors included in the multiple regressions. In conclusion, the aerobic endurance and muscular endurance assure the most important basis of the OC achievement. For that reason, in the periods where specific OC training is not executable, those two components of the physical fitness have to be targeted in PFT.

Key words: *special army forces; physical fitness; prediction; factor analysis*

Introduction

The physical fitness training (PFT) is one of the most important segments of the military training (Gordon et al. 1986). Since motor efficacy of any kind directly rely on level of, and inter-relations between different anthropological characteristics, the aim of the military PFT is achieving the appropriate level of each motor (physical fitness) component and to increase its' level to the optimal level (Maleš et al. 1999 and 2004). Probably one the most popular, but undoubtedly the most efficient form of the PFT is co-called situational-, and or field-specific-training. It mainly relates to the fact that during the situational-training the optimal ratio between training effects and training volume is accomplished. Consequently, the obstacle course (OC) is one of the most popular types of the military PFT. Briefly, the OC is a form of the physical fitness task consisted of different motor tasks and series of challenging physical obstacles an individual must navigate usually while being timed. From our point of view there are two main reasons for the attractiveness of the OC in military training. First, the OC effectively simulate the basic movement structures regularly used in the combat situations (different fundamental motor skills like crawling, climbing, running, jumping, etc), and second – the OC training is methodologically accurate and therefore time-convenient. The OC actually integrates several motor and endurance factors (Metikoš et al. 1988) mainly because of the fact that the muscular endurance of different body regions as well as the aerobic and/or anaerobic endurance differently influences the OC routine.

However, in many circumstances the OC training is not applicable. First, the OC equipment is regularly located in the Bases and/or Camps exclusively, but not to forget that it is not rare that the weather conditions directly restrict the possibility of training (e.g. heavy snow and/or rain, etc.) even in facilities where the OC is situated. Therefore, it is absolutely necessary to define the influence of the different anthropological predictors on the OC achievement. It will allow one to precisely train important motor-endurance factors even during the period when weather conditions and/or military duties do not allow the OC training, and to expect positive transfer on his (hers) OC achievement.

Consequently, the aim of the present study was to evaluate the influence of regularly measured motor-endurance predictors on the military obstacle course achievement in Croatian Navy special-unit members. Additionally, we tried to verify a particular methodological path in predicting the complex criterion variables in kinesiology (see later text).

Methods

The sample of subjects comprised 25 males, members of the special unit force of the Croatian Navy (mean age 22 years).

During the course of the study subjects participated in 18-week physical fitness training program (PFT; Table 1). The main goal of the PFT was the improvement of the specialized motor-skills and motor-knowledge, and development of the muscular and cardiovascular endurance (e.g. repetitive strength and aerobic endurance) as the main prerequisites for the effective military-task-execution in the urgent situations.

The sample of variables consisted of 8 motor – endurance predictors. Cardiovascular endurance predictors included: 6000 meters cross running (CROSS), 1500 meters running (1500m), 300 meters freestyle swimming (S300), 10000 meters of forced marching on +10% terrain level inclination (MARCH). Motor predictors consisted of: maximal number of pull-ups (PULL-UP), maximal number of push ups performed on dips (PUSH-UP), maximal number of sit-ups (SIT-UP), and maximal number of squats performed with 30 kg load (SQUAT). The criterion variable was military (infantry) obstacle course (OC). All variables were measured at the study entry (I), and after the each phase of the PFT (II, III, IV).

To accurately identify the potential OC predictors we applied factor analysis with varimax rotation. Next, selected predictors were included in four multiple regression analysis (one for each measurement; for more details see Results section), where the OC was targeted as criterion variable.

Table 1. Physical fitness training

Plan	**1st phase**		**2nd phase**		**3rd phase**	
Weeks	6		6		6	
Working days	30		30		30	
Daily working hours	4		6		7	
Total working hours	120		180		210	
Total trainings	84		78		72	
Trainings per week	14		13		12	
Basic training	Weekly	Duration	Weekly	Duration	Weekly	Duration
Morning footing	5	30 min	4	30 min	4	30 min
Aerobic endurance (running)	4	60 min	3	60 min	2	90 min
Aerobic end (marching)	1	180 min	1	240 min	1	240 min
Aerobic end (swimming)	2	30 min	2	30 min	1	60 min
Aerobic end (rowing)	1	60 min	2	45 min	1	90 min
Muscular endurance	4	60 min	3	60 min	3	60 min
Specific military training	Weekly	Duration	Weekly	Duration	Weekly	Duration
Obstacle course	2	45 min	2	60 min	2	60 min
Martial Arts	2	60 min	2	60 min	2	60 min
Apnea diving	2	30 min	2	25 min	2	20 min
Diving			1	40 min	1	50 min
Forced anaerobic diving			1	180 min	2	210 min
Situational military training	Weekly	Duration	Weekly	Duration	Weekly	Duration
Tactical skills and exams			1	420 min	1	540 min

Results

Table 2. Factor analysis calculated on the set of the motor-endurance predictors (F – factor structure; Expl.Var. – factor variance)

	F1	F2	F3
CROSS	-0,14	-0,94	0,10
1500m	-0,08	-0,61	0,66
S300	0,02	0,04	0,94
MARCH	-0,20	-0,93	-0,06
PULL-UP	0,75	0,05	-0,03
PUSH-UP	0,87	0,08	-0,07
SIT-UP	0,82	0,2	-0,11
SQUAT	0,56	0,12	0,17
Expl.Var	2,36	2,18	1,38

Table 3. Descriptive statistics (M – mean; SD – standard deviation) for the selected predictors (CROSS, S300, PULL-UP) and criterion variable (OC) in each measurement (I, II, III, IV)

	I.		II.		III.		IV.	
	M	SD	M	SD	M	SD	M	SD
CROSS (s)	2016.92	209.97	1768.32	138.14	1673.56	80.35	1657.24	78.41
S300 (s)	403.16	50.55	368.60	49.26	346.04	43.76	338.24	40.68
PULL-UP (rep)	6.60	3.17	11.44	5.60	14.76	4.13	17.60	3.67
OC (s)	165.24	22.22	146.52	15.39	132.40	12.70	123.00	11.97

*Table 4. Multiple regression results (BETA; coefficient of the multiple correlation – R^2; * denotes significant coefficients) between selected predictors and criterion (OC) in each measurement (I.-IV.)*

	I.	II.	III.	IV.
	BETA	BETA	BETA	BETA
CROSS	0,30	0,12	0,19	0,41*
S300	-0,10	0,27	-0,04	-0,14
PULL-UP	-0,29	-0,33	-0,21	-0,23
R^2	0,45	0,41	0,29	0,59*

Factor analysis (Table 2) extracted three significant factors from the set of eight motor-endurance variables measured at the study entry (I). In the first factor (F1) all four measured muscular endurance variables are significantly projected. The second factor (F2) is characterized by significant correlations of two aerobic endurance variables, while on the third one (F3) is elementary related to swimming ability. Such methodological approach allowed us to accurately select appropriate predictors in following multiple regressions (one from each factor).

In the Table 3 descriptive statistics for the three selected predictors and criterion variable is presented. Although dynamics of changes were not within the aims of the study, it is interesting to observe that results on each of the four presented variables improved from measurement I to IV.

Multiple regression revealed significant prediction of the criterion (OC), but only in fourth measurement. The significant Beta ponder is evident in variable CROSS which is previously chosen as a measure of the aerobic endurance.

Discussion and conclusions

There are several important findings in our results. First, the relatively original methodological approach we applied herein allowed us to precisely detect motor-endurance predictors of the OC (criterion), and second – we supported the observations from the recent studies (Sekulic et al.2007) where authors suggested necessity of selecting homogenized sample of subjects in defining the true nature of the anthropological influence on the complex motor criterion. Third, results obtained can have very practical repercussions in the PFT.

The factor analysis we applied in the first phase of the statistical procedures preserved us from doing one of the most common mistakes in selecting the (logical) set of the predictors from the relatively large sample of potential precipitation variables, by including multiple-suppressor-predictors. Briefly, predictors applied in the multiple regression analysis are urged to be "non-correlated within" and "correlated with criterion". Factor analysis divided potential predictors in three "non-correlated groups (three factors), and all we had to do is – pick one (or two/three) predictors from each group (factor). Consequently, it led us to proper selection of the predictors, and finally – natural and logical regression results.

Someone could be surprised by the fact that the multiple regressions are not significant in measurement I-III, while reaching statistical significance only in the measurement IV, but it is: (1) logical consequence of the motor learning process which was (as stated before) one of the most important goals of the POFT performed (see Table 1); but also (2) important support to the fact that prediction analysis (e.g. regression analysis) in kinesiology can be logically interpreted only when subjects are similar in the motor skill which is the basis for the achievement in the criterion test (for example: characteristic swimming skill when trying to predict 100 meters freestyle criterion; characteristic dancing skills when trying to predict dance achievement, etc.). Accordingly, all of our subjects had to reach equal (high) level of the "obstacle course skills" to allow motor-endurance predictors explain the appropriate level of the common variance. Consequently such homogenization of the subjects regarding "obstacle motor skills" happened in the measurement IV, after four months of the systematic physical fitness training.

The central aim of the present study was to identify the most significant predictors of the achievement on the military OC. The idea was that it will have practical repercussions in military PFT. Consequently, based on the results presented and discussed, we can conclude that aerobic endurance and muscular endurance assure the essential basis of the OC achievement. For that reason, in the periods where OC training is not executable because of the any objective reason, those two components of the physical fitness have to be targeted in PFT. More precisely, knowing the structure of the previously calculated predictors, we can suggest that the proper PFT training of such kind must include: (1) extensive running/walking workouts and – (2) muscular strength training (repetitive strength) of the arms, forearms and upper back. Knowing the training methodology – there is no doubt that those two physical fitness segments must be trained in separated training sessions.

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SMOKING HABITS AND PULMONARY FUNCTION IN MILITARY DIVERS: ONE YEAR FOLLOW-UP STUDY

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Abstract

This study examined pulmonary function (PF) of the military divers (MD) regarding their smoking status in a one-year period. The subjects were professional MD (all males; N = 17), divided according to their smoking status into smokers group (S; N= 8) and nonsmokers group (NS; N = 9). The variables included body height, body weight and parameters derived from the flow-volume curves: inspiratory vital capacity forced vital capacity, forced expiratory volume in one second (LAV); and peak expiratory flow, maximal expiratory flow after 50% and 75% of exhalation (SAV). The LAV and SAV were measured at the study entry and after the one year period. In conclusion, the PF values of the NS did not change significantly, while the PF status of the S deteriorated significantly during the course of the study. Also, there is certain evidence that physical conditioning training can reduce the negative effects of the smoking on the PF.

Key words: *respiratory function, analysis of the variance, physical conditioning training*

Introduction

Although it is clear that diving is generally a stressful activity, military diving is probably the most demanding of all. There are several reasons for such a statement. Firstly, military divers have to perform their tasks no matter what the weather and/or water conditions (something not usual in sport and commercial diving); secondly, combat duties put special psycho-physiological requests on divers (mainly because their duties are not related to diving and/or handling the material "only"); and thirdly – in most cases military divers have to take direct and exceptional responsibility for others (who might be incapable of helping themselves).

It is generally accepted and well documented that respiratory volumes, flows and capacities (pulmonary function – PF) change mostly as a function of age and consequently as a function of body height. It is defined by an increase of the lung volume which naturally follows an increase of body proportions, mostly defined by an increase of the BH. But, PF is also dependent of differences in the functionality of the respiratory system, not necessarily related to growth. One of such factors is smoking status. Smoking is found to affect PF negatively, mostly by decreasing lung volumes and capacities (Sekulic et al. 2008).

Although interesting, the relationship between smoking, diving and PF is relatively unknown. From our point of view, it is particularly important in military diving since previous studies reported that (historically) tobacco used by some countries' military personnel on active duty has greatly exceeded that found in the civilian population (Chisick et al. 1998). Finally, there are practically no follow up studies examining the pulmonary function in military divers (Bermon et al 1994).

Therefore, the aim of the present study was to define and interpret one-year changes in the relative PF values for Croatian military divers, concerning their smoking status, and pre-study accomplished physical conditioning training.

Methods

The sample of subjects were professional military divers (all males; N = 17), divided according to their smoking status into smokers group (S; N= 8) or nonsmokers group (NS; N = 9). All the subjects have been involved in professional military diving for 3 to 4 years, performing 146 to 187 dives per year.

We measured the subjects' body height (BH) and body weight (BW). The pulmonary function testing was performed using the Jaeger MasterLab (Erich Jaeger GmbH&CoKG, Wűrzburg, Germany) [8]. The parameters derived from the flow-volume curves were: inspiratory vital capacity (VCIN) forced vital capacity (FVC), forced expiratory volume in one second (FEV1), peak expiratory flow (PEF), and maximal expiratory flow after 50% and 75% of exhalation (MEF50 and MEF25). The VCIN, FVC, FEV1 were used to describe the large airways (large airways variables – LAV), whereas PEF and MEF values were used to describe the airway small airways (small airways variables – SAV). All the variables were interpreted in relative – percentage values (according to the predicted values for age and stature). All measures were taken at the study entry (initial) and after the one year period of the military diving service (final measurement)

The T test was applied to determine differences between groups in the BH, BW and age. The factorial (measurement x group) analysis of the variance (ANOVA) was calculated in defining initial-final (measurement) differences in S and NS (group).

Results

Table 1. Descriptive statistics (MEAN; standard deviation – SD) in smokers and nonsmokers; t-test differences between groups (t-value; p – level of the significance)

	NON SMOKERS		SMOKERS		T test	
	MEAN	SD	MEAN	SD	t-value	p
AGE (years)	20,00	3,07	19,22	1,20	0,71	0,48
BH (cm)	181,45	6,96	181,22	5,12	0,08	0,93
BW (kg)	84,45	17,45	79,56	10,55	0,74	0,47

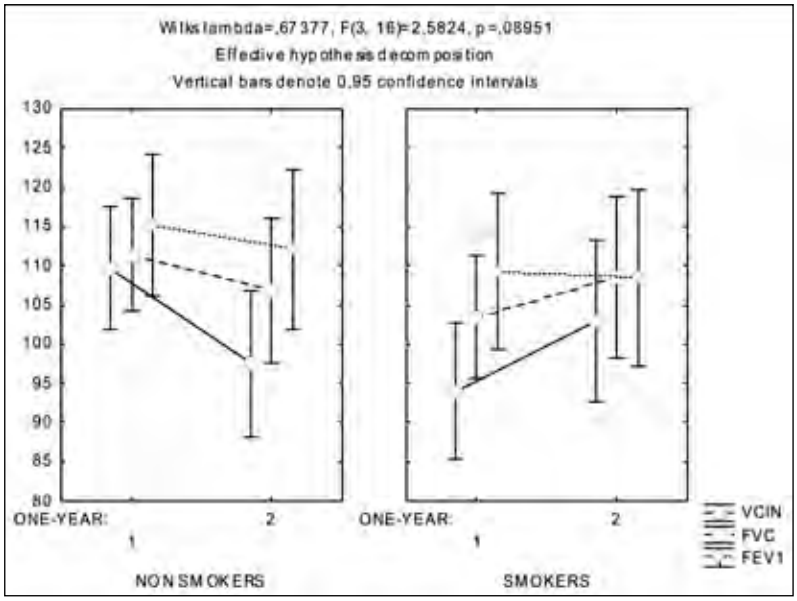

Figure 1. Data (mean ± range) and ANOVA results for the large airways variables (F – F test; p – level of the significance)

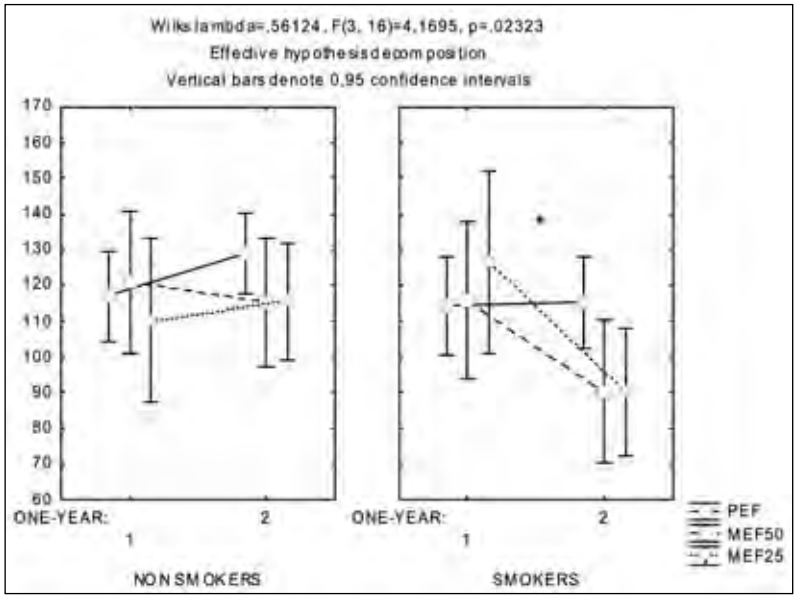

*Figure 2. Data (mean ± range) and ANOVA results for the small airways variables (F – F test; p – level of the significance; * denotes significant differences within the group)*

Discussion and conclusions

The T test results showed no significant differences between the groups (S and NS) in age, BH and BW (Table 1). Although PF variables are presented in relative values (predicted for stature) the fact that groups did not differ significantly in BW allow us to discuss data more precisely (Figure 1-2). Briefly, even though respiratory capacities and therefore PF measures, growth as a function of the BH (as a measure of the body-development), recent studies suggest that in active males and athletes BH is not the only relevant measure of the general growth. For example, there a certain indices that swimmers and waterpolo players increase their lung volumes relatively independently of the BH - as a result of highly developed respiratory muscles and lung capacities (for details see Sekulic et al 2007).

In the Figure 1, the ANOVA results regarding changes within one-year period in two observed groups for the LAV are presented. Although analysis' results did not reach statistical significance, some general observations are clear. First, minor decrease of the LAV in S, and increase in the NS are evident. Second, after the one-year period the level of the LAV in both groups equalized. In the following text some possible explanations are offered. Before the study entry the subjects performed extensive and rigorous physical exercising program. It can be hypothesized that such training regimen, which included aerobic and anaerobic endurance workouts, as well as strength training probably increased the LAV values in nonsmoker subjects (already suggested in the study of Sekulic and Tocilj 2006). But, during the study period, between initial and final measurement, subjects mainly performed diving tasks. Therefore, initially elevated level of the LAV declined in NS due to the decreased training volume and stimuli. On the contrary, the pre-study training regime for the S was very probably too intensive and their functional and respiratory capacities were practically overtrained. Next, during the study period, where the physical conditioning training was not so pronounced, they recovered and overcompensated (e.g. increased) their LAV status. Also, some additional explanation can be offered knowing the uniqueness of the breathing-technique during scuba diving. In scuba diving breathing is short and diver has to conquer the water pressure and to breathe against it. It undoubtedly stimulates the respiratory muscle in a most specific way, initiating the increase in the LAV for the S during the intensive diving period. One can argue that such improvement can be expected for the NS too, but they have already improved their LAV capacities in pre-study period, and further improvement would be hard to expect.

In figure 2 SAV changes are presented. In the S, the SAV values decreased significantly during the observed one-year period. At the same time, the SAV variables slightly (although not significantly) increased in NS. The only logical explanation for such diversity can be found in the previously explained - systematic physical conditioning training which took a part during the pre-study period, and not between the initial and final measurement. Therefore, the smoking status negatively influenced the PF of the S. During the same period, the NS maintained their PF status although did not accomplish physical conditioning training.

Based on the results presented and discussed following conclusions can be drawn:

- during the one year period of the military diving service with no additional physical conditioning program, the PF values in nonsmokers did not change significantly
- on the other hand, during the same time period the PF status of smokers deteriorated significantly in SAV measures
- there is certain evidence that physical fitness training performed regularly can decrease the negative effects of smoking on the PF, and therefore should be considered as a valuable curative and therapeutic base for the improvement of the PF
- further studies are necessary to precisely examine the potential positive influence of the different types of the physical fitness training on the PF

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INFLUENCE OF RELATIVE MUSCULAR ENDURANCE ON 2 MILES RUNNING IN CROATIAN ARMY MEMBERS

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Abstract

Purpose of this scientific work was to establish influence of muscular endurance on 2 miles (3.2km) running. Research was made on 10 active military personnel. Besides standard tests for physical preparedness evaluation – push-ups in 2 minutes, sit-ups in 2 minutes and 2 miles running; they were also tested by additional tests – squats in 2 minutes, pull-ups to failure and back extensions in 2 minutes. In data processing we used regressive analysis with 2 miles running as criterion variable. Conclusion of this research is that besides primary functional endurance training, muscular endurance of legs and torso flexors and extensors also has positive influence on 2 miles running. Study also shows that at certain number of individuals there is potential in muscular endurance development with positive influence on 2 miles running.

Key words: *military personnel, testing, concurrent training, anatomic adaption, core strength*

Introduction

Twice a year military personnel in Croatian army has physical fitness test. Test includes maximal repetitions of push-ups and sit-ups in 2 minutes and 2 miles running. Structure of tests shows that purpose of this testing is establishing relative muscular endurance and aerobic endurance.

Besides necessary level of aerobic endurance and results obtained in standard tests used for testing military personnel, this study investigates influence of some other tests for local muscular endurance on 2 miles running. It also investigates if some exercises for increasing muscular endurance can improve 2 miles running. In this way we want to point out that military personnel can develop physical qualities and reach passing level on army physical fitness test not only by exercises like push-ups and sit-ups but also by other practices.

Similar researches show that for performances with cardiorespirator demands we need certain level of lower limb muscular strength (Flouris, Metsios and Koutedakis, 2006).

Methods

Sample was made of 10 Croatian soldiers, 21 to 27 years old.

For assessing the relative muscular endurance following tests were used:

MSKL – push-ups – maximal repetitions in 2 minutes

MPRR – sit-ups – maximal repetitions in 2 minutes

MCUC – squats – maximal repetitions in 2 minutes

MEXT – back extensions – maximal repetitions in 2 minutes

MRAZGP – pull-ups – maximal repetitions to failure

Aerobic endurance:

F3200M – 2 miles running

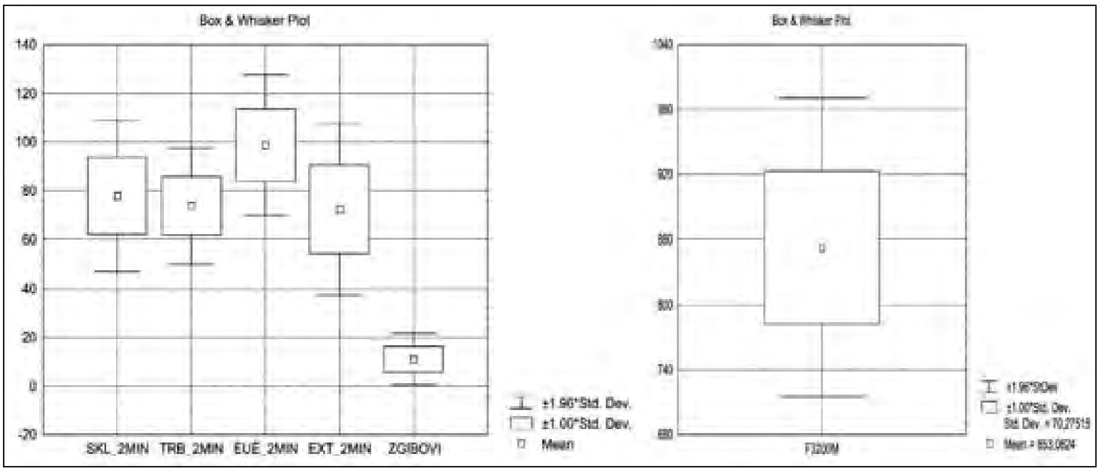
Obtained results were processed by descriptive statistics and regressive analysis.

Results

Table 1. Descriptive statistics

	Valid N	Mean	Minimun	Maximum	Std. Dev.
MSKL	10	73,60	49	105	17,69620
MPRR	10	68,80	61	80	5,49343
MCUC	10	90,10	77	106	8,21178
MEXT	10	73,80	44	95	15,36808
MRAZGP	10	13,70	2	25	10,19858
F3200M	10	878,90	770	993	75,16271

Legend: MSKL – push-ups in 2 minutes; MPRR – sit-ups in 2 minutes; MCUC – squats in 2 minutes; MEXT – back extensions in 2 minutes; MRAZGP – pull-ups to failure; F3200M – 3200 metres running



Picture 1. Box & Whisker Plot

Table 2. Corelation analysis

	MSKL	MPRR	MCUC	MEXT	MRAZGP	F3200M
MSKL	1,00					
MPRR	-,20	1,00				
MCUC	,34	-,23	1,00			
MEXT	***,78***	-,17	,05	1,00		
MRAZGP	***,87***	-,31	,34	***,74***	1,00	
F3200M	-,27	-,30	-,32	-,55	-,07	1,00

Legend: MSKL – push-ups in 2 minutes; MPRR – sit-ups in 2 minutes; MCUC – squats in 2 minutes; MEXT – back extensions in 2 minutes; MRAZGP – pull-ups to failure; F3200M – 3200 metres running

Table 3. Regressive analysis results

MULTIPLE REGRESSION N=10	Regression Summary for Dependent Variable: F3200M R= ,99469503 R^2=,98941821 Adjusted R^2= ,97619096 F(5,4)=74,802 p<,00048 Std.Error of estimate: ,20476 Std. Error: 0,20476					
	BETA	St. Err. of BETA	B	St. Err. of B	t(4)	p - level
Intercept			37,54751	1,437848	26,1137	,000013
MSKL	,13696	,121170	,01027	,009086	1,1303	,321528
MPRR	***-,38241***	***,055281***	***-,09238***	***,013354***	***-6,9176***	***,002292***
MCUC	***-,70203***	***,060254***	***-,11345***	***,009737***	***-11,6512***	***,000310***
MEXT	***-1,38682***	***,090371***	***-,11975***	***,007803***	***-15,3459***	***,000105***
MRAZGP	***,95379***	***,113594***	***,12410***	***,014780***	***8,3965***	***,001101***

Legend: MSKL – push-ups in 2 minutes; MPRR – sit-ups in 2 minutes; MCUC – squats in 2 minutes; MEXT – back extensions in 2 minutes; MRAZGP – pull-ups to failure; F3200M – 3200 metres running

Table 4. Variance analysis

Analysis of Variance; DV: F3200M					
	Sums of Squares	df	Mean Squares	F	p - level
Regress.	15,68078	5	3,136157	74,80154	,000485
Residual	,16771	4	,041926		
Total	15,84849				

Discussion and conclusions

From obtained results we can conclude that there is statistically significant correlation on level $p<0.01$ between 3.2 kilometres running results and relative muscular endurance tests – sit-ups, back extensions, squats and pull-ups. Statistically significant values have inversely algebraic signs because of variable F3200m which is inversely scaled. Relative muscular endurance of torso flexors and extensors and leg muscles are significant for better results in 3.2 km running. Torso flexors and extensors form body core, and they participate in all compound movements. Pull-ups used as test for relative upper body muscular endurance have negative influence. These results confirm hypothesis that extensive running makes lower body stronger while greater upper body strength has negative influence on longer running. That is because human body adapts on movements performed while running and during running the main movers are leg muscles and body core. Body core is very important and it participates in performance of all compound movements. Upper body doesn't significantly influence on running and because of that adaptation is made in lower body direction. That is why we can notice some negative influence as reducing upper body strength.

Compared to similar scientific works (Hortobagyi, 1991) advantage of this research is that besides standard tests – push-ups and sit-ups, it applies additional tests – back extensions and pull-ups. Results of this research are similar to the study conducted by Flouris et al., 2006. They concluded that lower limb muscular strength has certain influence on performance with cardiorespirator demands. The research presented confirms and supplements that statement by showing that lower back and abdominal muscles, whose strength are closely related to lower limb strength, have positive influence on running and activities with cardiorespirator demands. Considering obtained results and demands for certain level of military personnel physical preparedness – aerobic endurance and upper body strength, there is a request for implementation and expansion of both qualities at the same time.

Glowacki et al., 2004. showed that concurrent, simultaneous aerobic endurance and strength training did not negatively affect strength development but it was able to interfere with maximal aerobic capacity development. Christos et al., 2003. determined that simultaneous strength and aerobic endurance training had better influence on performance than two separated trainings. Franchini, 2007. established that intermittent aerobic training had negative influence on strength and endurance of leg muscles while Mulvaney, 1990. deduced that simultaneous strength and endurance training compromises strength improvement and increases probability of overtraining. Sale, 1990. determined that it was better to perform concurrent training for strength and endurance in different days. That was also confirmed by Kraemer, 2004. It showed that we could achieve better effect by separating aerobic running training from training for lower limb strength. But it is also established that upper body strength training and aerobic endurance training executed on the same day had positive influence on increasing both strength and endurance.

Based on these cognitions it is evident that during physical preparations for annual official evaluations and in everyday working out, military personnel can simultaneously practice exercises for aerobic endurance and for strength and muscular endurance. To certain level we can also positively influence on 2 miles running results by strengthening leg muscles and torso flexors and extensors. However, aerobic endurance has primary influence on that test and the greatest effects will be achieved by functional qualities development. Results of this research are just additional and supplementary instrument and among other segments they can help in better realisation of 2 miles running. These results should be verified on larger and more homogeneous sample because inside military population there are various subpopulations according to training level. Because of that, some future investigations should be made according to examinees' training level and also using specific tests for physical readiness assessment considering branch of military personnel.

Having in mind that military personnel are not homogeneous in training level this research made on 10 Croatian soldiers, showed that military personnel have certain potential in developing muscular endurance of leg muscles and torso flexors and extensors. It also showed that this development has positive influence on aerobic endurance test used by Croatian army – 2 miles running. Besides primary aerobic training, at certain number of individuals, result can be improved by additional muscular endurance training of mentioned body regions.

Conclusion of this study cannot be applied on individuals who are above average in physical training. Considering that military personnel require adequate aerobic endurance and upper body strength, it is necessary to perform both strength and endurance training simultaneously because previous researches confirmed that concurrent training did not influence negatively on quality development.

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SPORTS ACTIVITIES FOR THE MALE MEMBERS AT THE MINISTRY OF THE INTERIOR

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Abstract

With the research aimed at sports and recreation activities of employees in the security institutions, an attempt is made for determination of tendencies in deficiently defined sports programs of the Ministry of Interior, and for definition of the reasons that have influence on the form, mean and choice of certain sport. It was determined that sports activities decrease along with the age, no matter that working surroundings ask for sports activities, and indirectly better motorical abilities. In principle, sports activities of workers in security institutions, sharply decreases after the age at 30.

Key words: *sports activity, police officer, motor abilities, health*

Introduction

Many studies dealing with the association between sport and professional work impart the information about positive effects of the involvement in sports as an important factor of performance at work (Petrović et al, 1992). However, in modern and technologically rapidly developing society there can come to a destroyed relationship between the work of a police officer (energy input) and gathering of energy (sport activity). Therefore, involvement in sport undoubtedly belongs to those important factors which enable a police officer to preserve his health and regenerate his lost energy (Peak, 1992). The objective of our study has been to establish the factors of sports involvement of police officers and determine the parameters having effect on the selection of the branch of sport.

Methods

The study has covered the police officers of one of the police administrations in the Republic of Slovenia. The data were statistically processed using the SPSS program of the Institute of Kinesiology at the Faculty of Sport in Ljubljana.

Results

Interesting for police practice is the finding that the working position – which depends on the level of education of the respondents – is an important indicator of the active engagement in sports. Thus we can see that the police employees working as criminal investigators, commanders of the police station and assistant commanders are also those who engage in sports most; hence, those who, among the respondents, rank higher with respect to the educational structure – i.e. have higher positions – in the police hierarchy (table 1).

Table 1. Percentage of the subjects actively engaging in sports by working positions

WORKING POSITION	%
commander of the station	75.0
assistant commander	84.6
duty officer	60.0
chief beat officer	75.0
crime investigator	90.0
policeman	82.9

Table 2. Percentage of the active subjects by age

AGE	%
<- 25	100
26-30	89.2
31-40	74.0
41-50	56.3
51-60	50.4

We can establish that with the age there also decreases the number of respondents who are actively engaging in sports. However, it is worth mentioning that already in the age category between 31 and 40, the percentage of active subjects strongly falls off. This is even more drastically evident in the age category between 41 and 50 years when active engagement in sports falls off by almost 40 per cents (table 2). This data is important for the police administration as police officers of this age category still perform the tasks requiring a certain level of motor abilities.

It has been established that 47 % of the surveyed subject are involved in soccer, 30 % in skiing, 24 % in walking and 16 % in tennis. From the overall number 35 % of police officers are actively involved in sports activities two hours a week and less, 18.2 % three hours, and 11.6 % four hours a week. As an obstacle to more intensive participation in sports, 57 % of the surveyed subjects mentioned their working time, 37.2 % too much work, 22 % family obligations, 18 % money and 11 % distance to the sports facilities.

Conclusion

Although we have dealt only with some factors of sports involvement of police officers associated with their life and work, the results are important for police practice. In order to increase the awareness of the importance of sports programmes, it will be necessary to direct special attention to the police population past 30 years of age as this is the period in which sports activity begins, as a rule to decline. It will be necessary to improve the concepts regarding the contents of the strategy of sports at the Ministry of the Interior. For this purpose, it will be necessary to improve the organisation, concepts on the contents of sports involvement, promotion activities and information.

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VARIABLE VELOCITY TRAINING IN THE PERIODIZED MODEL

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Abstract

This feature discusses the potential benefits of emphasizing movement velocity rather than load during power training. The performance of high-velocity exercise is suggested as an appropriate component of a periodized resistance training program.

Key words: *variable velocity training, high-velocity training, periodization; resistance training, power*

Resistance training is widely regarded as an effective supplemental tool to the modern athlete's preparation for competition. With competition growing at all levels of athletics, coaches, athletes, and exercise professionals alike are constantly searching for new and better ways to enhance performance. It has been well established that the repetitive performance of resistive exercises with external loads improves muscular force, production, or strength (4, 5, 8, 11, 13). But great athletes are not built on strength alone. More recently, resistance-training protocols that address velocity of movement have been developed to enhance muscular power rather than strength. Power is defined as the amount of work done over time, whereas work is the force required to move a load a given distance. As such, power improves with an increase in force production much like strength does; however, power also improves with a decrease in time in which a given amount of work is done. Because velocity is often important in the performance of sport-related skills, power would appear to be a much more applicable measure of potential athletic performance than strength alone. The regular performance of ballistic, power exercises is now commonplace in many weight rooms. Of the 2 components of power, force and velocity, force is much easier to regulate. Because much of the resistance training that takes place uses free weights, controlling external loads is quick and easy. As such, a great deal of research on muscular power has been performed with the goal of determining the most appropriate load when seeking maximal gains (8, 10, 15, 16). Although these exercises are performed with the intention of moving a given load as fast as possible, actual movement velocities are often far below maximum. This paper will discuss the potential benefits of emphasizing movement velocity rather than load in power training. Rationale is provided for the performance of resistance exercises with high movement velocities as a supplement to be performed as part of a comprehensive resistance-training program.

Velocity specificity

The biggest argument for including high-velocity training in an athlete's resistance-training program deals with the concept of specificity. This concept states resistance-training programs will best produce positive effects on activities or tasks that closely mimic the training that is performed (2, 4, 6, 8, 15). In other words, resistance training undertaken to improve a specific sport should be similar in movement pattern, duration, and intensity to the various movements performed during competition. This concept holds true with respect to the velocity of training as well. In a recent review by Pereira and Gomes (12), numerous studies involving velocity of movement during resistance training were analyzed.

By examining research involving isokinetic exercise equipment, which controls for velocity of movement rather than resistance, these authors made it clear that training effects are most prominent at the specific velocity at which a person trains (12). Therefore, training that is undertaken to produce performance gains at the high movement velocities seen during athletics may need to include movements performed at or close to the actual velocities seen during competition. With this in mind, it may be as appropriate to vary movement speed as it is to vary load when training. Because sports are often performed at a spectrum of different velocities, a comprehensive training program should include appropriate exercises performed at a range of velocities.

Force-velocity relationship

Before one can have an intimate understanding of power training, one must first examine the relationship of its 2 components. Through studies involving isokinetic exercise, in which velocity of movement was strictly controlled, it has been well established that force and velocity of human movement are inversely related (3, 7, 14). That is, as speed of

movement increases, the amount of force one can produce decreases. This relationship can clearly be seen by examining the force-velocity curve in the Figure. This produces some inherent problems with training at high velocities and may be why resistance training has traditionally been performed toward the slower end of the velocity spectrum. Much of the benefit of resistance training can be attributed to providing the neuromuscular system with an overload stimulus, in which muscles adapt to being required to move under greater loads than those they encounter during everyday activities (9–11, 16). Because movements at high velocities require lower amounts of force compared with movements at low velocities (Figure), it would appear that there is a very different type of muscular overload. In the authors' opinion, this might result in less muscular hypertrophy.

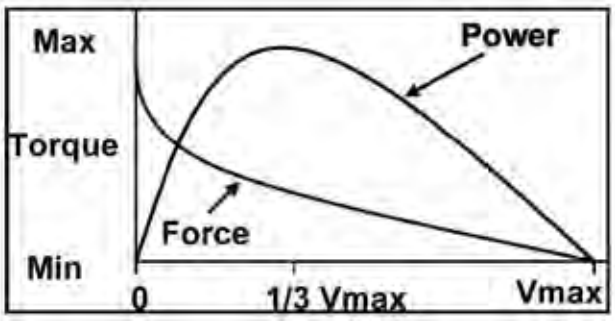

Figure 1. Force-velocity and power velocity curves

Velocity-specific adaptations to exercise

Although there is low muscular overload in terms of force production with highvelocity exercise, it still may have an appropriate place in a resistance-training program. In fact, the benefits of highvelocity exercise have been reported for many years. As early as 1975, Pipes and Wilmore (13) were able to conclude that high-velocity isokinetic exercise was more effective in producing strength gains than was low-velocity isokinetic or isotonic training. A group of 36 men (age 20–38 years) underwent 8 weeks of resistance training in which they performed bench press, bicep curl, leg press, and bent-over row exercises 3 times a week. Those participants who trained with high-velocity isokinetic movements recorded higher mean strength increases during subsequent testing than did those who trained with low-velocity isokinetic or isotonic movements. A later study by Wilson et al. (16) also addressed speed of movement during resistance training. Their study was undertaken to determine the optimal training load with which to enhance athletic performance. Participants were tested for gains in various sport-related skills, such as sprinting and jumping, after 10 weeks of resistance training. The authors reported that those participants who performed exercises with relatively light weights at high speeds performed significantly better on posttests than did those who engaged in traditional heavy-load resistance training or those who performed plyometrics. The participants who trained at high velocities used a load that was one-third of their 1 repetition maximum (1RM). This load was chosen because it is largely agreed upon to be optimal for creating maximal power output during exercise performance (10). In other words, a load of one-third of 1RM is heavy enough to require a significant force output but light enough to be moved at a relatively high velocity. Thus, a combination of moderate loads and high movement speeds yields the most mechanical power. This can be seen clearly when the relationships between force and velocity and between power and velocity are viewed together in the Figure. The peak of the power–velocity curve is seen at relatively high velocity and low load,with respect to given maximums. Furthermore, Morrissey et al. (11) performed a study in which participants performed squats with a load of 8RM. Experimental groups differed only in the velocity with which the exercise was performed. After 7 weeks of training, the fast-velocity group showed a greater improvement in standing long-jump distance (44%) than did the group who performed the same exercise at a slower velocity (31%). Because training loads were similar between groups, performance differences were attributed to the actual velocity with which the weight was moved. Hammett and Hey (4) also reported significant improvements in physical performance as a result of increasing movement speed during training. Half of the participants in their study incorporated a ballistic exercise into their regular off-season training program. After 4 weeks of training, participants who engaged in the ballistic training demonstrated significantly greater decreases in 40-yard sprint times than did participants who did not engage in the ballistic training. Jones et al. (8) agree that there is evidence to support the notion that training effects tend to be velocity specific. Participants in their study performed basic core exercises for 10 weeks with either heavy (70–90% 1RM) or light (40–60% 1RM) loads. Although differences between groups were not reported to be statistically significant, the lowload group presented strong trends toward greater increases in peak power and velocity of movement. Because both groups were attempting to move as quickly as possible, perhaps the actual speed with which the exercise was performed allowed for differences in training effect. Other authors may contend that the lack of statistically significantm differences supports a belief that the intention to move a heavy load quickly produces similar training effects as moving a light load quickly.

Intended versus actual movement velocity

Behm and Sale (1) performed a study to determine if actual movement at a high velocity was necessary to produce a velocity-specific training effect. After 16 weeks of training, they concluded that isometric exercise performed with the intention of moving quickly produced similar training effects to exercise actually performed at a high velocity. Therefore, it was reported that attempting to move a heavy load at a high velocity produced significant high-velocity adaptations.

Behm and Sale (1) argue that it is the attempt to move quickly, and not the actual velocity of movement, that is responsible for velocity-specific training gains. However, these results may be limited in their applicability to resistance-training programs, as ankle dorsi and plantar flexion were the only joint movements performed. Furthermore, results were reported in terms of strength gains only with no attention given to the ability to produce greater velocity. McBride et al. (10) were unable to support the findings reported by Behm and Sale (1). Participants in their study performed jump squats with either a heavy (80% 1RM) or light (30% 1RM) load. Both groups were instructed to perform the lifts as quickly as possible. After 8 weeks of training, the low-load group was able to produce significantly higher movement velocities whereas the highload group was not. These results indicate that the actual velocity of training is important when the goal of training is to be able to produce faster movements.

Increasing acceleration of movement

The benefits of high-velocity exercise may also have to do with the body's ability to reach top speed rather than its ability to produce greater force. Brown and Whitehurst (2) recently determined that high-velocity training improves one's ability to reach a given velocity of movement more quickly. These authors had 2 groups of participants train at either a fast or slow velocity. After just 2 days of training, participants were able to decrease the rate at which they were able to achieve their training velocity. In other words, a significant neural adaptation occurred in the fast-training group, which allowed them to accelerate to their desired speed more quickly. These findings may have particular applications to athletic activities that require speed, agility, and quickness. If we can train a muscle to achieve a faster limb movement more quickly, perhaps we can train athletes to have faster movements during competition.

Program ideas

It is clear to see from the power–velocity curve that peak power is achieved at approximately one-third of peak force (7) (Figure). Thus, it is thought that training with a load near 30% of 1RM will produce the greatest gains in muscular power (10, 11, 16). It is also clear when examining the Figure that the peak of the power–velocity curve occurs near one-third of peak velocity as well. Therefore, if the goal of resistance training is to improve high-velocity activities, an athlete may be better served by training at a velocity higher than one-third of his or her peak. Perhaps training at the high-velocity end of the power–velocity curve would allow for a shift of the peak upward and to the right. Then, the athlete would be able to produce more muscular power at velocities closer to those of the movements seen during competition. This is not to say that resistance training performed at slow velocities trains athletes to be slow and should be eliminated all together. In contrast, improved muscular strength should continue to be the stable base on which any resistancetraining pyramid is built. The idea here is to begin to get exercise professionals to think of movement velocity as an appropriate marker in which to gauge exercise performance rather than to strictly look at load.

Table 1. Sample high-velocity program

Sample high-velocity program		
Exercise	**Velocity**	**Volume**
Clean	Max	5 x 4-5
Squat	Max	5 x 4-5
Dumbbell chest press	Max	5 x 4-5
Step-up	Max	5 x 4-5
Dumbbell row	Max	5 x 4-5
Dumbbell shoulder press	Max	5 x 4-5
Standing calf raise	Max	5 x 4-5

The difficulty lies in that without the use of sophisticated computerized equipment, exercise velocity is very hard to set constant. Furthermore, each athlete possesses his or her own maximum velocity for a given movement. Therefore, it may not be as important to know precisely how fast an exercise is performed but rather that it is being performed as quickly as possible. Qualitatively, each athlete should perform the given exercise with maximal velocity. It may be pertinent to create a volume scheme that utilizes a set load lifted multiple times at or near peak velocity. Because attaining high velocity of movement would be the goal, very low percentages of RM (<30% 1RM) would need to be used. Table 1 provides a proposed high-velocity workout in which movements would be performed at each individual's peak velocity. A final problem lies in the prescription of an actual exercise volume. The effects of high-velocity exercise have been studied in detail, but currently there is no consensus in the literature regarding appropriate training volume (12). In theory, high-velocity exercise may be likened to high-intensity, heavy-load exercise with the goal of recruiting primarily type 2 muscle fibers. Instead of performing at the end range of a given athlete's force spectrum, though, exercise is performed at the end range of the athlete's velocity spectrum. High-velocity exercise may require fewer repetitions per set and more rest between sets in order to be effective.

Table 2. 4-week strength and power microcycle

4-week strength and power microcycle			
	Day 1	**Day 2**	**Day 3**
Week 1	Heavy load	High velocity	Moderate load
Week 2	High velocity	Low load	High velocity
Week 3	High velocity	Low load	High velocity
Week 4	Low load	High velocity	High velocity

Periodization

High-velocity exercise may have an appropriate place in a periodized resistance-training program designed for athletes who require speed and quickness. Attempting to make gains in these areas just before the onset of a competition phase may help these athletes achieve peak performance. For instance, incorporating 1 or 2 "speed" days during a strength and power microcycle, in which athletes performed power, core, and some assistance exercises with low loads and very high velocities, might help produce limb movement that reaches peak velocity more quickly. Table 2 provides a sample strength Band power microcycle, which includes highvelocity days. If this microcycle were placed just before an athlete's competition phase, it might help create a peak in speed and quickness.

Conclusion

Resistance training has become one of the modern athlete's primary tools with which to prepare for competition. Exercise professionals are constantly in search of new and different training stimuli to enhance performance. Applying attention to the velocity of exercise performed in addition to the load may be a way to promote gains in speed and quickness. Exercise performed in the highest ranges of an athlete's velocity spectrum may not produce significant muscular overload but may instead improve his or her ability to increase movement velocity and reach this velocity more quickly. With this in mind, exercise in which velocity of movement is kept near its peak may be appropriate to include just before the competition phase for athletes who require speed and quickness more so than shear strength. All resistance-training models should be predicated on the foundation of improving muscular strength. However, the inclusion of velocity-specific exercises may be appropriate when further sport specificity is desired.

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IS HYPERTHERMIA A LIMITING FACTOR DURING LONG ENDURANCE COMPETITIONS IN TOP LEVEL ATHLETES?

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Abstract

Hyperthermia (increases in core temperature above 38˚C) induced by intense exercise causes central fatigue ([1]) and reduces time to exhaustion during exercise in the heat ([2]). The cited studies have been performed in a laboratory setting. However, it remains unclear if elite athletes experience hyperthermia during their regular training and/or competition and furthermore if that could negatively affect performance. The purpose of this study was to measure core temperature response to regular training or competition in elite athletes. 29 athletes (8 professional cyclists, 12 rowers, 3 endurance runners of international level and 6 international triathletes) were studied during competition. At least 1 hour prior to the exercise subjects ingested a pill containing a telemetric temperature sensor (CorTemp™ Ingestible Thermometer, HQInc. USA) which signals were collected and recorded (CorTemp™ 2000 Recorder;HQInc. USA) at rest and frequently during exercise. The manufacture's reported sensitivity ranges from de 0º a 50ºC with an accuracy of ± 0.1 ºC. Dry bulb temperature and relative humidity were also recorded (Kestrel 4000 NK; Nielsen–Kelleman, USA). In addition heart rate was recorded using a telemetric unit (Accurex, Polar, Kempele, Finland). The highest core temperatures recorded during competition ranged from 38.1 to 42.3ºC with (average of 39.5 ºC). 5 out of the 29 athletes (17%) reached core temperatures above 40ºC. The highest heart rates during competition ranged from 185 to 203 bt/min (average 186 bt/min). In endurance sports during long lasting competitions events core temperature reaches high levels in elite athletes (39.5 ºC). This high core temperature is achieved despite normothermal environmental conditions (25º C). Thus it is possible that endurance performance during competition could be affected by hyperthermia.

Key words: *endurance events, performance, competition, hyperthermia*

Introduction

Hyperthermia increases in core temperature (Tcore) above 38˚C induced by intense exercise causes central fatigue (1), such as a recent study demonstrated in triathletes during a 226 km Ironman triathlon where the Tcore was 38.1±0.3 degrees (5). Moreover, time to exhaustion in cyclists in the heat is reduced (2) and alter the prefrontal cerebral area activity (1). Equally the hyperthermia increases oxidative stress and selectively affects specific lipid markers, independent of oxygen consumption in humans (4). During exercise, Tcore is proportional to the metabolic rate and largely independent of a wide range of environmental conditions (3). The cited studies have been performed in a lab setting using trained subjects (1,2) or during competition with medium athletes (5). However, it remains unclear: 1) if elite athletes experience hyperthermia during their regular training and competition and 2) furthermore if that could negatively affect performance. Therefore the aim of this investigation was to described Tcore responses to competition during endurance events in a selective group of top level athletes.

In this context, the purpose of our study therefore was to measure core temperature responses to regular training or real competition in a selective elite endurance athletes group using an ingestible pill telemetry system (Byrne et al., 2007).

Methods

29 volunteers elite athletes (8 professional cyclists, 12 rowers, 3 endurance runners of international level and 6 top level triathletes) were studied during competition and participated in this study after having the procedures explained to them in detail and giving their written consent. The investigation was carried out during the summer of 2005 when the sportmen were inside the competitive period. During the study period all the athletes carried out the training program. The coaches were informed carefully about the experimental procedures and the possible risk and benefits of the project with the approval of the local committee of ethics and gave written consent to participate in this study, which conformed

to the Declaration of Helsinki. Our selection of highly trained and motivated athletes for this study was based on our experience that competitive athletes are generally willing and able to withstand considerable discomfort and to exercise until the development of physiological signs of exhaustion.

Height (cm) was calculated by a tallimeter model SECA® (Germany), with a precision (2 mm) and a range (130-210 cm). The player in the plane (Frankfurt Horizontal) and mass (kg) were recorded by a weighing machine model SECA® (Germany), with a precision (0.2 kg) and a range (2 kg. a 130 kg). Body fat percentage was estimated by measuring skinfold-thickness (Amount: subscapular, tricipital, suprailiac, abdominal, thigh and lower leg) using skinfold calipers (Harpenden, British Indicators, LTD), with of accuracy (0.2 mm).

We scored the number of the years that the athletes have developed a top level training (4-5 hours per day).

Experimental design

The investigation was carried during real competition in different endurance events (cycling, rowing, running and triathlon), during 2005 summer. During the study period all the athletes carried out the training program competitions in all the sports were of international level.

Pre-events determinations

Participants carried out their routine pre-competition programme with a few minor changes. They arrived to the competition places with their upon-waking urine sample, and subjects reported at least 1 hour prior to the exercise ingested a pill containing a telemetric temperature sensor.

Core temperature

Core body temperature was measured telemetric temperature sensor (CorTemp™ Ingestible Thermometer, HQInc. USA) which signals were collected and recorded (CorTemp™ 2000 Recorder; HQInc. USA) at rest and frequently during exercise. The manufacture's reported sensitivity ranges from de 0º a 50ºC with an accuracy of ± 0.1ºC. Dry bulb temperature and relative humidity were also recorded (Kestrel 4000 NK; Nielsen–Kelleman, USA). Each pill contains a crystal quartz oscillator which transmits a low frequency radio wave to an external receiver/data logger. The ingestible pill was swallowed 3 hours before the races to ensure that it would be past the stomach and insensible to swallowed hot or cold liquids.

Heart rate

In addition heart rate (HR) was recorded using a telemetric unit (Accurex, Polar, Kempele, Finland). Each athlete was familiar with the use of the monitor since these were employed during daily training sessions. Before warm-up, each player is fitted with a monitor below the chest at the level of the xiphoid appendix held in place by an elastic band.

Using this set up, movement is not restricting and the monitor does not bother the athlete or rest of the team in the event of contact between participants. Performance times and HR were measured every kilometre. During the course of each competition, the HR was recorded by the monitor at one-second intervals. These data were introduced into the computer by the software Polar Precision Performance®, to provide a HR trace for each race and athlete. The data provided by the software were the maximum HR (HR_{max}) and mean HR (HR_{mean}) for each athletes and both these rates expressed as percentages of the individual HR_{max} recorded .

Statistics analyses

Student's t test for paired observations was used to evaluate the significance of differences between the values obtained. A repeated-measure analysis of variance (ANOVA) and a least significant difference procedure were used to determine the time points deviated significantly from the initial resting value.

Results

For most test ambient temperatures averaged 25 ºC and relative humidity never exceed 60%. In one test dry temperature rose to 32.5ºC and humidity to 72 %. The highest Tcore recorded during competition ranged from 38.1 to 42.3ºC with (average of 39.5ºC). 5 out of the 29 athletes (17%) reached Tcore above 40ºC. The highest HR during competition ranged from 185 to 203 bt/min (average 186 bt/min).

Discussion

The present research was designed to investigate Tcore responses to regular training or real competition of a selective elite male athletes group in endurance events (professional cyclists, Olympic rowers, endurance runners and triathletes of international level) during real competition, because there is a few scientific data about this phenomenon in elite population during real competition. The main finding of our study was the highest Tcore recorded during competition ranged from 38.1 to 42.3ºC with (average of 39.5 ºC). Morever, 5 out of the 29 athletes (17%) reached Tcore above 40ºC and the highest HR during competition ranged from 185 to 203 bt/min (average 186 bt/min). The highest Tcore recorded during competition ranged from 38.1 to 42.3ºC with (average of 39.5 ºC). Morever, 5 out of the 29 athletes (17%) reached Tcore above 40ºC. Previous studies with triathletes during a 226 km Ironman triathlon also described Tcore [(38.1 (0.3) degrees C)] (5) and described that Ingestible telemetric temperature sensors demonstrated utility for continuous measurement of Tcore during mass-participation running (6). In our study we observed that the highest HR during competition ranged from 185 to 203 bt/min (average 186 bt/min), such us previous studies have described in different sports, in running, in triathlon, in rowing, in cycling, but another phenomenon has it described that hyperthermia increased thermoregulatory demands and reduced exercise performance and HR increased during exercise (9).

Limitations

One limitation to the present study that should be mentioned is that, whereas Tcore was measured at least 1 hour prior to the exercise, we evaluated Tcore in the stomach, because the athletes although and in the intestine 4 hours before, given that Intestinal temperature proved a useful method of recording Tcore, such us previous studies have reported (Edwards and Clark, 2006), however, technological limitations still restrict the wider application of this method, especially at a competitive level (Edwards and Clark, 2006).

Conclusions

In conclusion, our findings suggest that in endurance sports during long lasting competitions events Tcore reaches very high levels in elite athletes (39.5ºC). This high Tcore is achieved despite normothermal environmental conditions (25ºC). Thus it is possible that endurance performance during competition is affected by hyperthermia. Further studies in endurance athletes during real training and/or competition are required to prove this possibility.

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CORRELATES OF SUCCES IN BASKETBALL: PHYSIOLOGICAL PROFILING OF ELITE PLAYERS

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Abstract

In the last two decades, there has been significant accumulation of scientific data regarding basketball physiology and medicine. Previous investigations have evaluated ideal physiological and anthropometric profile of successful basketball players mostly from North America although there is a lack of descriptive data concerning characteristics of elite basketball players from Europe. The physique of basketball players may be one of the essential factors that contribute to the success of basketball teams in international competition. Aspects such as experience, body composition, endurance, balance between anaerobic power and aerobic power, among other factors, are of primary importance in evaluation of elite players. Since basketball is consisted of variety of individual and collective skills that are executed in the context of competitive match-play, ideal physique and physiology is not sufficient in itself for excellence in basketball. It is highly possible that other components of basketball (e.g. technique, tactics, strategy of the coach) play a key role in final sport result which requires further investigation.

Key words: *basketball, body composition, VO_2 max, muscle fiber types*

Introduction

Basketball is one of the world's most popular court games, being played in almost every nation without exception. Yet, basketball in United States is considered by many to be at the level that most countries strive to reach and lots of teams try to adopt the American style of play with specific physiological requirements of the athlete and original athlete's training programs. In the last two decades, there has been significant accumulation of scientific data regarding basketball physiology and medicine (Parr et al. 1978, Gillam 1985, Soares et al. 1986, Bolonchuk et al. 1991, Hoffman et al. 1991, Latin et al. 1994, Viviani 1994, Tavino et al. 1995, Caterisano et al. 1997, Hoffman et al. 1999; Ostojic et al. 2006). Previous investigations have evaluated ideal physiological and anthropometric profile of successful basketball players mostly from North America although there is a lack of descriptive data concerning characteristics of elite basketball players from Europe, particularly Serbia. Yet, during the last 30 years, along with Americans, Serbian basketball players and coaches established well-known and successful style of play. The physique of basketball players may be one of the essential factors that contribute to the success of Serbian national basketball teams in international competition (Ostojic et al. 2006). Aspects such as experience, body composition, endurance, balance between anaerobic power and aerobic power, among other factors, are of primary importance in evaluation of elite players (Scheller and Rask 1993; Hoffman 2003). However, it is difficult to find specific physiological and anthropometric "correlates of success". The purpose of this paper was to describe structural and functional characteristics of elite basketball players, and to evaluate whether players in different positional roles have different physical and physiological profiles. Understanding the profile of successful players could give coaches, trainers, and exercise scientists better working knowledge of this particular group of athletes.

Biographical data and correlations

The biographical profile of basketball players can be characterized by the heterogeneity expressed within teams, between players' competitive levels and across nationalities (Bolonchuk et al. 1991, Hoffman et al. 1991, Viviani 1994). However, in modern sport, particularly basketball, professional experience and mature tactical judgement became important factors of performance excellence (Ostojic et al. 2006). The average age of top players is about 25 years (Parr et al. 1978; McInnes et al. 1995) with guard players were older and had significantly higher professional experience than other positional roles. Nowadays professional players do seem prepared to stay in the game for longer than was traditional. This is probably due to fact that professional level of game-play requires competent and well-versed players and commercial attractions of maintaining players' career as long as possible. The fact that the guards are the oldest and most experienced players may be related to the specific requirements of the position, and unique tasks during the game (e.g. play-making, commanding, assisting) could play a role in mentioned difference. Yet, correlation between age and learning effects, skills and abilities requires more investigation.

Body size and composition in elite players

Unique types of body size and proportion may constitute important prerequisites for successful participation in basketball. Recent research on elite male basketball players has illustrated the development of the trend towards an increase in height and the variation in height and weight for positional play in basketball (Viviani & Casagrande 1990; Latin et al. 1994, Ostojic et al. 2006). Previous studies of physical and physiological characteristics of male basketball players are summarized in table 1. Centers are ussually significantly taller and heavier than guards and forwards. Since the game involves physical contact with the intention of getting the ball in a basket elevated 3.05 m above the ground level, physical attributes of centers could help them to dominate in "low-post" position which involves box-outs, picks and rebounding. The shorter the center, the higher he has to jump in order to play successfully in this aerial zone. On the other side, the playmakers (guards) with the lower mass, height and body fat percentage are the most skilful players and are used to set up the attacks which are sometimes completed by the taller players. Data on height, body mass and body composition of basketball teams from other studies suggests that players vary widely in body size (Gillam 1985; Hoffman et al. 1991; Ostojic et al. 2006). Thus, these parameters are not essential factors for success in basketball; moreover, they might determine the playing positional role. A particular body size may be an advantage in certain match-play situation while disadvantage in other.

Table 1. Physical and physiological characteristics of male basketball players

Investigator	Population	*N*	Height (cm)	Weight (kg)	Body fat (%)	VJ (cm)	VO_2 max ($ml \cdot kg^{-1} \cdot min^{-1}$)
Parr et al., 1978	NBA League	34	C - 214.0 ± 5.2 F - 200.6 ± 5.0 G - 188.0 ± 10.3	C- 109.2 ± 13.8 F - 96.9 ± 7.3 G - 83.6 ± 6.3	7.1 - 13.5	- - -	C - 41.9 ± 4.9 F - 45.9 ± 4.3 G - 50.0 ± 5.4
Soares et al., 1986	Brazilian National	21	C - 206.6 ± 4.1 F - 196.9 ± 4.6 G - 185.4 ± 8.6	C - 102.1 ± 17.6 F - 92.0 ± 6.9 G - 79.3 ± 7.3	- - -	C - 55.9 ± 8.1 F - 66.8 ± 8.3 G - 61.6 ± 8.5	C - 59.7 ± 6.9 F - 59.9 ± 5.1 G - 74.4 ± 6.8
Hoffman et al., 1991	NCAA Division I	9	196.4 ± 11.9	89.0 ± 11.3	-	64.3 ± 7.9	-
Latin et al., 1994	NCAA Division I	437	C - 205.5 ± 6.1 F - 198.4 ± 3.8 G - 187.4 ± 5.8	101.9 ± 9.7 95.1 ± 8.3 82.9 ± 6.8	C - 11.2 ± 4.5 F - 9.7 ± 3.9 G - 8.4 ± 3.0	C - 66.8 ± 10.7 F - 71.4 ± 10.4 G - 73.4 ± 9.6	C - 55.0 F - 56.0 G - 56.0
Tavino et al., 1995	NCAA Division I	9	-	87.7 ± 6.7	9.8 ± 1.9	-	65.2 ± 6.2
Hoffman et al., 1996	NCAA Division I	29	197.9 ± 8.1	91.9 ± 10.1	-	67.3 ± 6.0	-
Caterisano et al., 1997	NCAA Division I	9	-	92.2 ± 8.2	5.9 ± 3.1	-	53.0 ± 4.7
Hoffman et al. 1999	Israel National	20	194.2 ± 6.0	88.4 ± 8.0	12.9 ± 3.1	-	50.2 ± 3.8
Ostojic et al. 2006	Serbian National	60	C - 207.6 ± 2.9 F - 200.2 ± 3.4 G - 190.7 ± 6.0	C - 105.1 ± 11.5 F - 95.7 ± 7.1 G - 88.6 ± 8.1	C - 14.4 ± 5.6 F - 10.1 ± 3.2 G - 9.9 ± 3.1	C - 54.6 ± 6.9 F - 57.8 ± 6.5 G - 59.7 ± 9.6	C - 46.3 ± 4.9 F - 50.7 ± 2.3 G - 52.5 ± 4.8

Note. From studies Hoffman et al. (1991) and Tavino et al. (1995) we included variables from preseason phase/group. From study Hoffman et al. (1996) we included variables from season 1991/92 and from Caterisano et al. (1997) only characteristics of starters. Abbreviations VJ - vertical jump; VO_2 max - maximal oxygen uptake; C - centers, F - forwards, G - guards.

Energy requirements in basketball

A question concerning whether to characterize basketball as an aerobic or anaerobic sport has been a subject of debate. Most investigators classify basketball as a sport relying on the ATP-PCr system and on the lactic acid system (Bergh et al. 1978; Hoffman et al. 1999). The aerobic system is one of the secondary sources of energy provision during basketball match-play and the average values of VO_2 max for elite basketball players tend to be relatively low as compared to endurance athletes, supporting the above statement (McInnes et al. 1995; Caterisano et al. 1997). However, while VO_2 max values may be influenced by differences in standards of play, training regimes and the phase of season, team with superior aerobic fitness would have the advantage, being able to play the game at a faster pace. Higher level of endurance capacity (higher VO_2 max, lower HR_{max}) will give guard players a better base for on-field performance regarding intensity and demands of basketball match-play (Ostojic et al. 2006). This is probably a consequence of the style of play undertaken by guard players who had the highest workrate. The maximal oxygen uptake of the elite players was about 50-55 $ml \cdot kg^{-1} \cdot min^{-1}$. It appears that most elite players generally fall toward the center of the continuum of maximal oxygen consumption of elite athletes from different sports. Yet, it has been suggested by a number of investigators that success in basketball appears to be more dependent upon the athlete's anaerobic power rather than on aerobic power and capacity (Parr et al. 1978; Hoffman et al. 1996). The vertical jump height itself is a good measure of specific muscular performance (anaerobic power). For vertical jump heights, we found similar results between different positional roles while vertical jump power was significantly higher in centers as compared to guard players and we also found strong negative correlation between subjects physique and vertical jump. Latin et al. (1994) proposed that a higher level of anaerobic and strength parameters would be preferable and would reduce the risk for injuries and allow for more powerful rebounds,

shooting and shuffling among other factors. It would be reasonable to expect that the elite basketball player have values higher than 60 cm according to the recent findings (Viitasalo et al. 1992). However, several authors have reported that the mean vertical jump in male basketball players was over 70 cm and vertical jump power was over 1700 W (McInnes et al. 1995; Hoffman et al. 1996). Moreover, significant differences were seen between positions with guards and forwards jumped significantly higher than centers (Ostojic et al. 2006). The problem with making comparisons of vertical jump data from various literature sources can be related to the methods of testing employed, different testing protocols and the phase of the season. Moreover, performance of basketball players in vertical jump test tends to show up influences of training stage and specific plyometric training program employed which requires more investigation.

Muscle performance characteristics of basketball players in many respects are determined by their distribution of different fiber types: fast twitch (FT) and slow twitch (ST). A basketball player demands an ability to sustain physical effort, mostly discontinuous, over 40 minutes, some of which is at high intensity. As the activity profile is compatible with both slow and fast twitch muscle fiber characteristics, a combination of muscle fiber types (with predominance of fast twitch) would be expected in elite players (Costill et al. 1976; Bergh et al. 1978). The most investigators found a significantly higher percentage of estimated fast twitch muscle fibers in elite players (Komi & Karlsson 1978; Bolonchuk et al. 1991). However, estimated percentage of fast muscle fibers seems to be similar in all positional roles. Although, any conclusions about fitness level, muscle fiber type and elite basketball play could be incomplete. Method of assessment, nature and intensity of training are, among others, factors that can influence measurement of fiber type distribution and amount.

Conclusion

Dominance of Serbian basketball teams in international competitions is probably not due to their superior physical and physiological parameters since measured parameters were in general agreement with previous data from elite basketball players from other countries. Since basketball is consisted of variety of individual and collective skills that are executed in the context of competitive match-play, ideal physique and physiology is not sufficient in itself for excellence in basketball (Latin et al. 1994). It is highly possible that other components of basketball (e.g. technique, tactics, strategy of the coach) plays a key role in final sport result which requires further investigation. The success of the basketball team depends on how different individuals are blended into an effective playing unit. The coach could decide to alter the team's style of play according to the physical condition of the players, opponent or the circumstances in a game. These strategic differences in play style could have a large impact on the physiological requirements of the basketball player and athlete's training regime (Hoffman 2003). More research work has to be done before definitive inference can be made; however, the results of the present study demonstrated relationship between aerobic and anaerobic power and positional roles in basketball. Such qualities are prerequisite and advantage for playing basketball on elite level. From a practical standpoint, this information is important for coaches and trainers to adjust training regimes and concentrate on the variables that are specific to improve performance and achieve success in basketball.

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BALANCE AND FUNCTIONAL JOINT STABILITY AS IMPORTANT ELEMENTS IN PHYSICAL CONDITIONING AND INJURY PREVENTION

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Abstract

The term *proprioception* was first introduced by Sherington in 1906, who described it as a type of feedback from the limbs to the central nervous system. Since that time, numerous authors have investigated various aspects of proprioception and neuromuscular control. The contemporary terms of joint position sense, kinesthesia, and sense of tension or force are considered submodalities of proprioception.

According to the chosen exercise and corresponding geometry of the facility we can determine most suitable load for each individual. The effects of proprioceptive training are: the increase of muscular activation after the injury, the reduction of reflex-reaction times on stretching, the improvement of inter-muscular coordination, the improvement of poise and balance, the improvement of the awareness of one's body in a room and therefore, the reduced susceptibility to injuries.

A comprehensive amount of trainings and competitions, to which players are exposed today, should play a key role in training planning and consequently in careful planning of indispensable health prevention contents. We are firmly convinced that health prevention contents like joint stability training should be a part of every physical conditioning and rehabilitation program.

Key words: *balance and functional joint stability, physical conditioning, injury prevention*

Introduction

The term *proprioception* was first introduced by Sherington in 1906, who described it as a type of feedback from the limbs to the central nervous system. Since that time, numerous authors have investigated various aspects of proprioception and neuromuscular control. The contemporary terms of joint position sense, kinesthesia, and sense of tension or force are considered submodalities of proprioception.

It has also been described as an ability of the organism to consciously and reflexively recognize the position of its body parts in a certain room and time (Enoka, 1994). When protecting joints from unexpected quick and violent mechanical disturbances, reflex control is important. Conscious contractions are in most cases too slow to prevent the injury, because their nerve paths are usually longer than that of a reflex and therefore also slower. Proprioception obviously involves different sensory systems of muscles, ligaments, tendons, joints and skin, and organs of vision and balance.

Proprioception, the combined functions of joint position sense and kinesthesia, has been identified as an important component for optimal joint function (Allegrucci et al., 1995; Borsa et al., 1994; Lephart et al., 1994). Joint injury can affect proprioception, disrupting the normal neuromuscular function such as affected protection reflexes (Smith, & Brunolli, 1989), impaired joint reposition sense (Rogol et al., 1998), and other proprioceptive deficits (Lephart et al., 1994).

The interaction between all the involved components is mediated by the sensorimotor system, which encompasses:

- *sensory part* – peripheral receptors for different modalities with accompanying afferent nerve fibers that transmit sensory information to the central nervous system. Sensors differ according to their detection properties: (i) low-threshold, slow-adapting Ruffini-type afferents in a capsule and ligaments, (ii) low-threshold, rapid-adapting, Pacinian-type afferents in a capsule and ligaments, (iii) tension sensitive Golgi tendon organs, (iv) length and rate-of-length sensitive muscle spindles, and (v) cutaneous mechanoreceptors.
- *central nervous system* – integration of afferent information and subsequent processing of motor responses on different levels (i) spinal cord, (ii) brain stem, (iii) motor cortex. Each level elicits unique motor responses (reflex, automatic, and voluntary) vital to coordinated movement and functional joint stability.
- *motor part* – peripheral motor pathways together with the end-effectors, the muscles. They represent adjustable dynamic stabilizers of the joint complex.

Different methods have been used in order to evaluate the components of joint stability ranging from most analytical to more complex kinds of measurements. Assessment of the sensory and sensorimotor system in the context of functional

joint stability has been extensively reported in the literature and involves (i) threshold to detection of passive motion, (ii) joint position sense, (iii) active joint position reproduction, (iv) force reproduction, (v) single-arm closed chain dynamic stability test on the force plate, etc. (Dover, & Powers, 2003; Myers et al., 1999; Myers, & Lephart, 2000).

Review of experimental work

Study 1: Joint stability training in top level basketball players reduces susceptibility to overuse injuries: a 4-year longitudinal study

The aim of our study was to evaluate the effects of a continuous systematic and progressive SMT on injury prevention in a top basketball team.

15 senior top basketball players (23.2±2.4 years) were studied throughout the four consecutive seasons. Statistics on trauma of the last two years was compared to the statistics of the first and the second year. The main distinction between the two two-year periods was introduction of injury-prevention contents, by means of SMT, into the training programs of the last two seasons. In a preparatory phase SMT was performed 3 to 4 times a week for at least 25 minutes on each occasion. Training was individualised and the principle of progressive increment of complexity and amount of the exercises was strictly respected. In the competition phase the SMT was maintained within at least 2 sessions a week. Basic statistics and chi-square test were used to compare data on trauma of the seasons.

In every analysed season the team had 15 players. In the first season 14 players reported 87 overuse injuries, while in the second season 12 players reported 78 injuries of this type for which they received medical attention. The three most common injuries were low back pain, jumper's knee, and Achilles tendinopathy. However, in the seasons three and four the number of overuse injuries dropped dramatically; 7 players with 24 injuries and 8 players with 28 injuries, respectively. The most common were low back, groin, and thigh pain. Differences between the two two-year periods were statistically significant ($P<.05$).

Our data confirm the hypothesis that predicted the reduction of level as well as frequency of the lower limb injuries during the training season as a result of SMT. Diminished absence of the athletes from the conditioning process enabled the coach to gradually develop the whole team through the extended time period. The high quantity of drill and competitions that an athlete normally experiences should also dictate the shape of a training process. We strongly believe that health supportive contents such as SMT should become a part of every strength and conditioning program in basketball.

Study 2: The length of the lever arm of the instable platform affects muscle activation

Current knowledge lacks to explain how to gradually advance the pretentiousness of the balance exercise in order to optimize its efficiency. The aim of the present study was to test the differences in muscle activation patterns and mechanical parameters during the execution of the ankle balancing exercise. Additionally, we tested the effect of the geometry of the instable platform on the muscular activity.

20 volunteers participated in the study. They performed single-leg balancing exercise standing on the platform which was instable in the frontal plane. During the 60s balancing we acquired signals of the goniometer and 7 pairs of EMG electrodes glued over the muscles on the exercised side. The same measurements have been carried out using 10 different lengths of the lever arms (from -8 cm to +8 cm). The dynamics of the changes of the platform position and the muscular activity were compared among conditions.

Mechanical as well as EMG signals depended on the length of the lever arm of the platform. The length of the lever arm affects the stability of the system more when the axis is below the platform. When the rotation axis is above the instable platform, there is more co-contractions and sustained muscular activity than when the axis is bellow the platform.

It seems possible to use systematic changes of the geometry of the instable platform as the method for the control of the joint stability training intensity. Based on our results we developed a training-diagnostic mobile machine convenient for clinical use.

Study 3: Trunk stability training in chronic lumbago

Low back pain is one of the most common orthopedic problems. Etiology can be very diverse, if only the patients share many deficiencies of their locomotor system. The aim of our study was to check the effectiveness of the sensory-motor trunk stability training in chronic low back pain patients.

10 subjects (3♂, 6♀; 48±8 yrs) volunteered for the study. After the initial measurements had been done, the experimental group was exposed to 8-week trunk stability training. Training sessions supervised by a professional staff have been carried out two times a week, for 50 to 75 min (10 min warm-up, 35 to 60 min stability training, and 5 min warm down). The subjects performed circuit training that consisted of 8 stations. Intensity as well as quantity of the exercises has been progressively modified. To test the training effects on flexibility, strength, reflex stabilization of the trunk, and individual self satisfaction, final measurements were done using the same diagnostic battery as at the beginning. We

measured maximal isometric force (trunk flexion and lateral flexion, hip flexion and extension), flexibility (hip flexion and extension, Schober thoracic and lumbar, lateral flexion), m. multifidus reaction time to sudden external disturbance, Oswestry questionnaire, visual pain scale. Paired t-tests have been carried out in order to test statistical significance of the differences.

The general satisfaction of the subjects with the exercise program was very high (average 8 out of 10). After the training intervention, Oswestry total as well as pain level decreased significantly (7.0±2.1 to 4.0±2.5; P<.01 and 3.8±0.7 to 2.3±0.5; P<.01 respectively). The strength tests showed significant effects of the training program on trunk flexors and lateral flexors (41.7±15.1%; P<.001 and 33.3±25.2%; P<.05 respectively) while no significant changes were identified for the strength of hip muscles. Inversely, the flexibility tests indicated improved maximal range of motion for hip flexion and extension (10.4±12.8%; P<.05 and 34.4±26.1%; P<.01 respectively), while trunk flexibility remained unchanged. Multifidus reaction times to sudden perturbation was significantly decreased (98±12 ms to 87±14 ms; P<.05) after the trunk stability training.

Our data suggest that a changed neuro-muscular control in patients with chronic lower back pain can be affected by the use of systematic trunk stability training. Combining both basic situations that require trunk stability ("legs-to-center" and "arms-to-center") is a promising kinesioterapheutic approach.

Study 4: Development of the balance board for the purpose of feed-back training and quantitative evaluation of joint stability

The aim of our study was to test sensitivity and reliability for two commonly used balance tests and compares it to that of a novel method for balance testing (Clever Balance Board (CBB)).

The study was carried out on 102 pupils (39♂, 41♀; 14.3±2.7 yrs; 4.86±.76 ft; 97.2±22.3 pt; 21.5±7.8% body fat). Every subject performed three balance tests (Flamingo, advanced Rhomberg, and test on the CBB), each of them three times with 3 to 6 minutes rest between consecutive trials. All of the measured parameters related to a single test were analyzed for sensitivity (stdev, min/max) and repeatability (correlation based test-retest analysis).

Results showed that Romberg and Flamingo tests have poor sensitivity since there were a large number of subjects achieving the best results possible. Therefore, frequencies showed right-asymmetrical type of distribution for these two tests. However, normal distribution and high sensitivity was observed for all the parameters of the CBB test. The latter has also dominated considering the repeatability, ICCs of Rhomberg, Flamingo, and CBB parameters were 48.9, 61.1, and 73.0-81.2 % respectively.

It can be concluded that metric characteristics of the CBB in comparison to the other two (Flamingo & Rhomberg) clinical balance tests are dominating. Because of its portability and moderate price CBB could be easily applied to routine balance diagnostic procedures. Our results prove that the CBB dominates other two tests regarding both metric characteristics, sensitivity and repeatability, tested.

Study 5: Use of Stance Width and Asimetry to Progressively Load Hip Abductors during Balancing

One of the options to increase intensity in closed chain stability training is to increase weight bearing function in the active body segment. The aim of this study was to test the effect of the stance width during balancing on a tilt board on muscle activation patterns.

Eleven healthy volunteers (9♂, 2♀; 24.4±3.1 yrs) were included. After the standardized warm-up had been carried out, they balanced four times 60 seconds on a tilt board, thereby using different position of the foot each time - (i) wide symmetrical, (ii) narrow symmetrical, (iii) asymmetrical, and (iv) single leg. Trials were carried out in a randomized order to avoid systematic effects. Rest between two consecutive trials was 4 minutes. EMG electrodes were glued over the m. vastus lateralis, m. vastus medialis, m. biceps femoris, and m. gluteus medius on both sides. Signals were acquired by the polygraph (Noraxon, USA) and analyzed off-line. Average values of the filtered, rectified and smoothed EMG signal were observed and normalized using the MVC-EMG as the normalization criteria. Repeated measures ANOVA and t-tests were used for statistical analyses.

Analyses revealed a systematic effect of the foot position on the amount of muscle activation (ANOVA, P<.01). During a symmetrical both-legs balancing, regardless of the stance width, m. gluteus medius remains low in its activity. Other muscles showed increased activity in the symmetrical narrow stance. Activity of the m. gluteus medius was significantly higher in asymmetrical both legs balancing task and single leg stance.

These results point out the importance of the foot positioning while balancing on a tilt board for the actual muscle function. We believe different levels of positioning asymmetry should be used for gradual loading of the extremity and for evoking activity in hip side stabilizers.

Study 6: Additional exteroceptive plantar stimulation does not affect motor control of balance

This study was carried out in order to test the effects of additional plantar stimulation on EMG activation characteristics and mechanical efficiency during balancing on stable and unstable surface.

11 recreational sportsmen (9 men, 2 women; 24.4±3.1 years). Sixty seconds balancing: (i) single-leg standing on a force plate (eyes closed, hands akimbo), (ii) single-leg balancing on the frontally unstable tilt board (extended knee), (iii) both-legs balancing on the frontally unstable tilt board (flexed knees). Each of the balancing tasks was performed on different textures of the standing surface: (i) flat, (ii) soft rubber cobblestones, (iii) hard rubber cobblestones, (iv) pain-limiting texture. The twelve repetitions (3 tasks, 4 surfaces) were performed in a random order (4 minutes rest). EMG electrodes on m. tibialis anterior, m. soleus, m. peroneus longus, m. gastrochenimus lateralis, m. vastus lateralis, m. vastus medialis, m. biceps femoris, m. gluteus medius. Signal processing (filtered, rectified,smoothed, and normalized) and statistical analyses (ANOVA and t-tests).

Results showed no statistically significant differences among different textures of surface in any of the balancing tasks ($P>.05$). Post-hoc t-tests showed limiting values for the hardest surface, which might be assigned a random character, since absent after applying Bonferoni correction. There were also no significant differences in mechanical signals which were acquired synchronously with the EMG.

Our results suggest that additional plantar exteroceptive input during balancing tasks have no significant effect on the quality of the motor act. Neither muscle activation nor mechanical parameters measured were changed as a result of different roughness of the standing area.

Conclusion

The contents of proprioceptive training are very effective, relatively safe, demand little energy and are at the same time very entertaining. Means of such exercise include balance exercises on tilt and wobble boards and other unstable supporting surfaces, which cause dynamically unstable positions of joints or joint systems. This ability also displays a great degree of connection to the other motor abilities, especially to coordination and agility. The agility of an individual depends on the degree of coordination, whereas the realization of coordination depends on the ability to assure balance. As in motor abilities, it is reasonable to adhere to the principle of gradual progression in proprioceptive training. Each basic exercise can be performed in many different ways. And if we want to make a basic exercise more demanding, we can in addition perform a coordination exercise, or preliminarily disturb the balance organ, or eliminate the organ of sight, etc. According to the chosen exercise and corresponding geometry of the facility we can determine most suitable load for each individual. The effects of proprioceptive training are: the increase of muscular activation after the injury, the reduction of reflex-reaction times on stretching, the improvement of inter-muscular coordination, the improvement of poise and balance, the improvement of the awareness of one's body in a room and therefore, the reduced susceptibility to injuries (DeLee, Drez, & Miller, 2003).

There are some suggestions important for the applications in rehabilitation, and injury prevention programs of the shoulder complex:

- position sense and stability exercises should be performed within mid ranges of motion to stimulate musculotendinous mechanoreceptors;
- postion sense and stability exercises should be performed in end ranges of motion, in positions of vulnerability, to stimulate capsuloligamentous;
- weightbearing closed chain exercises in the upper extremity are most effective in evoking glenohumeral coactivation necessary for dynamic stabilization;
- good scapulothoracic stabilization can be achieved by the exercises that facilitate synergistic contraction of the para-scapular muscles, such as punches, push-ups, press-ups against high resistance;
- all the subcomponents involved in joint stability are mobilized by different types of joint perturbation that stress the shoulder joint with different types (direction, amount, repeatability) of unexpected forces similar to those experienced during athletic competition;
- rhythmic-stabilization exercises include both preparatory muscle activity and reactive muscle activity, which is very important functional stimulus combination;
- plyometrics play a vital role in prevention and late rehabilitation of the athletic shoulder, since it involves preparatory activity, eccentric muscle control, increases muscle spindle sensitivity and stiffness;
- late rehabilitation and especially injury prevention programs should mimic sport functional activities, thus employing sport specific positions (overhead, extreme external rotations, etc.) and function (eccentric contractions, stretch-shortening cycle, etc.);
- because of the amount of forces plyometric and advanced perturbation exercises should only be introduced after full, pain-free range of motion, strength, and dynamic stability are achieved.

Proprioception training is used mainly in health care and rehabilitation programs as well as in sports. The possibilities of its employment in sports are namely extremely good, but often not used enough. Primarily the contents were aimed at rehabilitation, but nowadays they take on a role of sports injuries prevention (particularly ankle, knee and shoulder joints) and of quality improvement of movement control in general. The training is suitable for all age groups because of the nature of movement apparatus exertion and physiological mechanisms, which we provoke through such contents. With younger groups the aim is to prepare them for the later, more serious strength training, but for senior groups exercises are more demanding and aimed at injury prevention and development of situational strength and coordination. To achieve effective proprioception training, the authors of this paper developed a type of balance boards, which enabled athletes to carry out planned exercises that fulfilled one of the principles of this training – the principle of gradual progression.

A comprehensive amount of trainings and competitions, to which players are exposed today, should play a key role in training planning and consequently in careful planning of indispensable health prevention contents. We are firmly convinced that health prevention contents like joint stability training should be a part of every physical conditioning and rehabilitation program.

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NEW ASPECTS OF ALTITUDE TRAINING, GENES AND HEALTH

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Abstract

Since the years around the Olympic Games at Mexico City in 1968, many studies have been done about the effects of physical training under hypoxic conditions. Lately more details are known about these effects, mainly in relation with the expression of some transcription factors called hypoxia inducible factors (HIF). Then, the relative hypoxia associated to altitude and even more to exercise at altitude could have more effects than classically described. This presentation would try to summarise the relationships between hypoxia and the expression of certain genes and the implications in performance and health.

Key words: *hypoxia, hypoxia inducible factors, muscle metabolism, haemoglobin, efficiency.*

Introduction

Human body responds to the decrease of barometric pressure and the decrease of oxygen partial pressure as occurs at altitude. Altitude/hypoxic training has traditionally been an intriguing and controversial area of research and sport performance. Man and some other animals show a remarkable ability to adapt to living at high altitudes, a process known as acclimatization. Until recent years, various factors were considered to participate in this acclimatization process including hyperventilation, increases in the red blood cell concentration of the blood and in the number of capillaries in peripheral tissues, and changes in the oxidative enzymes within the cells. Some people also believe that the rightward shift of the oxygen dissociation curve which sometimes occurs is also beneficial.

Aerobic performance is clearly affected by the relative hypoxia at altitude as was noticed during the Olympic Games at Mexico City in 1968. Studies by our group (1) confirmed that already at 900 meters above sea level the elite athletes decrease significantly their VO2max. This decrease in aerobic capacity could be of great practical interest to elite athletes.

During exposure to altitude the human body initiates several physiological adaptations. The stimulus of hypoxia associated with the training stimulus seemed to induce improvements in the enzymes, myoglobin, capillaries and haemoglobin (2, 3, 4, 5, 6, 7). It further was established that hypoxia/ischemia-related metabolic perturbation is likely to be involved as stimuli in this process in human skeletal muscle. Training in hypoxia results, at the molecular level, in an up regulation of the regulatory subunit of hypoxia-inducible factor-1 (HIF-1). Possibly as a consequence of this up regulation of HIF-1, the levels mRNAs for myoglobin, for vascular endothelial growth factor and for glycolytic enzymes, such as phosphofructokinase, together with mitochondrial and capillary densities, increased in a hypoxia-dependent manner. Functional analyses revealed positive effects on maximal oxygen uptake, when measured at altitude, on maximal power output and on lean body mass. In addition to the positive effects of hypoxia training on athletic performance, there is some recent indication that hypoxia training has a positive effect on the risk factors for cardiovascular disease (8).

There are evidences of factors other than accelerated erythropoiesis that can contribute to improved athletic performance at sea level after living and/or training in natural or artificial hypoxia. Several studies have demonstrated performance improvements after various forms of altitude exposures despite no increase in red cell mass (9). In addition, the multifactor cascade of responses induced by hypoxia includes angiogenesis, glucose transport, glycolysis, and pH regulation, each of which may partially explain improved endurance performance independent of a larger number of red blood cells. Specific beneficial non-haematological factors include improved muscle efficiency probably at a mitochondrial level, greater muscle buffering, and the ability to tolerate lactic acid production. (9)

Altitude effects and genes

There is a marked individual variability in the response to altitude (10). This variability to both natural and simulated altitude is only partially explained by physiological factors related to oxygen delivery to tissues. While some investigators have reported substantial increases in red cell mass following exposure to moderate altitude, other studies have found no change in haemoglobin mass after exposure to similar altitude (10). It is plausible, thus, that genetic polymorphisms may explain, at least in part, such variable responses to moderate-altitude exposure (11).

In our study at Teide mountain at Canarias Islands (11), at 2400 meters above sea level, we verify that short term natural exposure to moderate altitude is a powerful stimulus for erythorpoietic response in endurance athletes showing a great individual variability. This biological response was not modified by the ACE gene polymorphism.

In a near future should be investigated the responsible factors of the great individual variation in response to altitude training. As mentioned before genetic polymorphisms may explain such individual variability.

Hypoxia inducible factors; performance and health

Recent studies of adaptive mechanisms to hypoxia led to the discovery of the transcription factor called hypoxia inducible factor (HIF). HIF is a ubiquitously expressed, heterodimeric transcription factor that regulates a cassette of genes that can provide compensation for hypoxia, metabolic compromise, and oxidative stress including erythropoietin, vascular endothelial growth factor, or glycolytic enzymes (12). Also being responsible of increases of the plasma membrane lactate transporter MCT4, like other glycolytic enzymes, that is up-regulated by hypoxia through a HIF-1alpha-mediated mechanism. This adaptive response allows the increased lactic acid produced during hypoxia to be rapidly lost from the cell (13).

Diseases associated with oxygen deprivation and consequent metabolic compromise such as stroke or Alzheimer's disease may result from inadequate engagement of adaptive signalling pathways that culminate in HIF activation. The discovery that HIF stability and activation are governed by a family of dioxygenases called HIF prolyl 4 hydroxylases (PHDs) identified a new target to augment the transcriptional activity of HIF and thus the adaptive machinery that governs neuroprotection. PHDs lose activity when cells are deprived of oxygen, iron or 2-oxoglutarate. Inhibition of PHD activity triggers the cellular homeostatic response to oxygen and glucose deprivation by stabilizing HIF and other proteins.

Of medical importance is that HIF transcription factors could have a role as oncogenes. As a consequence of HIF stabilisation, the cell constitutively up-regulates the hypoxic programme resulting in the expression of genes responsible for global changes in cell proliferation, angiogenesis, metastasis, invasion, de-differentiation and energy metabolism. Of note, its role in tumour angiogenesis, squamous cell carcinoma, ovarian clear cell carcinoma, and kidney function and disease. It is also very important to take into account that the modulation of HIF regulating pathways is a potential therapeutic target that may have benefits in the treatment of cancer (14).

These genetic responses to altitude training and the new knowledge about the transcription factors induced by hypoxia would change the approach to altitude training in a near future.

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THE ORGANISM'S REACTION TO LOAD IN SPECIALIZED SCUBA DIVING ACTIVITIES

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Abstract

The paper deals with the monitoring of heart rate during apnoe diving in a competition of teams in swimming pool conditions. The competition took one hour and the results showed that the divers swam in the 3rd, 4th and 5th intensity zone.

Key words: *scuba diving, aqualung, training, aerobic zones*

Objectives

The term diving is currently being used for a range of various activities which are performed under water. In general we could differentiate so called hobby or leisure time diving and professional diving. Professional diving includes working diving, diving of armed forces and diving in terms of armed forces activities. In the field of leisure time diving we could find more and more fans of apnoe diving despite the fact of high popularity of scuba diving. This fact is supported by lower costs of technical equipment what makes apnoe diving affordable for more people including youth and children. With natural development of apnoe diving there have been found various sport disciplines which are considerably different from snorkelling. Apnoe diving is also called Freediving and involves different disciplines. The most famous disciplines are:

- constant weight: to reach the maximum depth with help of fins (return to water level with own power)
- variable weight: to reach the maximum depth with help of load (return to water level with own power)
- no limits: to reach the maximum depth with help of load (return to water level with help of balloon)
- dynamic: to swim the longest distance in swimming pool under water
- static: hold the breath in swimming pool

In connection with the development of above mentioned sport and leisure time activities and also related improvements of human physiological limits including the increase of injuries there is arising a requirement of detailed analysis of mechanisms which in terms of these activities proceed in the human body.

The basic organism's reaction on diving is a so called diving reflex (DR). The most markable signs are higher blood pressure, lower heart rate and lower flow of blood on periferies (Rozloznik, 2004). The research of DR has been oriented in two ways. One group of scientists has observed adaptation changes of natural inspiration divers (Anderson, 2001) and second group (Schagatay, 1998; Ferrigno, 1997) has observed the effects of DR during sport activities of apnoe diving.

The basic effects of DR are bradycardia, higher arterial blood pressure, vasoconstriction on periferies and lower minute volume of blood (Finley,1979). Reactions of cardiovascular syste after the DR proceed in two steps. At first there is the acceleration of heart rate (tachycardia), which is followed by higher cardiac output minute volume and then is followed by lower heart rate. The decrease of heart rate of deep divers can occur at the minimum of 8 bpm (Feretti, 2001).

The effects of DR have been observed also during physical activity in such amount that it was possible to cover the load tachycardia (Lindholm, 2002). It has been validated that bradycardia can reach during 30 s of swimming the same level as during relaxed diving which is also despite the fact that the starting heart rate during swimming is higher considering the load (Butler, 1987). Olsak (1997) has found out that the heart rate during diving has completely other progress comparing to other kind of physical load. During diving with fins without aqualung equipment in the intervals of 30 s during 5 hours there has been observed that comparing to the load during running there has been measured much lower heart rate in average by 94 bpm. He validated the remarkable influence of hydrostatic pressure on decrease of heart rate. During the monitoring the diver was performing physical activity in aerobic zone, but in reality it was anaerobic work without oxygen income. After the experiment there was measured an increase of heart rate as a result of oxygen debt.

In our paper we tried to focus on monitoring of heart rate during competition in apnoe diving in terms of 1 hour long swimming. The divers swam in shifts 25m lengths according to scheduled order. The team swam altogether 6500 m during the competition, whilst each of the competitors swam cca 32 lengths. The average swum distance of one team member was 825 m. The divers swam the lengths in short wet suits with standard fins and swimming goggles.

The aim of the research was to get an idea of heart rate zones during a test of 1 hour long diving apnoe marathon in pool conditions. The figure 3 shows the number of swum meters, the number of swum lengths and the time of swimming of particular divers.

When we considered the level of diving skills of competitors and the influence of motivation factors (competition) and the fatigue process, we expected the divers to swim their lengths in the 3rd and 4th intensity zone.

For evaluation of monitored heart rate we applied the differentiation of zones according to the intensity of load (Vilmore-Costill, 1999) as following:

zone	**heart rate**	**intensity of load**
1st zone	under 144	enough for fast regeneration
2nd zone	145-159	light aerobic zone
3rd zone	160-174	intensive aerobic load
4th one z	174-184	aerobic-anaerobic load
5th zone	above 185	anaerobic load

As an example we present a heart rate curve of a competitor who is not only a diver but also a swimmer and his performance was one of the best ones. It is possible to see his heart rate curve in the light aerobic zone in 47%, in intensive aerobic zone 48% and only 5% was performed in aerobic-anaerobic zone. The average HR of this proband was 144 bpm.

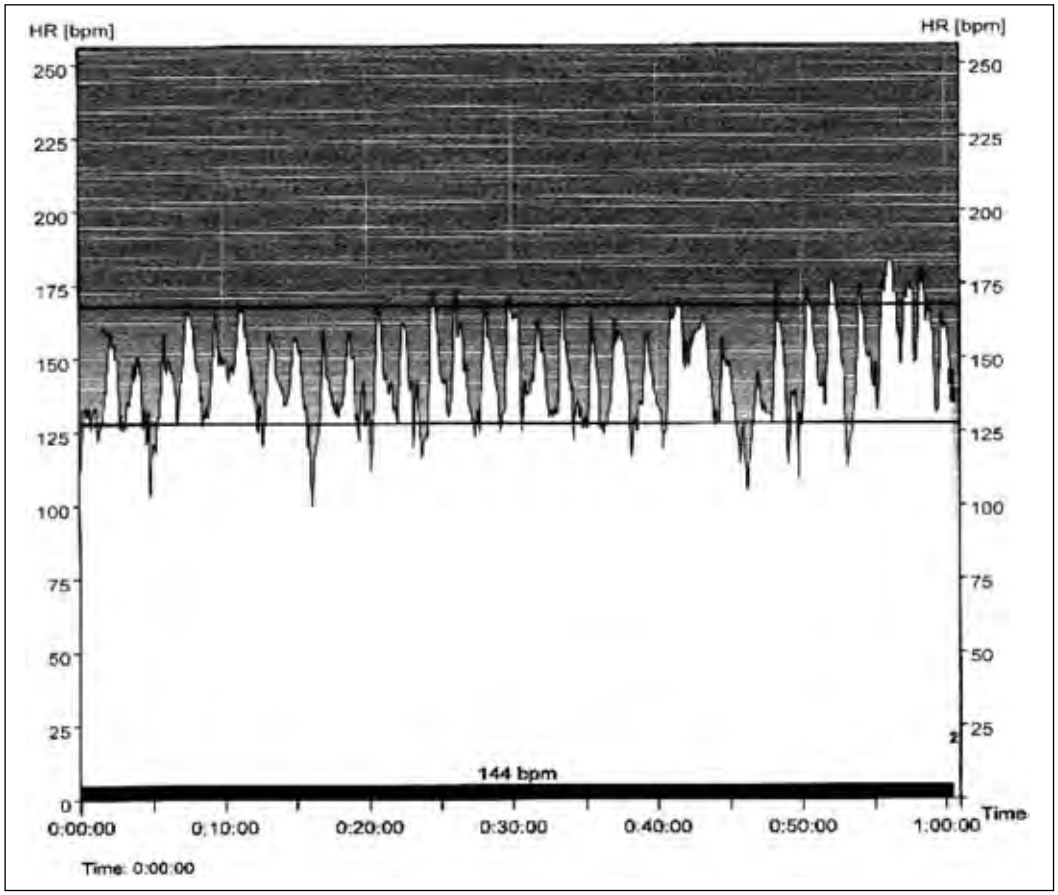


Fig. 1 Heart rate curve during swimming the 25m lengths within the one hour long apnoe diving of a 23 years old diver.

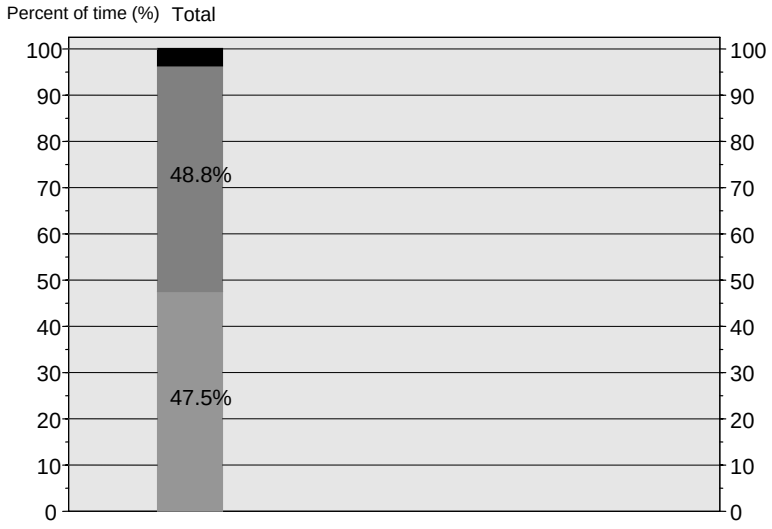
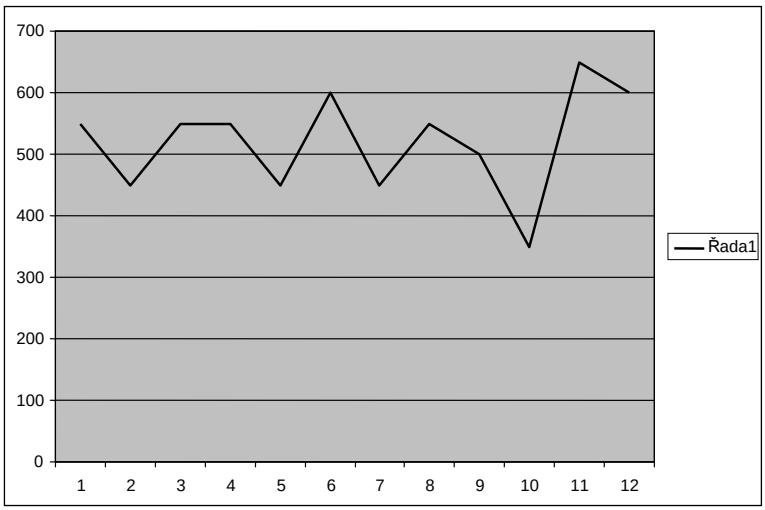


Fig. 2 Heart rate zones during swimming the 25m lengths within the one hour long apnoe diving of a 23 years old diver (2nd zone 47%, 3rd zone 48%, 4th zone 5%).

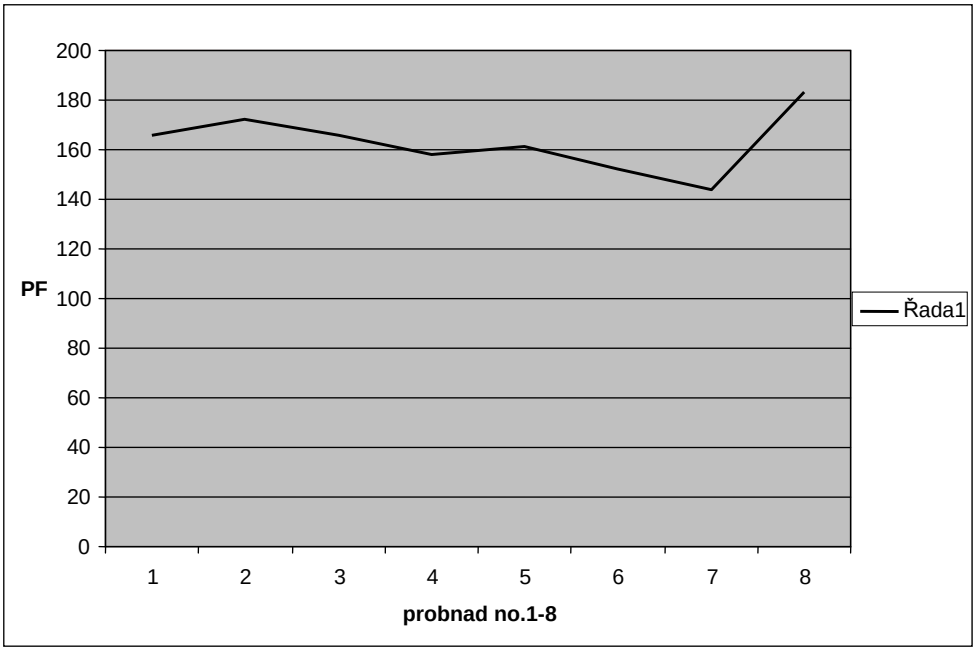
Nr	Diver	Number of swum metres (m)	Number of swum lengths	Time of swimming (hours)
1	I. M.	650	26	0:07,8
2	M.K.	775	31	0:08,3
3	P. Š.	850	34	0:07,6
4	L. K.	775	31	0:07,2
5	P. K.	850	34	0:07,4
6	B.K.	925	37	0:07,5
7	E. S.	850	34	0:07,2
8	M. H.	825	33	0:07,1
	Sum :	6500	260	1:00,0

Fig. 3 The number of swum meters of the team which were registered in 5 min intervals.



	TEAM / time	0:05	0:10	0:15	0:20	0:25	0:30	0:35	0:40	0:45	0:50	0:55	1:00
1.	FTVŠ UK Bratislava	550	+450	+550	+550	+450	+600	+450	+550	+500	+350	+6500	6.500 m

Fig. 4 The number of swum meters of the divers' team in 5 min intervals.



Proband no.	1	2	3	4	5	6	7	8
Max .HR	166	172	166	158	161	152	144	183

Fig. 5 Max. HR values of each divers by swimming 25 meters anoe

Summary

The resuls of research did not completely validate our expectation that the divers would swim the swimming lengths under water in 3rd and 4th zone of load. We suppose that under competition pressure they did not swim the lengths with maximum effort. Regarding the 5 min long parts we observed a range of swum lengths from 350m to 650m in the last 5 minutes of the competition they speeded up the lenghts by 71 %. Three of the divers swam theis lengths in the 2nd intensity zone, 4 divers swam in the 3rd zone and only 1 diver swam in the 4th intensity zone.

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THE EFFICIENCY OF FITNESS PREPARATION FOR SPORT PERFORMANCE IN LATIN DANCES

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Abstract

The aim of our research is to unveil the influence of fitness-preparation on the level of general and specialised movement efficiency and the sport performance of Latin dancers through the rising of proportion of the general fitness-preparation on the one hand, and decreasing proportion of special dance tools on the other hand. During our work we experimentally verify the efficiency of the fitness-programme by means of fitness and aerobic gymnastics on the general and special movement performance, but above all on the improvement of the dance performance of the couples performing Latin dances. The object of the research were 5 Latin couples, or 10 dancers from the Uni dance club Bratislava and dance club Inter Madit Bratislava, who had a diverse performance categories. We examined the fitness aptitude by means of a diagnosis consisting of six general movement performance tests and ten tests of special movement performance in the framework of three measurements. The expert valuation confirmed the significant influence of our fitness-programme on the special dance performance in Latin dances, like samba, cha-cha, rumba, paso-doble and jive.

Key words: *dance sport, latin dances, fitness-preparation, dance sport performance*

Based on long years of experience and personal knowledge of national as well as international competitions of Latin American dances, it is known (Chren, 2005) that sport preparation only focuses on special dance techniques. The aim of our research is to find out what effect fitness preparation has on the overall and specific levels of sport performance as well as on the sporting results of dancers. Further research will focus on the results of an increase in overall fitness preparation and a decrease in special dance techniques.We conducted an experiment checking the effectiveness of a fitness preparation program consisting of conditioning and aerobic gymnastics, foremost aimed at increasing the dance results of couples dancing Latin American dances. Five dance couples from two clubs in Bratislava: Uni dance club and Inter club Madit, were surveyed. Their performance levels varied from couple to couple. The average age of the dancers at the start of this research was 20.8 years.

The experiment took place from the 17th of September 2007 to the 5th of March 2008, approximately six months. The first overall evaluations were taken on the 17th, 18th and 19th of September 2008. During the course of the first three months, the dance couples concentrated on special dance preparation and had practices three times per week. These consisted of six training sessions with a focus on dance and technical aspects and a further two individual lessons of dance choreography. The length of one training session was 45 minutes. During the first three months, the couples completed a total of 96 training sessions, 72 being focused on dance as were the 24 individual sessions. Thus, 100% of the dance preparation focused on dance techniques alone. After three months, second (or middle) overall evaluations were recorded from the 13th to the 15th of December 2007 and it was after these evaluations that our fitness preparation program was applied to the previous dance trainings, also taking place three times per week at a length of 45 minutes. During the next three months, the dance couples completed a further 96 training sessions, 60 of these being focused on dance techniques (36 group and 24 individual sessions) while the remaining 36 training sessions focused on fitness preparation. When looking at this information in terms of percentage, 37.5% of the practices were fitness oriented while 62.5% were devoted to dance techniques. After these three months, during which our fitness preparation program was applied, a final evaluation was recorded from the 17th to the 19th of March 2008 . This assessment took place on a parquet floor and conditions were similar to those of a real competition. The dance couples went on to compete in national as well as international competitions where their results were further monitored. This experiment and its consequent evaluations were assimilated into the dance trainings of these couples and in no way interfered with their natural training process. Our research was primarily aimed at improving the quality and level of sport, a target which basically all research in this area should strive to achieve. After the three-month experimental phase, we expected the addition of a fitness preparation program into the usual dance preparation routines to have a significant effect on the evaluation by experts of Latin American dancers of varying performance categories.

We evaluated the fitness abilities of the dancers using six tests which assessed the overall movement performance and ten tests evaluating specific movement performance. The results of these tests are recorded in another work of ours.

We consider the most important part of our observations to be the way in which our fitness preparation program was able to improve firstly, the quality of a sport performance in each category of Latin American dances, and secondly to better evaluating criteria. The sporting performance was evaluated from DVD recordings in the order of the experimental process. Therefore, first recording was taken at the start of this research project, the second was taken after the first three-month phase and the third was taken at the end of the experiment, after the completion of the fitness preparation program. The dance couples were evaluated by three qualified judges all having a valid IDSF license, and their results were recorded on a scale from 1 to 5 (1 being the best and 5 the worst). During the evaluation of the recordings the judges did not know which recording represented which stage of the experiment (beginning, middle or end). Each dance couple was given a mark form 1 to 5 in each assessed area of Latin American dances.

These areas were chosen by us, yet on the basis of the criteria which are evaluated in international competitions. The eight specific judged areas are as follows:

1. rhythm
2. balance
3. technical skill
4. body alignment and posture
5. lower limb dynamics
6. overall movement dynamics
7. dance characteristics
8. artistic skill

Evaluation scale:

1 – completed without faults
2 – completed with slight faults
3 – completed with faults
4 – completed with significant faults
5 – inadequate

Based on the expert evaluation of these eight dance criteria, we were able to see the result of the implementation of our fitness preparation program into the training sessions of the dance couples. The following dances were evaluated: the Samba, Cha Cha, Rumba, Paso Doble and the Jive.

Due to the extent of information concerning these eight dance criteria we will now focus on the lower limb dynamics results only. The results of this test were judged in accordance with results of overall and specific movement performances which monitored the dynamics of the lower limbs. The judges'marks confirmed the hypothesis that fitness preparation training would significantly improve the quality of this criterion. We may conclude that this is directly connected with improvements demonstrated in overall and specific performance tests.

The average of the first marks given by the three judges in all five dances was 2.6, the second being lower at 2.3. During the third evaluation an average mark of 1.8 was given for the 'lower limbs dynamics' criterion. An improvement on a significant level ($p < 0.10$) was noted between the second and third evaluations as well as between the first and the third one (Figure 1). Based on this fact we conclude that a desirable improvement was reached due to fitness preparation training. It is this criterion where significant improvement was reached in a 90-second test on jump ergometer. The individual Latin American dances last the same length of time in a competiton.

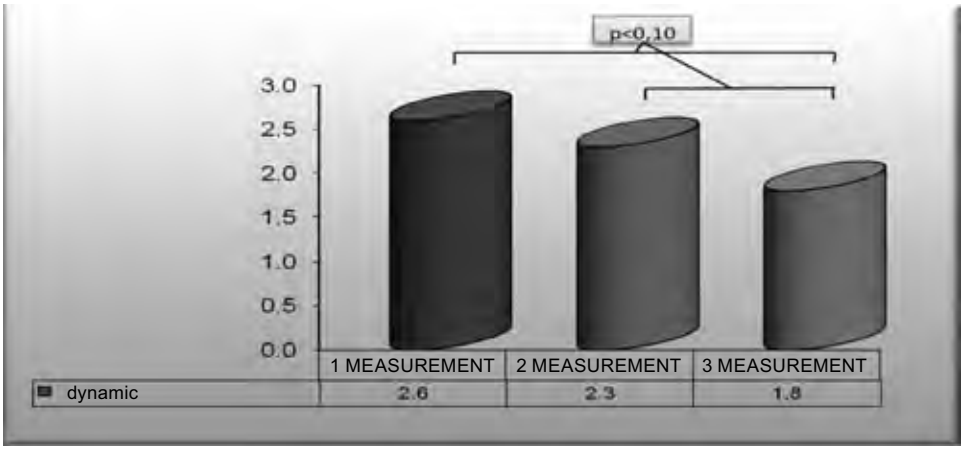

Figure 1. Results of 'lower limbs dynamics' evaluation criterion for all pairs in five Latin dances.

Marks received from the judges confirmed a significant improvement in the 'lower limbs dynamics' criterion while evaluating an individual dance as well as the five dances. In the first evaluation the average mark given by the three judges in jive dance reached 3. In the second evaluation the average mark dropped to 2.8. This mild improvement between the first and second evaluations was significant on the level ($p < 0.05$). In the third evaluation the 'dynamics of lower limbs' criterion reached 1.9, which was the lowest average mark. Improvement on a significant level ($p < 0.01$) was noted between the second and third evaluations as well as between the first and third evaluations (Figure 2). This means that the desirable improvement of the lower limbs dynamics in individual jive dance was achieved in the third evaluation due to fitness preparation training.

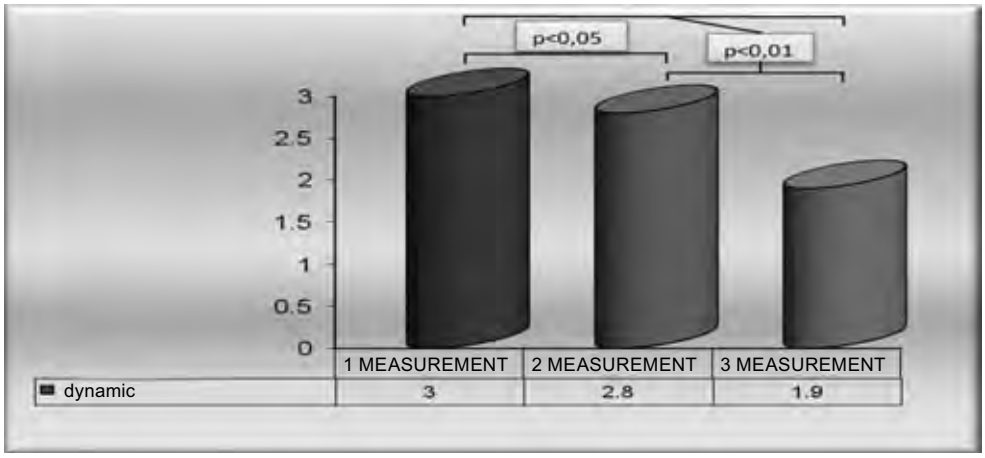

Figure 2. Results of the 'lower limbs dynamics' evaluation criterion for all dancers in jive solo dance

The aim of our research was to find out, by conducting an experiment, if a change in the proportion of dance technique preparation in favour of fitness preparation would be beneficial.

We came to a conclusion that the fitness preparation program we created significantly improved overall and specific movement performance as well as dance quality performance of the monitored group, which was evaluated by qualified judges in eight criteria in accordance with the international Latin American dance competition rules.

When analyzing the quality of our subjects' dance performance in jive solo dance, we concluded that progress was made not only in the dynamics of lower limbs, but the improvement occurred in all eight monitored criteria. In addition to positive changes in evaluation criteria of dance performance after five dances, dancers in jive solo dance also greatly improved their posture and overall artistic skill which affects mainly the aesthetic aspect of dance performance.

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EFFECT OF PROPRIOCEPTIVE STIMULATION ON ISOKINETIC STRENGTH TRAINING WITH ECCENTRIC OVERLOAD

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Abstract

The aim of the study was to evaluate the changes of speed-strength capabilities after 8 weeks of systematic isokinetic eccentric overload strength training with integrated proprioceptive stimulation. 31 sport students were randomly divided in experimental (ES) and control group (KS). ES consisting of 16 men (age 23,3 ± 2,6 years, height 182,9 ± 6,3 cm, weight 77,4 ± 9,8 kg). KS consisting of 15 men (age 22,6 ± 3,9 years, height 180,8 ± 5,9 cm, weight 80,1 ± 10,3 kg.

The ES as the KS performed 8-week isokinetic strength training on computer controlled linear isokinetic leg press machine. Experimental – proprioceptive stimulation was applied by fast counter movements with amplitude of 5mm and frequency of 9Hz.

The results showed in both groups significant ($p \leq 0,05$) improvement of maximal isometric contraction by 37% in ES and 25% in KS, jump height in counter movement jump by 5% ES and 5% KS, maximal force in concentric phase of isokinetic test ($v=0,5m.s^{-1}$) by 42% ES and 44% KS, mean force in concentric phase of isokinetic test ($v=0,5m.s^{-1}$) 40% ES and 28% KS, maximal force in eccentric phase of isokinetic test ($v=0,5m.s^{-1}$) by 36% ES and 25% KS, mean force in eccentric phase of isokinetic test ($v=0,5m.s^{-1}$) by 45% ES and 25% KS, time 30 m run by 1,3% ES and 0,7 % KS. Force gradient have been significant ($p \leq 0,05$) improved only in ES by 26%. Also jump height in squat jump showed significant ($p \leq 0,05$) improvement only in ES by 5%. The compare of improvements showed significant ($p \leq 0,05$) difference by force gradient in favour of experimental group. The compare of other improvements were not significantly different. It can be concluded that an 8 weeks of systematic isokinetic eccentric overload strength training with integrated proprioceptive stimulation improves the speed-strength capabilities. Compared with isokinetic eccentric overload strength training without proprioceptive stimulation provides significant improvement of force gradient, which can be explained with specific neuro-muscular adaptation on a specific stimulus. No significant differences by 30 m run, where force gradient is included, can be ascribed to the fact that, the implementation of condition factors into coordinative complexes requires special methodological treatments with utilisation of special training exercises.

Key words: *Proprioceptive stimulation, isokinetic training, sport students, strength, reflexes*

PHYSICAL FITNESS DIAGNOSTICS OF 10-YEAR-OLD WRESTLERS OF DIFFERENT WEIGHT CATEGORIES

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Abstract

Wrestlers are expected to develop their motor and functional abilities individually and in different ways, that is, in accordance with already mentioned differences related to their age and weight category. The aim of this study was to define physical fitness in 10-year-old wrestlers according to categories in which they compete. A sample included a hundred wrestlers, elementary school male pupils aged 10 ± 6 years. A series of 16 assessment tests of anthropological characteristics (motor and functional abilities, and anthropometric characteristics) was used in the study. The ten-year-old wrestlers have to strategically develop their anthropological characteristics using an individual approach. The results of this study will help perform a better and more accurate selection of boys into wrestling as well as in maintaining a higher training standard of boy wrestlers of different weight groups.

Key words: *boys, motor and physiological abilities, anthropometric characteristics*

Introduction

According to Marić et al., (2003) the result of the senior Greco-Roman style wrestlers is most affected by strength (30%), endurance (25%), coordination (15%), speed (15%), balance (10%) and flexibility (5%). However, not only these rates change according to a wrestler's age and his weight category but they also depend on the changes of wrestling rules, which have occurred very often over the last ten years.

Wrestlers are expected to develop their motor and functional abilities individually and in different ways, that is, in accordance with already mentioned differences related to their age and weight category. This fact has been confirmed by a great number of studies, in which the wrestlers were classified according to weight groups (Baić, 2006) and also according to their weight categories (Petrov 1997; Baić et al., 2002). These studies mainly relate to senior wrestlers, whereas there has been a lack of studies on young wrestlers, apart from the study by Slačanac et al., (2007) which relates to eleven-year-old wrestlers.

The aim of this study was to define physical fitness in 10-year-old wrestlers according to categories in which they compete. This study should facilitate the selection of boys with different body mass values into wrestling.

Methods

A sample included a hundred boy wrestlers, elementary school pupils aged 10 years ± 6 months. The subjects were involved in wrestling training program in Croatian wrestling clubs such as: "Metalac", "Hrvatski Dragovoljac", "Podravka", "Lokomotiva", "Zagreb", "Lika", "Sesvete", "Gavrilović", "Varaždin" and "Slatina". The sample was considered representative because it comprised about 75% of wrestlers of that age in Croatia. The average wrestling training period of examinees was 14.22 ± 13.96 months, the average number of training per week was 3.01 ± 0.81 times with the duration of each session 75 ± 15 minutes.

A series of 16 assessment tests of anthropological characteristics (motor and functional abilities, and anthropometric characteristics) was used in the study. The testing was performed according to measurement requirements prescribed in the book of normative values, "Norme" (Findak et al., 1996) and according to the scientific research project "*Praćenje promjena antropološkog statusa djece u hrvačkim sportovima*" (*Monitoring the changes of the anthropological status of children involved in wrestling, code 0034214*) which was approved by Ministry of the Science and Technology, Republic of Croatia.

The following four tests were used to assess anthropometric characteristics: 1. body height; 2. body weight; 3. forearm circumference; 4. upper arm skinfold.

The following tests were used to assess motor abilits:

1. coordination tests: agility on the ground, side-step, obstacle course backwards;
2. strength tests: long jump, flexed-arm hang, pull-ups in 60 seconds, push-ups in 60 seconds, squats in 60 seconds;

3. flexibility tests: V-sit;
4. speed: hand tapping test;
5. specific muscle endurance test: throw + two push-ups in 90 seconds;

Functional abilities were assessed by the following test: 6 minutes run.

The data were processed by Statistica 7.0 for Windows. The central dispersion parameters were calculated by descriptive statistics: arithmetic mean and standard deviation for each weight category separately and for wrestlers in total.

Results

Table 1 shows that different results were obtained in different weight categories. Also, the physical fitness in 10-year-old boys differed according to the weight category they competed in.

The obtained results of anthropometric tests showed a linear increase in longitudinal dimensions of the skeleton–body height with increase of weight category. In addition, with variables for the assessment of body fat and lean body mass (upper arm skinfold and forearm circumference) there was an increase of the result in both variables which led to an increase of body weight, that is, weight category.

Table 1. The structure of anthropological characteristics in 10-year-old wrestlers of different weight categories

	WEIGHT CATEGORIES											
Variables	**30 kg (n=2)**	**33 kg (n=3)**	**35 kg (n=5)**	**38 kg (n=11)**	**42 kg (n=23)**	**47 kg (n=17)**	**53 kg (n=13)**	**59 kg (n=10)**	**66 kg (n=6)**	**73 kg (n=6)**	**73-85kg (n=4)**	**47,02 ± 11,86 kg (n=100)**
Body height (cm)	138.00 ± 0.71	140.67 ± 4.51	142.94 ± 54	148.45 ± 7.37	151.94 ± 7.08	155.51 ± 5.43	158.23 ± 6.46	164.15 ± 6.54	163.98 ± 7.78	170.85 ± 8.14	177.08 ± 6.44	155.60 ± 10.07
Body weight (kg)	29.75 ± 1.34	31.67 ± 0.40	340 ± 0.55	36.55 ± 1.05	40.26 ± 1.11	44.24 ± 1.56	49.02 ± 1.43	55.54 ± 1.43	61.62 ± 1.53	69.98 ± 2.02	78.53 ± 4.84	47.02 ± 11.86
Forearm circumference (cm)	19.45 ± 0.64	19.60 ± 0.40	20.75 ± 0.87	20.68 ± 0.71	21.29 ± 1.20	22.24 ± 1.09	23.07 ± 1.01	24.02 ± 0.58	24.87 ± 0.72	26.07 ± 0.67	25.85 ± 1.48	22.46 ± 2.01
Upper arm skinfold (mm)	6.17± 1.65	6.00 ± 1.76	9.93 ± 4.52	9.73 ± 4.36	11.33 ± 5.25	11.90 ± 5.47	14.03 ± 7.17	14.33 ± 6.70	19.00 ± 10.43	16.44 ± 10.25	27.75 ± 7.71	12.99 ± 7.32
Agility on the ground (sec)	18.43 ± 2.69	19.61 ± 2.32	20.25 ± 3.93	18.11 ± 2.86	18.81 ± 3.73	21.70 ± 6.19	19.55 ± 5.01	17.50 ± 5.65	25.97 ± 14.13	23.16 ± 10.35	24.55 ± 4.08	20.19 ± 6.24
Side-steps (sec)	10.39 ± 0.12	10.70 ± 1.24	11.14 ± 0.79	10.76 ± 0.70	10.97 ± 1.50	10.96 ± 0.78	11.05 ± 1.23	10.57 ± 0.83	11.43 ± 0.73	11.71 ± 1.46	12.05 ±1.61	11.03 ± 1.14
Obsticle course backwards (sec)	12.60 ± 1.70	11.01 ± 3.18	14.26 ± 2.02	12.06 ± 2.46	12.53 ± 3.18	12.49 ± 3.24	13.36 ± 4.10	11.58 ± 2.86	14.39 ± 3.27	13.91 ± 4.99	19.55 ± 4.95	13.00 ± 3.57
V-Sit (cm)	49.67 ± 12.26	36.22 ± 9.39	45.60 ± 4.58	49.76 ± 12.29	49.04 ± 9.76	47.41 ± 10.40	49.59 ± 6.08	53.37 ± 8.03	48.50 ± 12.40	54.44 ± 13.48	56.58 ± 6.71	49.40 ± 9.93
Long jump (cm)	179.17 ± 24.28	183.33 ± 23.88	176.67 ± 14.43	180.00 ± 21.44	175.02 ± 25.62	184.74 ± 23.43	176.08 ± 32.74	187.10 ± 24.23	174.44 ± 30.11	194.22 ± 49.40	166.67 ± 17.14	179.76 ± 26.59
Hand tapping test (number of repetitions)	31.00 ±	29.67 ± 2.08	28.07 ± 2.10	28.53 ± 2.53	28.38 ± 3.31	29.92 ± 2.31	32.59 ± 11.22	32.81 ± 2.64	28.22 ± 3.01	32.00 ± 2.62	25.08 ± 5.68	29.81 ± 5.22
Flexed arm hang (sec)	46.50 ± 7.78	55.67 ± 29.70	47.00 ± 38.36	51.73 ± 13.15	45.10 ± 26.87	27.00 ± 15.40	28.17 ± 15.23	28.30 ± 15.30	20.33 ± 14.46	19.50 ± 17.96	4.25 ± 4.92	34.61 ± 23.15
Pull-ups (number of repetitions)	42.50 ± 10.61	41.00 ± 11.79	44.00 ± 9.82	47.82 ± 11.51	43.05 ± 9.55	42.71 ± 9.66	41.54 ± 9.84	47.90 ± 8.31	37.17 ± 10.63	42.17 ± 13.23	30.75 ± 5.44	42.88 ± 10.22
Push-ups in 60 seconds (number of repetitions)	32.00 ± 12.73	36.00 ± 19.08	30.40 ± 13.74	31.80 ± 8.32	27.50 ± 17.47	21.40 ± 13.35	19.83 ± 16.28	16.50 ± 6.10	10.17 ± 6.88	16.33 ± 14.45	8.25 ± 6.60	22.67 ± 14.76
Squats in 60 seconds (number of repetitions)	55.00 ± 4.24	61.00 ± 12.29	57.00 ± 5.48	56.50 ± 8.92	50.38 ± 9.46	45.67 ± 8.31	47.75 ± 6.66	48.60 ± 7.46	41.67 ± 10.33	47.17 ± 13.23	40.25 ± 0.50	49.35 ± 9.59
Throw + push-up (number of repetitions)	13.00 ± 1.41	12.00 ± 0.00	12.00 ± 3.24	12.30 ± 3.40	12.16 ± 3.59	11.00 ± 3.04	12.00 ± 3.44	11.50 ± 1.84	9.00 ± 1.26	10.80 ± 2.77	8.75 ± 0.96	11.46 ± 2.99
	23.00 ± 7.07	24.00 ± 0.00	23.60 ± 6.54	23.60 ± 6.29	23.21 ± 7.30	20.57 ± 5.68	21.18 ± 9.72	21.80 ± 3.46	17.00 ± 3.52	20.60 ± 6.69	16.25 ± 2.06	21.60 ± 6.45
6-minute run (meters)	1132.00 ± 59.40	1219.67± 46.50	1113.20 ± 135.15	1169.82 ± 115.35	1138.90 ± 194.45	1100.27 ± 169.33	1115.58 ± 167.58	1142.22 ± 125.90	1009.33 ± 105.05	1058.83 ± 204.14	900.25 ± 106.01	1111.22 ± 162.74

With respect to growth and development standards in ten-year-old children, the obtained results for assessment of anthropometric characteristics are as expected and in accordance with normative values determined in the book ″Norme″ (Findak et al., 1996). The results of motor ability tests showed that ten-year-old male wrestlers obtained poorer results compared to eleven-year-old wrestlers (Slačanac et al., 2007). Coordination was assessed by obstacle course backwards tests

and by agility on the ground. The ten-year-old boy wrestlers obtained poorer results compared to eleven-year-old wrestlers, whereas higher weight category in which the young wrestlers competed did not result in more significant deviations from the obtained results. Coordination improvement in this age group plays a vital role. Therefore, good selection of boys in wrestling is needed as well as appropriate high quality program of training in wrestling clubs. A linear decrease in results could be noted in variables for muscular endurance assessment, which was also valid for push-ups in 60 seconds tests for the assessment of arm endurance as well as squats in 60 seconds for the assessment of leg endurance. A mild decrease of results in variables for muscular endurance assessment could be observed with increase of weight category in which young wrestlers competed. It has been determined that the body fat percentage per total body weight increase in higher weight categories. The body fat percentage significantly impeded obtaining better results in the previously mentioned tests and consequently it also impeded the increase of repetitive arm and leg endurance. In pull-ups, which served for the assessment of repetitive strength of the arms, the obtained results were grouped around mean values in all weight categories. The poorest result was obtained in the heaviest weight group where the values of the obtained results were lower. The total average result in the variable for the assessment of muscular endurance of the arms in ten-year-olds was better compared to the obtained results of eleven-year-olds. For the assessment of explosive leg power by use of long jump variable, the average results were obtained almost in all weight groups apart from the heaviest weight group wherein the poorest results were obtained. The result in long jump significantly depended on longitudinal dimensions of the skeleton. In consequence, with the increase in weight categories in which wrestlers competed, it is expected that results will be better. Nevertheless, this is not evident in the obtained results of these tests because the results are all grouped around mean values. The explosive power of plyometric type is essential in a number of wrestling techniques because of possible manifestation of maximal explosive strength. In order to improve specific wrestling techniques in ten-year-old wrestlers, it is necessary for wrestling clubs to take special care of the development of explosive leg power. Static arm and shoulder strength was assessed by flexed arm hang variable. It was obvious that static arm and shoulder strength declined by the increase of weight category in ten-year-old wrestlers, likewise in eleven-year-olds. The poorer results in this test were expected since the increase in body fat percentage and body weight had negative impact on the results. In V-sit test for flexibility assessment, the results were distributed in such a way that the best results were obtained in heavier weight groups whereas the poorest result was obtained in the second weight group. This can be explained by the fact that children with greater body mass also have longer limbs and therefore better results were obtained in heavier weight groups. In hand-tapping variable for the assessment of movement speed as well as in side-step variable for agility assessment, the results showed grouping around mean values whereas the decline of results occurred in the lowest weight groups. This happened because grouping wrestlers in heavier weight categories also indicated an increase in body mass which resulted in more difficult performance of hand-tapping and side-step tests.

The 6-minute run test was used to assess functional abilities. A linear decline of results with increase of weight category in which boy wrestlers competed has been noted in the obtained results. Also, the decline in results with the increase of weight group occurred in the throw + push-up variable for the assessment of specific muscular endurance. The decline in results was typical of physiological ability assessment in both ten and eleven year old wrestlers.

Discussion and conclusions

The results of different weight groups were obtained by defining physical fitness in ten-year-old wrestlers. The results of anthropometric characteristic assessment variables are as expected and in accordance with growth and development criteria valid for children of that age. In most of variables for motor and functional ability assessment, the ten-year-old wrestlers obtained poorer results compared to eleven-year-old counterparts, but these results are still above average compared to other children of the same age.

The decline of the results in certain motor and functional abilities occurred with passing into a heavier weight group which boy wrestlers competed. This was most apparent in the 60 seconds squats and 60 seconds push-ups variables which served to assess the arm and leg endurance. Besides, this was apparent in flexed arm hang variable, which assesses static arm strength and also in 6 minutes run variable which assesses physiological abilities as well as in one throw + two push-ups in 90 seconds variable which assessed specific muscular endurance. The decline of the results in these tests can be explained by the increase in body mass and by the existence of subcutaneous fat tissue which had negative effects on the obtained result. In obstacle course backwards and agility on the ground variables which assessed coordination as well as in side-step variable which assessed agility, the results increased with the increase in weight group and the poorest results were obtained in the heavier weight groups. In the variable which assessed muscular endurance of the arms, that is, in the 60 seconds sit-up test, the results were grouped around the mean values in all weight groups, apart from a heavy weight group where the results had somewhat lower values. In the hand -tapping variable which served to assess movement speed, it was determined that the mentioned ability increased linearly from the lighter to heavier weight groups, while the heaviest weight group obtained the poorest result compared to other weight groups. In long jump variable used to assess explosive leg strength, the results were grouped around the mean value except in the heaviest weight group in which wrestlers obtained the poorest results. In V-sit variable used to assess flexibility, an almost linear increase in results was visible; and a better total result was obtained in this test compared to eleven-year-olds. This increase can be

explained by the fact that wrestlers in heavier weight groups have longer limbs than wrestlers in lighter weight groups and consequently an increase in weight group leads to an increase of results.

In conclusion, ten-year-old wrestlers have to strategically develop their anthropological characteristics using an individual approach. The training process should be programmed in such a way as to develop the anthropological characteristics according to the weight group in which the boy wrestlers compete and also to facilitate the development of all anthropological features in order to support a healthy development of children and later, to facilitate obtaining of good competitive results. The results of this study will help perform a better and more accurate selection of boys into wrestling as well as in maintaining a higher training standard of boy wrestlers of different weight groups.

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QUANTITATIVE CHANGES OF MOTOR ABILITIES IN SENIOR SOCCER PLAYERS

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Abstract

The aim of the work is to define the global quantitative changes of motor abilities realized on the sample of 27 senior soccer players. 18 variables have been used in this work and they cover latent area of motor abilities. After determination of initial condition of examinees, the programmed soccer training process has been done with lasting of 6 months , and that was consisted of 45 days of preparing period and winter semi-season of competitive 2006/7 in Premier League of Bosnia and Herzegovina in soccer. After program had been finished, the final measuring was done. Canonical discriminative analysis under the model of differences was used in order to determine quantitative changes. After analysis of realized results, it was determined that certain statistic differences had appeared in the tests of motor abilities. Positive quantitative changes appeared in almost all researched motor abilities especially with agile, coordination, and segmentation of movement rapidity.

Key words: *quantitative changes, soccer, motor abilities, discriminative analysis*

Introduction

Correctly programmed and planned training process includes the existence of fine conjugation whose function is to improve anthropological status of sportsman. Observing of changes appeared under influence of training process as well as finding more efficient means and work methods is always actual problem area in sport. Transformational training process in general means change of anthropological status of sportsman (Malacko & Rađo 2004). Every change of condition in entrance and exit in the system is performed in the way that some entrance by the time becomes exit i.e. initial condition is transformed into next new-formed condition. Motor abilities are defined as latent motor structures responsible for practical endless number of manifest motor reaction and it is possible to measure and describe them. Cybernetic model of motor abilities represents synthesis of results got in former structural, functional researches of motor abilities (Momirović et al. 1970; Gredelj et al. 1975; Kurelić et al. 1975; Metikos et al. 1979). The aim of work is to determine the level of quantitative changes in the group of motor abilities with senior soccer players after one competitive semi-season. Motor abilities enable the basic motion function of man and they are responsible for solving motor tasks and the level of their appearance is conditioned by character, volume and intensity of motor activity. The changes initiated by programmed work will influence on the structure of generator of motor output which is responsible for quality of motion under the conditions similar to those during training process.

Methods

This research has longitudinal character with the aim to determine quantitative changes of motor abilities appeared between two time points on the sample of 27 senior soccer players.

The research has been done on the sample of 27 soccer players of Soccer Club "Velež" from Mostar in 2006/7 season. For final processing we used only results of examinees who took part in the beginning and final measuring, and played winter semi-season of competitive 2006/7 in Premier League of BIH.

In order to estimate of motor area of examinees , 18 manifest ant variables were used and they cover latent area of motion and energetic process of soccer players. We think that these variables has influences on realization of motion structures and successful performing of technical elements in soccer. Variables for estimate of motor abilities used in this research are : step aside (MAGKUS); steps in coordination with stick (MKTOSP); eight (MAGOSS); dynamometry of right fist (MDSSTSD); dynamometry of left fist (MDSSTSL); push up max (MRESKL); body setup max (MRSDTMAX); the long jump (MFESDM); taping of right hand (MBFTAPD); taping of left hand (MBFTAPL); taping of right leg (MBFTAND); taping of left leg (MBFTANL); 20m running (MFE20V); touch-toe, touch (MBFPZ); standing on one leg with open eyes (MBAU10); touch in straddling (MFLPRR); tipping with stick (MFLISK).

For processing and analyzing of results we used proper mathematics-statistics methods and procedures. Processing of results has been done in program package SPSS 12.0 for Windows. Canonical discriminative analysis has been used in order to determine quantitative changes in the group of motor abilities on the given sample of examinees. Discriminative

method represents the special type of factor analysis in which orthogonal factors are isolated in the area of manifest ant variables, and they are settled on the way that they separate the groups of examinees in the area of variables. (Rađo and Wolf 2002.). We calculated the value of discrimination coefficient (Eig. Val.); canonical correlation coefficient (Can.Corr.); the percentage of explained variability (%); the value of Bartlets Hi-square test (Chisquare); Hi-square degree of freedom (Df); value of Wilks Lambda (Wl); and the mark of value of mistake during hypothesis rejecting that the real value of canonical correlation is zero (Sig).

Results

According to the results given in tables 1-5 the differences between initiative and final measuring have been analyzed in the quantitative effect of programs lasting in the period of 6 months. Based on results mentioned in tables it can be determined that there were major breakthroughs in the tests of motor abilities in the program interval. Criteria for the discriminative strength of changeable variables was co-called Wilkos Lambda (table 3) which is statically important on the level of 99% (Sig =.00). Determining of statistical importance of each discriminative variable was done on the basis of Bartlets Hi square test. In table 1 (Box M-test) the similarity between two groups has been tested, i.e. between initial and final measuring. It can be seen that the difference of matrices is statistically important (Sig =.02) on the level of 95%, what is the condition for further procedure of canonical discriminative analysis.

Table 1. Box's M tests

Box's M		335,541
F	Approx.	1,226
	df1	171
	df2	8299,885
	Sig.	**,02**

Table 2. Eigenvalues

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	9,489	100,0	100,0	**,95**

Table 3. Wilks' Lambda

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	,095	101,063	18	**,00**

Table 4. Standardized Canonical Discriminate Function Coefficients and structure matrix

Standardized coefficients	Function 1	Structure matrix	Function 1
MBTAPDR	-,195	MAGKUS	,515
MBTAPLR	,541	MAGOSS	,441
MBTAPDN	-,294	MBTAPDN	-,315
MBTAPLN	,148	MKTOSP	,311
MFLPRR	-,307	MFE20V	,304
MFLISK	-,003	MBTAPLN	-,245
MKTOSP	,190	MFLISK	,240
MAGKUS	,937	MBTAPDR	-,233
MAGOSS	,481	MFLPRR	-,155
MRESKL	-,408	MRSDTMAX	-,151
MRSDTZMAX	-,235	MFESDM	-,140
MRSDTMAX	,047	MRESKL	-,114
MBFPZ	-,231	MBTAPLR	-,108
MDSSTSD	,006	MDSSTSD	-,072
MDSSTSL	,640	MBAU10	-,058
MFESDM	,565	MRSDTZMAX	-,049
MBAU10	-,294	MBFPZ	-,038
MFE20V	,491	MDSSTSL	,016

The results of discriminative analysis have been shown in table 2 and 3. One very important discriminative function was gotten which has statistically very high value (Canonical Correlation = .95) and which showed us the correlation between the group of data on which basis we did discriminative analysis and results in discriminative functions.

Based on the results in table 4, it can be seen that the highest correlations with discriminative function, i.e. with variable that makes the difference of values of motor abilities in initial and final measuring, have the following variables: MAGKUS (.51); MAGKUS (.44); MBTAPDN (.31); MKTOSP (.31); MFE20V (.30); MBTAPLN (.24). So, this is about two variables of agility, two variables of speed space, one variable of coordination and explosive strength space. Further analysis of structure matrix in which is shown correlation with discriminative function, with variable that makes difference between the first and second measuring, it can be seen that positive changes appeared in the most of motor abilities, especially in those that represent in above mentioned variables. The program was extensive when it is about situational method, i.e. when it is about the game that has these psycho-motor features and they made the difference – agility, explosive strength motion speed, and coordination. So, it is about soccer play where powerful and explosive motions, with agility and body control, are dominant.

Table 5.- Functions at Group Centroids

Group	Function 1
1	3,023
2	-3,023

Discussion and conclusions

From many former researching of influence on efficiency in soccer play from which we mention: Elsner (1974), Gabrijelić (1977); Mekić (1984, 1985, 1987); Rađo (2000, 2003, 2005); Talović (2002), follows that motor abilities has important place, but anthropological space of soccer players is the consequence of interaction of large number of regulative mechanisams. The highest result in soccer can be reached under the condition of programmed work and according to these cognitions we started to program training cycle in Football Club " Velež " that lasted 45 days of preparing period and competitive winter semi-season of 2006/7 in Premier League of BIH. On the beginning we determined initial status of players, we initiated some allowed energetic supplements in training process and it was used as addition in soccer players nutrition. In the programmed training we involved the elements of aerobic (twice a week) and training on ergometers (twice a week). Players had psychological training and mutual talking in the group. According to the results we can conclude that such programmed and planned program that lasted six months made statistically important quantitative changes with senior soccer players. Motor abilities changed in this research, can be defined as latent motor structures and they are responsible for structure of motion with players and they correspond with the results above-mentioned researchers. It is clear that agility, coordination, explosive strength, and motion speed are dominant motor abilities that influence on realizing motion structures in soccer.

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ISOKINETIC MUSCLE TRAINING OF YOUNG ATHLETES

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Abstract

The primary aim of this study was to increase the strength of the upper leg musculature using a specific, 4-week isokinetic training programme. The study sample consisted of 16 male track and field athletes between 21-34 years of age. The athletes were subjected to a specific isokinetic training programme, performed on the Easytech prima DOC isokinetic dynamometer. After the initial testing, training regimen was individualized according to the athletes' abilities. Statistical analyses of the differences between the initial vs. final testing revealed an increase in muscle strength of the upper leg at the level of significance p= .00. The athletes' post-training trial demonstrated improved results in the strength of both knee extensors and flexors, which led us to conclude that statistically significant increases of the upper-leg musculature had indeed occurred as a result of the specific isokinetic training programme.

Key words: *upper-leg musculature, muscle strength, athletes*

Introduction

Re-emphasizing the importance of strength in contemporary sport is unnecessary, considering its obvious effects in numerous sport disciplines. Track and field has especially high requirements in terms of an athlete's musculo-skeletal abilities for high-level performance.

Strength can be applied and developed in various ways in the training process; it is also displayed differently, depending on the conditions in which muscle action occurs: with or without movement (Doder, 2000). It is well established that muscle strength is a fundamental motor ability necessary for successful athletic performance. This is why much focus has been placed on its development, resulting in steady improvements of top-level performance.

The application of isokinetic testing is highly recommended in different phases of an annual training cycle. Based on the collected data, the training process can target an enhancement of the "weakest links", in this investigation – the upper-leg musculature, and also ensure the stabilisation of the knee joint, which may in turn improve athletic performance and minimise injuries.

During isokinetic training, resistance is adapted to the individual patient at any point in time during movement; this allows for rehabilitation of even "the freshest" injuries, and also for early post-operative rehabilitation (Shelbourne and Gray, 1997, and De Carlo et al., 1999).

A number of previous studies have demonstrated that individuals with stronger lower extremities are generally more resilient to maximal efforts during various athletic activities (Lacerte et al., 1992; Colak, 1999). During conditions of great muscle exertion, track and field athletes perform muscle contractions (of the lower extremities) which are essentially isokinetic. This fact was one of the main rationales for designing and applying a realistic, empirical model of an isokinetic training programme.

The main purpose of this study was to increase muscle strength of the upper-leg musculature in track and field athletes, using a specific, 4-week isokinetic training programme.

Methods

Study population included 16 male volunteers, all track and field athletes between 21-34 years of age. The sample was deliberately derived from the population of trained athletes from the territory of the Province of Vojvodina, Serbia. All the athletes were in good clinical health, without any contraindications regarding isokinetic exercise; they were also selected based on the results which were below the criteria set by the Provincial Institute for Sport in Novi Sad, Serbia. The most common reasons for sub-standard muscle strength performance were injuries, as well as disrupted or inadequate training process. All athletes were subjected exclusively to the 4-week training programme on the isokinetic dynamometer, and did not engage in any other physical activity during the trial.

Testing protocol included the following variables: (TELVI) body height, (TELMA) body mass, (EXTDI) right-knee extensors – initial testing, (EXTLI) left-knee extensors – initial testing, (EXTDF) right-knee extensors – final testing,

(EXTLF) left-knee extensors – final testing, (FLXDI) right-knee flexors – initial testing, (FLXLI) left-knee flexors – initial testing, (FLXDF) right-knee flexors – final testing, and (FLXLF) left-knee flexors – final testing.

Athletes were subjected to a specific, individualised training programme on an isokinetic dynamometer (Easytech prima DOC), that took place over a 4-week period. The training programme consisted of isokinetic exercises including maximal leg extensions and flexions, at various angular velocities generating corresponding resistances.

For isokinetic testing and the 4-week training protocol, the Provincial Institute for Sport's Easytech prima DOC isokinetic dynamometer was used. All measurements were taken according to a standard protocol. The range of motion was set to 90°. It was ensured that instructions prior to testing, testing itself, and the training protocol were overseen by the same investigator. Subjects were strapped to the apparatus, in order to isolate targeted muscle groups (flexors or extensors). Testing of the peak torque was performed at the angular velocity of 60°/sec, with four maximal contractions of the front thigh, followed by those of the back thigh. During testing, the apparatus recorded the following: maximal angular momentum, maximal angular momentum relative to body mass, strength deficits, the agonist-antagonist relationship, total work performed, fatigue etc. The same protocol was followed for both legs (Madsen, 1996; Gleeson and Mercer, 1996).

Training protocol (Table 1) on the isokinetic apparatus consisted of maximal exercises lasting 1-2 minutes, interrupted by 1-6-minute breaks, with gradual weekly increases in resistance (240, 180, 90, 60°/sec). The protocol was the same for both legs, and it was performed in 6 series lasting 45 minutes, 5 times a week.

Interval training proved to be the best method for muscle strength development. One of the principal concerns was to determine the highest possible intensity with the least amount of fatigue. Providing optimal resting periods between individual exercise bouts were necessary in order to ensure the best possible conditions for proper training (Lord et al., 1992).

Table 1. Week 1 of the training programme protocol

Isokinetic training	SET					
	1	2	3	4	5	6
Velocity (degree/sec) Repetition	240 015	240 020	240 025	240 030	240 035	240 040
Rest/min	001	002	003	004	005	006

Prior to and following the 4-week training programme, peak torque; expressed in Newton metres (Nm) was measured of the front and back thigh at the angular velocity of 60°/sec. This particular sort of method of training on an isokinetic apparatus has been extensively used in research studies, and has generated valuable information concerning the development of strength of the upper-leg musculature (Lacerte et al., 1992; Narici et al., 1996; Čolak et al., 1998).

The following central and dispersion parameters were calculated: arithmetic mean (M), minimal value (min), maximal value (max), standard deviation (S), standard error of mean (SM), skewness (Sk) and kurtosis (Ku). T-test was used to determine mean differences between initial vs. final testing for all dependent variables.

Results

For all the measured morphological and motor variables in both the initial and final testing, the obtained results do not significantly deviate from normal distribution (labeled with *). The degree of kurtosis of data distribution was mesokurtic and platikurtic (Table 2).

Results from Table 3 show mean differences (D) between initial and final testing (MF-MI), so that changes in variables can be immediately observed. Since a dependent sample (one group) was used, and only two measurements (initial and final) were made, we used t-test to determine potential differences. Another rationale for this was found in the fact that significant within-group differences were expected for each dependent variable as the experiment took place over four weeks. Statistical significance (p) between the initial and final test is marked with (*).

Table 2. Central and dispersion parameters

Varijable	M	Min	Max	S	Se	Sk	Ku
TELVI	182.25	169	198	11.00	2.76	-.16	-1.59
TELMA	79.13	59	90	46.34	11.59	-.57	.85
EXTDI	191.75	99	266	43.34	11.59	-.57	.85
EXTDF	206.63	127	276	41.27	10.32	-.34	.69
EXTLI	230.63	182	297	38.34	9.59	.40	-1.03
EXTLF	258.88	200	332	41.22	10.31	.35	-.69
FLXDI	102.63	48	168	39.12	9.8	.37	-1.05
FLXDF	124.38	72	187	35.95	8.99	.26	-.70
FLXLI	108.63	62	146	29.693	7.41	-.25	-.69
FLXLF	124.86	69	181	34.59	8.65	-.13	-.67

Legend: M - arithmetic mean , Min/Max - minimal/maximal value, S - standard deviation, Se - standard error of mean, Sk - skewness , Ku – kurtosis, TELVI– body height, TELMA – body mass, EXTD1 – right-knee extensors (initial testing), EXTLI – left-knee extensors (initial testing), EXTDF – right-knee extensors (final testing), EXLF – left-knee extensors (final testing), FLXDI – right-knee flexors (initial testing), FLXLI - left-knee flexors (initial testing), FLXDF – right-knee flexors (final testing), FLXLF – left-knee flexors (final testing)

Tabela 3. Statistical significance of mean differences between final vs. initial testingfor isokinetic variables (MF-MI)

Variables	D (MF-MI)	S (MF-MI)	t	p
EXTD	14.86	8.64	-.688	.00*
EXTL	28.25	15.40	-7.34	.00*
FLXD	24.75	24.36	-3.57	.00*
FLXL	16.25	16.03	-4.05	.00*

Legend: D (MF-MI) - mean differences (D) between final vs.initial testing (MF-MI), S (MF-MI) standard deviation differences between final vs. initial testing (MF-MI), t – t-test value, p – reliability

Level of significance of p= .00 was set for all statistical analyses. Athletes showed better results in the final testing for both knee extensors and flexors in both legs, suggesting there was a significant improvement in strength of the upper-leg musculature. These positive changes were brought about by the experimental, isokinetic 4-week training programme.

Discussion and conclusions

Isokinetic diagnostics of a large number of athletes can offer an insight into their locomotor status. Performance testing has repeatedly shown that athletes normally display disbalances in muscle strength that are typical for their own sport discipline. Each sport is unique due to the specifics of its training process. Isokinetic diagnostics can give us valuable insights into some of its main problems, as well as directions for possible solutions.

Isokinetics is a muscle exercise model characterised by constant speeds of movement, in which resistance is always determined by the subject's strength and also his/her fatigue in each point of motion. Isokinetic resistance allows for training at a functional speed in order to develop muscle strength, and also provide adaptations of the neuromuscular system to speeds necessary for various dynamic functions of the extremities (Akima et al., 1999; Keays et al., 2000).

In order to perform isokinetic training, one needs an isokinetic dynamometer, with which one can optimally program muscle contractions to constant speed, leading to rapid and safe development of muscle strength in trained athletes (Lacerte et al., 1992; Čolak, 1999).

Muscle contractions occurring at constant speeds of motion, typical for isokinetic training, bring about increases in muscle strength faster than the isometric ones. Isokinetic muscle contractions increase muscle strength by promoting both functional and structural adaptations of the neuromuscular system (Narici et al., 1996). Total work performed may be 5-12 times greater than on standard fitness machines, thereby improving results much faster. With isokinetic training, there are no "musculfiber", cartilage or ligament strains. Exercises can be performed at greatest speeds because they can be programmed. It can all be done according to programmes and instruments (Kuvalja et al., 2002).

In this research paper, we have presented a specific, 4-week isokinetic muscle training programme of 16 track and field athletes. Based on the univariate analyses of mean differences between initial and final testing (t-test), significant

differences were found for all dependent variables at the level of statistical significance of .00 (p= .00). Accordingly, we conclude that the observed increases in muscle strength of the upper-leg were caused by a well-designed, well-operationalised isokinetic experimental training programme.

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A CANON OF DYNAMOMETRIC (ISOMETRIC) POWER OF ATHLETES IN RELATION TO THEIR AGE AND SEX

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Abstract

The purpose of this study is to create a universal canon of hand, upper-body and leg muscle power of their ideal relationship in athletes, relative to their age. The study population included 1427 male and female athletes, aged 8-22, divided into sub-groups based on their age. A dynamometer was used to determine the status of isometric muscle power of the left and right hand flexors, upper-body flexors and extensors, and knee extensors. Left-hand measurements were considered to be the point of reference from which all the power relationships were determined. The relationship of muscle power between the left hand, the right hand, abdominal press, the back and the legs was determined to be 1 : 1 : 1 : 3 : 6. This relationship has been defined as the canon ("gold standard") for the determination of harmony or disharmony of muscle power. Since the canon is rather simple, it can be easily carried out in practice. One must bear in mind that the canon will somewhat stray from the original for some sports or disciplines, because it is only proposed as a general canon, being generated from a sample of athletes from various sports.

Key words: *unit of measurement, muscle power relationship, harmony/disharmony of muscle power.*

Introduction

Of all bio-motor abilities, power and strength are the most important in most sports. All team sports, as well as those dominated by explosive strength, rely on a strong status of power and strength. By understanding the process of training of muscle power, and by implementing these principles into the training programme, tweaking of form for competition will be possible (Bompa, 2006).

Our Provincial Institute for Sport, located in Novi Sad, Serbia, offers anthropological testing of both athletes and other residents living in the Province of Vojvodina. The technology has been updated for the last 50 years, especially the segment concerning motor abilities. Apart from the new dynamometry equipment, there has been standardization of all testing procedures and instruments (Babiak and Doder, 2007c).

After establishing the status of muscle power of specific muscle groups and identifying their relationship, a canon of power is created for each athlete. Following this, the individual canon is being compared with the "gold standard", the ideal canon, for the purpose of determining the existence of harmony or disharmony ("the weakest links" in the muscle power chain). Eventually, recommendations and directions for further training are given to athletes and their coaches (Babiak, 2005; Babiak and Doder, 2007a). Based on the clusters of these models, ideal canons are created for each sport. The ultimate goal is creating a universal model of muscle power for athletes and champions for various sports and individual disciplines.

Methods

Study population consisted of 965 male and 462 female participants aged 8-22. The sample was drawn from the population of Serbian athletes who had undergone some sort of sport training for at least two years prior to the study. Participants were pooled by their age as follows:

1. males: 63 (8-10 years of age), 75 (11-12 y.), 177 (13-14 y.), 240 (15-16 y.), 219 (17-18 y.) and 191 (19-22 y.).
2. females: 20 (8-10 y.), 38 (11-12 y.), 75 (13-14 y.), 96 (15-16 y.) 84 (17-18 y.) and 149 (19-22 y.).

Using the topological concept of dynamometric (isometric) power (Zaciorskij, 1975), the following tests were used for its assessment:

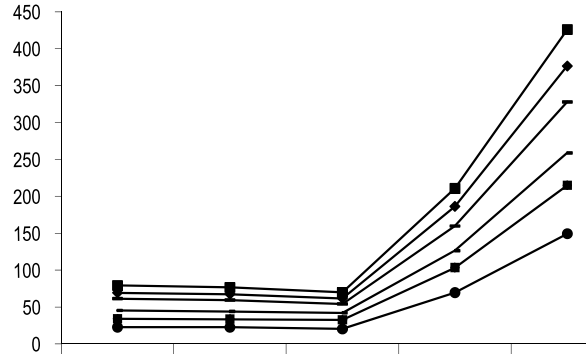
- absolute power of right-hand flexors (SDA)
- absolute power of left-hand flexors (SLA)
- absolute power of upper-body flexors (PTA)
- absolute power of upper-body extensors (OLA)
- absolute power of knee-extensors (ONA)

All participants were tested at the Provincial Institute for Sport on the dynamometry testing apparatus, in accordance with the existing testing procedures.

Statistical analyses were used for calculating central and dispersion parameters of the data, as well as those of relevant power relationships.

Results

The obtained data for dynamometric power were sorted by age, after which central and dispersion parameters were calculated. All central parameters are presented in Table/Figure 1 below:



	SDA	SLA	PTA	OLA	ONA
8-10 years	22,64	22,48	20,31	69,46	149,13
11-12 years	34,08	33,59	32,68	103,36	214,87
13-14 years	45,35	43,93	42,08	126,46	258,93
15-16 years	61,34	59,38	54,13	159,73	327,9
17-18 years	69,33	67,52	61,75	186,29	376,51
+18 years	79,33	76,74	69,94	210,69	425,81

Table/Figure 1. The results for dynamometric (isometric) power for male athletes by their age

Based on central parameters of the tested muscle groups in male athletes, power relationships were determined. The relationships are as follows:

Table 2. Harmonious canon of power for male athletes

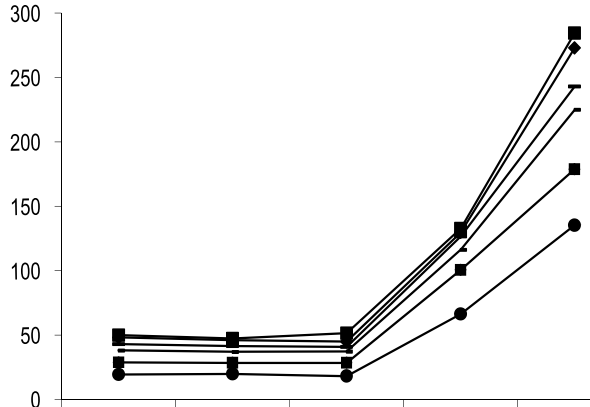
8-10 years:	SDA : SLA : PTA : OLA : ONA = 1.01 : 1.00 : 0.90 : 3.09 : 6.63
11-12 years:	SDA : SLA : PTA : OLA : ONA = 1.01 : 1.00 : 0.97 : 3.08 : 6.40
13-14 years:	SDA : SLA : PTA : OLA : ONA = 1.03 : 1.00 : 0.96 : 2.88 : 5.89
15-16 years:	SDA : SLA : PTA : OLA : ONA = 1.03 : 1.00 : 0.91 : 2.69 : 5.52
17-18 years:	SDA : SLA : PTA : OLA : ONA = 1.03 : 1.00 : 0.91 : 2.76 : 5.58
18+ years:	SDA : SLA : PTA : OLA : ONA = 1.03 : 1.00 : 0.91 : 2.75 : 5.55

It can be concluded, if one takes the power of left-hand flexors (SLA) as the reference point, that each athlete's values for the other hand should be approximately the same, negligibly lower for abdominal press, almost three times higher for the back, and nearly six times higher for the legs. This relationship may be defined as the "harmonious canon of power".

The above canon will definitely vary for each sport or discipline, because this is only a general one, extracted from the population of athletes from a variety of sports and sport disciplines.

Regarding its longitudinal trends, dynamometric (isometric) power does not demonstrate steady development. It is the fastest at the early ages, then the line bends between the ages of 13-16, and finally slows down as the age increases.

The female dynamometric power data, apart from the consistently lower values, which are in agreement with previous studies (Byrd and Jenes, 1982; Verhošanski et al., 1992), have shown similar trends as for the male population. However, the rate of development of dynamometric power in the younger subgroups is higher, and the stabilization of power with age is more evident than for the males (Table/Figure 3).



	SDA	SLA	PTA	OLA	ONA
8-10 years	19,38	19,85	18,12	66,33	135,32
11-12 years	28,73	28,46	28,38	100,57	178,76
13-14 years	37,95	36,92	37,22	116,23	224,88
15-16 years	42,98	41,53	40,81	126,68	242,9
17-18 years	48,05	45,99	44,83	129,67	272,82
+18 years	50	47,27	51,46	132,75	284,53

Table/Figure 3. The results for dynamometric (isometric) power for female athletes by their age

The canon of power in young female athletes, subgrouped by their age, is as follows:

Table 4. Harmonious canon of power for female athletes

8-10 years:	SDA : SLA : PTA : OLA : ONA = 0.98 : 1.00 : 0.91 : 3.34 : 6.82
11-12 years:	SDA : SLA : PTA : OLA : ONA = 1.01 : 1.00 : 1.00 : 3.53 : 6.28
13-14 years:	SDA : SLA : PTA : OLA : ONA = 1.03 : 1.00 : 1.01 : 3.15 : 6.09
15-16 years:	SDA : SLA : PTA : OLA : ONA = 1.03 : 1.00 : 0.98 : 3.05 : 5.85
17-18 years:	SDA : SLA : PTA : OLA : ONA = 1.04 : 1.00 : 0.97 : 2.82 : 5.93
18+ years:	SDA : SLA : PTA : OLA : ONA = 1.06 : 1.00 : 1.09 : 2.81 : 6.02

The results imply that the power relationship in females is almost exactly the same as in males. However, relative values for the upper-body and the legs are slightly higher for females compared to males. The root-causes for such a relationship may be found in genetics. Further studies are necessary in order to determine potential impacts of sport with regard to these findings.

Discussion and conclusions

Static power is the ability to generate maximal power of an attempted movement, or the ability of sustaining muscle contraction in a static regime (Milanović, 2004), whereas harmonious canon of power (an ideal model, a "gold standard") is an indicator of an ideal relationship between individual muscle groups in an athlete.

If the measured power of an athlete's individual muscle groups is consistent with this canon, one can conclude there is a harmonious relationship of muscle power for this individual. On the other hand, any disagreement or discrepancy with this model, speaks of a disharmony of muscle power, and requires additional adjustments during training.

It is well established that the power of a kinetic chain within a system is only as strong as its "weakest link" allows it to be. Since it is necessary to recognize and identify the intra-dependence between individual muscle groups, their values in the figures were connected with a line. For top-level performance and excellent results, the power relationship between individual muscle systems is more relevant than their maximal values.

Having this in mind, the discussed norms and principles of muscle power in humans, especially in the athletic population, are just another reason for a holistic approach to sports training, for insisting on creating a solid foundation of basic motor abilities and their harmonization before differentiation and specialization. In practice, a high price is often paid as a result of shortened, neglected or inappropriate basic training in the quest for maximal performance.

Taking into account the aforementioned conclusions, success in sport should be understood as a complex series of various parameters, simply because the equation of success in sport is not straightforward to begin with. In most sports,

this equation should be considered as one of the main generators of success without which it cannot be achieved. Moreover, it should be looked upon as a motor ability with all its rules and norms, advantages and disadvantages.

In the present study, we determined the level of dynamometric power of the four most frequently measured muscle groups in humans. These values can be compared with similar samples of both sexes, divided into the age subgroups. A relative approach in the evaluation of muscle power has been presented. Also presented is a canon for both sexes and the tested ages, as well as the principle for simple inferences concerning muscle harmony, without using any tables or other reference values.

For these reasons, this study was meant to provide its own contribution to understanding the problem of dynamometric (isometric) muscle power. It is suggested that any sport training and success are impossible without it; one should never forget the overall relationship of all the systems when planning for specific power development. Every partialization can be dangerous, while any serious analysis must take into account the position of a relevant power segment in relation to the overall system and vice versa. One cannot do without this intra-dependence, and every partial approach - so common in practice, is a step-back, an unnecessary distraction in the search for success in sport.

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EFFICIENCY OF DIFFERENT METHODS ON STRENGTH PARAMETERS

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Abstract

The aim of the study was to evaluate the efficiency of two strength training protocols with different power in concentric phase due to different numbers of reps in sets (3 x 10 vs. 10 x 3). Results showed that higher power in less fatiguing 10 set, 3 reps each as compared to 3 sets, 10 reps each lead to significantly more pronounced improvement of force production during initial 200 ms – period of isometric contraction.

Key words: *speed-strength sports, maximal isometric force*

Introduction

One of the determining factors affecting performance in events of speed strength types of sports is ability to produce higher force in shortest possible time. Therefore we were interested in possibilities of its improvement.

We know from literature (Fleck-Kraemer, 1997), that to improve explosive strength we use training methods that are based on stretch-shortening cycle. We can also use exercises with lighter loads including 30 – 60% of 1RM (e.g., pulls, cleans) where minimal inhibitory or antagonist facilitation is activated (Newton et al., 1996).

In the second type of exercise (there in before) power decreases more (Bosco, 1999). Therefore we decided to use such method in which we can hold the power in each repetition on higher value.

Methods

Altogether 25 subjects were divided into 2 groups. The first one consisted of 11 boys mean age 19.5 ± 0.8; body mass 74.6 ± 11.5 kg. The second group consisted of 14 boys mean age of 20.4 ± 2.22; body mass 75.0 ± 12.0 kg. Both groups performed strength training session three times a week consisting of 30 bench press repetitions. First group performed 3 sets with 10 repetitions each, the second one 10 sets 3 repetitions each. The weight used was equal to the one with which the athletes were able to produce maximal power in pre-training testing. Rest intervals between sets were 3 minutes and 30 seconds.

Following tests were used in pre and post training testing: estimation of maximal power by means of device Fitrodyne premium and measurement of maximal isometric force production using force platform Fitro force plate in initial intervals of 0-50 ms, 0-100 ms, 0-200 ms.

Results

Production of force in interval 0-50 ms in first group (3 sets x 10 reps) after the training program decreased from 103 N to 96 N (i.e. - 7 N). In interval 0-100 ms decreased from 236 N to 221 N (i.e. - 15 N). In interval 0-200 ms decreased from 422 N to 404 N (i.e. - 18 N). In maximal isometric force this group has improved from 807 N to 857 N (i.e. + 50 N). Changes of all parameters were not statistically significant (tab. 1).

The second group (10 sets x 3 reps) after training program improved in mean production of force in interval 0-50 ms from 106 N to 123 N (i.e. + 17 N). In interval 0-100 ms improved from 247 N to 274 N (i.e. - 27 N). In interval 0-200 ms improved from 438 N to 476 N (i.e. + 38 N). In maximal isometric force this group has improved from 862 N to 891 N (i.e. + 29 N). Changes in intervals 0-50 ms, 0-100 ms and parameter of maximal isometric contraction were not statistically significant. Only changes in interval 0-200 ms have reached statisticall significance ($p<0,05$).

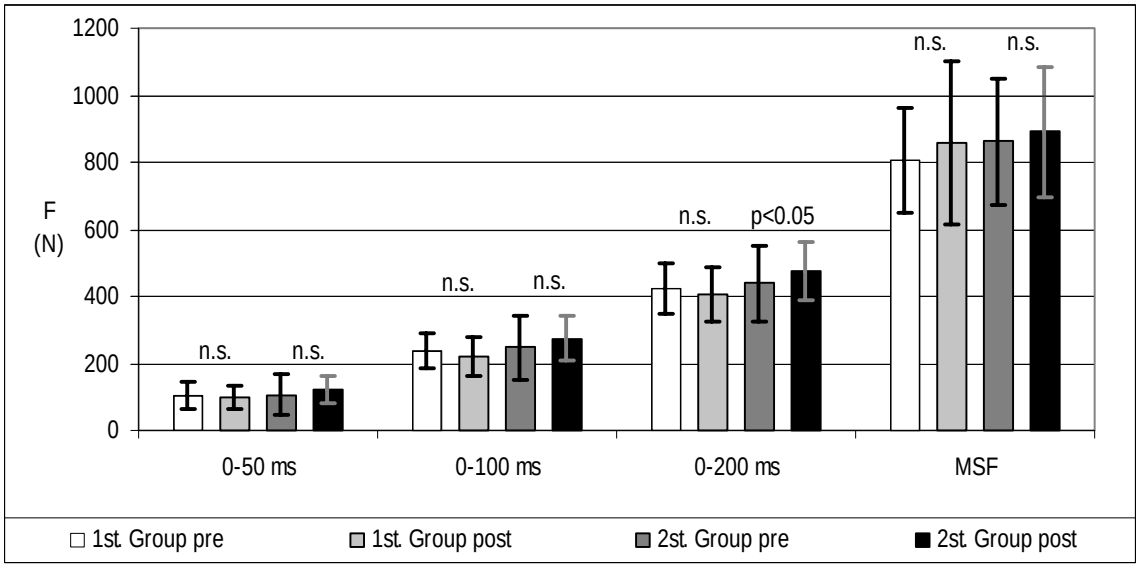

Figure 1. Mean force production in initial periods of maximal isometric contraction and maximal static force

Discussion and conclusions

Results indicate that 10 sets x 3 reps is more efficient means for improvement of force production in initial phase of isometric muscle contraction. This may be a consequence of more pronounced activation of fast twitch fibers due to higher power production in concentric phase of muscle contraction. In method with 3 sets x 10 repetitions the higher number of reps caused fatigue and decrease in lifting velocity in final slope of the set. When we count number of faster repetitions in this method (10 sets x 3 reps) we get 30 repetitions on high intensity during one workout. In the other method (3 x 10) it is only 9 repetitions on high intensity.

There were no differences between more intensive strength training (10 sets, 3 reps each) as compared to less intensive intervention (3 sets, 10 reps each) in improvement of maximal power, maximal isometric force and average values of force production in initial phase 0 - 50 ms and 0 – 100 ms of maximal isometric muscle contraction.

However, intensive training was significantly more efficient mean for enhancement of force production in initial 200ms phase of maximal isometric contraction.

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INFLUENCE OF SPECIALLY PROGRAMMED RHYTHMIC GYMNASTICS TRAINING ON CHANGES OF CERTAIN BASIC MOTOR ABILITIES IN GIRLS

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Abstract

The motor improvement has crucial meaning for overall child development. Namely, it affect on intellectual, social and emotional enlargement. The rhythmic gymnastics belongs to basic sports which are full with natural movements. So, in this research it was tendency to affect with adequate program of rhythmic gymnastics on quantitative and qualitative changes of some motor abilities of girls ages from 8–11 years. The quantitative changes between initial and transitive testing were established with program SSDIF, while the qualitative changes were verified by using LSDIF program. The obtained results showed that there is a significant different only for quantitative changes which are related to the differences in sizes of specific motor abilities of subjects, while the obtained qualitative changes, based on relations of those sizes, are not statistically significant.

Key words: *rhythmic gymnastics, quantitative changes, qualitative changes*

Introduction

Training of younger age groups is a years-long, organized process of development and maintenance of abilities, knowledge and characteristics. Its objective is to get adjusted to biological and sports level of development of children in certain phases of sports improvement.

According to levels of sports development, i.e. periodization of long-term training, girls of this age enter an initial phase of the children's training or initiation (Tudor O. Bompa, 2000). The emphasis is on the multilateral development of motor and functional abilities with exercises including running, jumping, catching, balance, rolling, etc.

The structure, modalities and resistance must stimulate the dynamic development of anthropological functions, motor abilities and competitive performance, following first of all knowledge about sensitive phases for the development of motor and functional abilities (Milanović et al., 2003).

Changes in quantity and quality in some functional, motor and morphological characteristics of female pupils in the 7^{th} and 8^{th} grade were analyzed, under the rhythmic-sports gymnastics influence, in the Bogić research (1995). The research was conducted on 92 female pupils during 70 school hours in the course of one school year. The research results showed that, together with the quantitative changes, significant qualitative changes also occurred in the measured anthropological characteristics, and the result of those changes represents an interaction of the kinesiology treatment effect and the growth and development factor.

There is a very small number of researches dealing with an analysis of transformation procedures for the purpose of finding optimal kinesiology treatments that would use potential predispositions of female pupils and influence as comprehensive as possible on their entire psychosomatic status.

The objective of this research is establishing the efficiency of specially programmed kinesiological treatment, made during 17 weeks on a group of girls aged between 8-11, on quantitative and qualitative changes of motor abilities and analyzing transformation effects followed throughout two time points.

Methods

The sample of examinees consists of 15 girls of the primary school Ivan Filipović in Zagreb. The examinees, aged between 8 and 11, are healthy i.e. without morphological, pathological or other locomotor system limitations.

The sample of variables consisted of tests for evaluation of basic motor abilities: coordination (MAGOSS – figure of eight with ducking), shoulder's joint flexibility (MFLISK – shoulder twist), entire body flexibility (MFLPRK – forward bend on a bench), balance (MBAP2O – standing on two legs facing sideways on a balance bench with eyes opened), torso repetition strength (MRCTRB – lifting the torso from a lying position) and tests for the rhythmic structures realization evaluation (MKRBUB – arrhythmic drumming).

Experimental procedure lasted four months in the period from February 03, 2006 until June 02, 2006. Together with the mandatory Physical Education class, the girls also had the training of rhythmic gymnastics of one hour twice a

week. In 17 weeks it was realized that 30 hours of training represented both initial and final verification. The program of rhythmic gymnastics included: overcoming of directions in space, walking and running rhythmically, dance steps, leaps (˝little one˝ hop, leaps with bent and extended front, back and side splits), jumps (scissor kick, cat leap, stag leap, split leap), orientation in space, balance positions, agility (lateral and frontal body wave), stretching exercises for shoulder area, stretching exercises for entire body (body bent forward against stall bars, body bent with legs apart in pairs, side and straddle splits, body bent sideward, body bent backward in kneeling and standing position), elements with rope, torso strength exercises.

Data processing was made with the program package Statistics for Windows, ver 5.0. Central and dispersion variables were calculated for all variables in every measuring.

In order to establish quantitative changes between initial and transitive verification the SSDIF program (Momirović et al., 1984) was applied. The significance of differences in size of quantitative changes between initial and transitive verifications was tested with the canonical discriminant analysis for independent samples. The significance of discriminant functions will be tested with Bartlett's χ^2 test. Qualitative changes between initial and transitive verification were established by using the LSDIF program (Momirović et al., 1987). The difference significance of correlation matrixes of initial and correlation matrixes transitive situation was tested with the LSDIF program.

Results

An increase, i.e. improvement of results of transitive verification in relation to results of initial verification in all tested motor abilities, was noticed by analyzing descriptive parameters. From values of standard deviations, assuming smaller values in transitive verification, it is possible to conclude that an increase in the results homogeneity occurred (Table 1 and 2).

Table 1. Central and dispersion parameters of initial measuring

	Valid N	Mean	Minimum	Maximum	Range	Std.Dev.	Skewness	Kurtosis
MFLISK1	15	68,07	50,33	90,00	39,67	12,30	0,10	-1,07
MFLPRK1	15	8,84	2,33	18,67	16,33	4,36	0,55	0,61
MAGOSS1	15	19,26	17,08	21,62	4,54	1,13	0,17	0,36
MKRBUB1	15	9,12	4,00	12,50	8,50	2,11	-0,78	1,37
MRST1	15	16,58	9,00	21,67	12,67	3,95	-0,60	-0,67
MBAP201	15	2,16	1,31	3,17	1,85	0,46	0,11	0,61

Table 2. Central and dispersion parameters of transitive measuring

	Valid N	Mean	Minimum	Maximum	Range	Std.Dev.	Skewness	Kurtosis
MFLISK2	15	62,31	45,67	95,67	50,00	12,13	1,23	3,43
MFLPRK2	15	11,34	8,17	20,50	12,33	3,17	1,85	4,40
MAGOSS2	15	18,77	17,65	20,07	2,42	0,73	-0,02	-0,80
MKRBUB2	15	13,38	9,25	16,50	7,25	1,88	-0,39	0,41
MRST2	15	18,09	8,67	23,67	15,00	3,52	-1,35	2,92
MBAP202	15	2,98	1,40	5,78	4,37	1,10	1,31	2,15

In accordance to one of the objectives of this research, which is to establish whether significant quantitative changes occurred, a detailed analysis of differences of arithmetic mean of the initial and transitive verification variables was carried out, since they are at the same time the most significant indicators of quantitative changes (Table 3). Differences of quantitative changes are evident also from the correlation matrixes of initial, transitive and initial-with-transitive verification. That is to say, based on changes in the number of significant correlation coefficient and in the level of their values, it can be concluded that the programmed kinesiological treatment applied during 17 weeks on rhythmic gymnasts caused quantitative changes.

Table 3. Arithmetic means of the first and second measuring and their difference

	AS1	AS2	AS2-AS1
MFLISK	68,07	62,31	-5,76
MFLPRK	8,84	11,34	2,50
MAGOSS	19,26	18,77	-0,49
MKRBUB	9,12	13,38	4,27
MRST	16,58	18,09	1,51
MBAP20	2,16	2,98	0,82

The last objective in this research is to establish whether significant qualitative changes occurred. The hypothesis on equality of correlation matrixes obtained in different time points, i.e. the significance of difference between correlation matrix of initial and transitive condition, was tested with the LSDIF program.

Table 4. Testing of differences between initial correlation matrix and correlation matrix of transitive verification

	TraceR2	df	Chi2	p
1	1,12	6,00	8,42	0,21

The difference between initial and transitive correlation matrix on the significance level p<,00 (Table 4) was tested through the value with χ^2 distribution. The statistically significant difference in characteristics relations that the situation of an individual entity is described with, i.e. motor abilities of the examinees, was not obtained as a result of that procedure.

Discussion and conclusions

The objective of the kinesological treatment was to improve the flexibility of the shoulder area and torso, balance, torso repetition strength, frequency of movement and agility. As the outcome of the data analysis, the results of the transitive verification were better than the results of the initial verification. However, the statistically significant differences were obtained only in quantitative changes related to the differences in sizes of specific motor abilities of rhythmic gymnasts, while the obtained qualitative differences, based on relations of those sizes, are not statistically significant. The reason for it can be looked for in a small number of training in the one-week microcycle. The program was implemented only two times a week; therefore in the case when a single examinee missed one training, there would be quite a long pause until the next training.

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SWIMMING PERFORMANCE OF CANDIDATES FOR PHYSICAL EDUCATION STUDIES IN SLOVAKIA

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Abstract

This contribution analyses swimming performance of candidates for physical education studies at chosen Slovak Universities - Faculty of Humanities at Matej Bel University in Banská Bystrica, Faculty of Physical Education and Sport at Comenius University in Bratislava and Pedagogical faculty at Constantine the Philosopher University in Nitra in the school year 2007/2008. The total number of participants in this research was 1002 (790 men and 212 women).

Results of each candidate have been processed on basis of their time limits on 100m and their scores in individual swimming styles according to a point system. On the basis of achieved results and further analysis of candidates' swimming performance of physical education at chosen Slovak Universities the criteria for swimming performance in Slovakia should be modified. The conclusion of this paper tells that the physical preparation of candidates in swimming slightly decreases each year and it would be dangerous to lower the criteria that would consequently decrease the level of future teachers' and trainers' physical preparation. The number of candidates remains high or slightly increases each year and there is absolutely no need to modify the criteria towards the "bottom".

Key words: *candidates, studies, Physical Education, swimming, swimming performance, points, rating*

Introduction

Entrance exams for Universities in Slovakia are obligatory. Swimming at Slovak Universities for future physical education teachers remains still a compulsory subject in the studies program as a part of the international credit system of studies.

Students of physical education are encountered with a swimming theory and methodology throughout their studies to obtain theoretical knowledge and practical swimming skills and to support their future teaching process on adequate level.

Candidates' interest in physical education studies in Slovakia at universities in Bratislava, Banská Bystrica and Nitra is above Slovak average. The number of candidates for studies exceeds quotas for accepting the students for the first year of studies.

The history of entrance exams, increasing number of candidates' for physical education and decreasing quality in terms of preparation determine the obligation of entrance exams for physical education studies.

Entrance exams serve as the talent selection tool that makes the primary selection of the future students every year and helps teachers to maintain the quality level of students. The entrance talent selection is an inseparable part of the entrance exams at universities with physical education specialization. Their aim is to find out the level of kinetic readiness of candidates, for example the level of their condition and special skills. The entrance talent selection is based on evaluating criteria in Athletics, Gymnastics, Games and Swimming. The complexity of these requirements shows the level of candidate's kinetic readiness to make sure he will be able to manage specific requirements throughout his or her studies.

The problem of talent and entrance exams from physical education and the criteria put on candidates are a subject of many discussions among university professors and professionals working in the field of physical education.

JURSÍK (1995) compared dynamic swimming capacity changes of physical education candidates at Faculty of Physical Education and Sport at Comenius University in Bratislava in years 1983 – 1993.

MACEJKOVÁ, BENČURIKOVÁ, RAMACSAY (1996), besides swimming performance monitored also other factors influencing its level which included for example high schools where candidates for physical education had studied.

CHEBEŇ (2001) by analyzing swimming styles he recorded serious lack of swimming technique of candidates for physical education studies in Nitra.

BENCE, CHEBEŇ (2002) compared swimming performance of candidates for physical education studies in Banská Bystrica and in Nitra, where they found out that swimming performance corresponds to the requirements for the entrance talent selection, but reaches only an average level on both universities monitored.

BENCE, MANDZÁKOVÁ (2006) detected influence of talent selection on swimming performance of students of physical education at Faculty of Humanities at Matej Bel University in Banská Bystrica.

Similar results to the ones in Banská Bystrica and in Nitra were achieved at Faculty of Physical Education and Sport at Comenius University in Bratislava

KALEČÍK (2007), who recorded only an average level of swimming, and he noted a decrease of swimming readiness of candidates that apply for studies at this faculty.

Goal and tasks

The aim of our paper is to find out, to evaluate and to compare the reasonable level of swimming performance of physical education studies candidates in school year 2007/2008 at chosen faculties that prepare physical education teachers and trainers in Slovakia to be able to answer the question if our present performance criteria are reasonable, helping to maintain the high quality level of future teachers of physical education.

We have determined three tasks to be able to answer the core question of our aim. These assignments are:

- to find out the selection of the swimming styles in groups of men and women.
- to evaluate the swimming performance of candidates according to the point system.
- to compare achieved results at individual universities.

Methodology

An experimental group was created consisting of candidates for physical education studies at Matej Bel University in Banská Bystrica (FofH MBU), at Comenius University in Bratislava (FPES CU) and at Constantine the Philosopher University in Nitra (CPU). The entrance talent selection in school year 2007/2008 in Banská Bystrica attended 209 men and 37 women (total number of candidates is 246), the highest number in Bratislava 498 men and 139 women (the total of 637), and in Nitra 36 women and 83 men (the total of 119). Results of each candidate and of partial groups of candidates, like men or women, are evaluated on a statistical basis and on the base of causal relations. The quantitative data are also in relation with our long-term experience based statistics supported by observations and interviews.

Table 1. Number of candidates for physical education at Faculty of Humanities at Matej Bel University, Faculty of Physical Education and Sport at Comenius University and at Pedagogical faculty at Constantine the Philosopher University in school year 2007/2008

Faculty	Faculty Bystrica	Fac. Bratislava	Fac. Nitra	Total
Women- n	37	139	36	212
Men - n	209	498	83	790
Total -n	246	637	119	1002

n = number

The entrance talent selection consisted of swimming 100m distance with optional starting jump. Swimming performance was evaluated according to swimming rules and point system. According to the swimming style and the swimming time we gave points and we put all results into the frequency scheme from the standard to 10 points.

The point scheme that was used is the same at the universities in Bratislava and in Banská Bystrica. It is different at the university in Nitra

For the results processing we used a basic statistic methods, a percentage reference, a logical analysis and a synthesis. The quantitative analysis was complemented by information acquired by long-term observation of techniques and occasional interviews with some students during our teaching career at University.

Results

Resulting from the scheme 1,the highest number of physical education studies candidates is in Bratislava, next in Banská Bystrica and Nitra, together 1002 candidates.

The scheme 2 shows that in group of women at FofH MBU, 76,5% of candidates chose breast stroke swimming style, at FPES CU 72,6% and at CPU 78%, which confirm a balance of an interest in this swimming style and its use,

especially in recreational swimming. The swimming style crawl chose 24, 5% female candidates at FofH MBU, 27, 4% at FPES CU and 22% at CPU.

A similar division to the one in the female group was in the group of men, where 59,3% chose the breast stroke at FofH MBU, 40,6% of candidates at FPES CU and 47% at CPU in Nitra.

Less candidates, 40,7% swam crawl at FofH MBU, at FPES CU it was the highest number, 59,4% and at CPU 53%.

Table 2. A choice of candidates and swimming styles

Swimming style	breast stroke	crawl	B (%)	C (%)	Total (%)
Fac. Bystrica W n 37	28	9	76,5	24,5	100
Fac. Bystrica M n 209	122	87	59,3	40,7	100
Fac. Bratislava W n 139	101	38	72,6	27,4	100
Fac. Bratislava M n 498	202	296	40,6	59,4	100
Fac. Nitra W n 36	28	8	78	22	100
Fac. Nitra M n 83	39	44	47	53	100
Total	*520*	*482*	*51,9*	*48,1*	100

Point system of the breast stroke and crawl - men and women: Faculty of Humanities, Matej Bel University (FofH MBU)

Women

a) Crawl

Four participants out of nine reached the highest score- ten points. One participant didn't finish swimming this style, but in spite of that the average score was 8 points, according to the table time 1:41 min.

b) Breast stroke

Out of 28 participants at the breast stoke only one scored the maximum 10 points. Most frequently they scored 3,5 to 2 points (39,2% of the participants). An average score among women at the breast stroke was 3,5 points, what according to the table corresponds with an achievement of 2:01 min.

The average score of both swimming styles among women was 5,7 points.

Men

a) Crawl

Only 12 students of the total of 87 "crawlers"reached 10 point rating, which represents 13,8%. The average point rating in this swimming style is 4,6 point which means the time of 1:36,0 min. Most frequently men scored 6,5 to 1,5 points. There were 46 "crawlers" which makes up 52,8%. The average men's point rating was 4,2 points.

b) Breast stroke

Only one participant scored 10 points. We were surprised by the fact that as many as 53 men (43% "breast-strokers") did not score even one point in this swimming style which shows an irresponsible attitude of the physical education studies candidates towards the entrance exams. Most frequently they scored 4 to 1 points – 45 participants which makes up 36,8%. The average point achievement within men was 3,9 points what corresponds with the time 1:50 min.

Table 3. The total point rating of the physical education studies candidates at the Faculty of physical education and sport of Comenius University in Bratislava (FTVŠ UK)

n	N.	St.	1 b.	2 b.	3 b.	4 b.	5 b.	6 b.	7 b.	8 b.	9 b.	10 b.	total
M	88	27	22	30	50	46	66	57	54	37	8	13	498
W	22	9	6	6	17	12	11	17	18	9	3	9	139
Total	110	36	28	36	67	58	77	74	72	46	11	22	637

N. = didn't meet the criteria, St. = standard, to. = together

Table 4 shows the representation of the participants at the individual points that we divided from "didn't meet the criteria", "standard" and 1 to 10 points. We took into account also the number of participants present who didn't meet the required limit of the standard. Definitely the highest number we can find in the column "didn't meet the criteria" where those participants were put who swam 100 m over the requested limit – 100 m crawl over 2:00,0 or 100m breast stroke over 2:10,0. Out of the total amount of participants there are as many as 109 (88 men and 22 women), who did not fulfill the minimum standard. This state shows their insufficient preparedness for the entrance exams from swimming.

Point system of breast stroke and crawl - men and women: Faculty of Physical Education and Sport, Comenius University (FPES CU)

Men

a) Crawl and breast stroke

Out of men who did meet the swimming requirements of the entrance exams at FPES CU, the most frequent representation shows in the 5 point score. 66 men swam like this which represents the swimming achievement of 1: 36,0min for 100 m crawl and 1:50,0min for 100 m breast stroke. Mostly participants who scored the most (13 men scored 10 points and 8 men scored 9 points) are in the frame for meeting the requirements.

When choosing the swimming style crawl prevailed in men before the breast stroke. Out of the total number of participants-498, 296 swam crawl, which is more than a half of the total number of the candidates and 202 candidates swam breast stroke. Mostly the swimmers scored from 3 to 8 points. Most of them scored 5 points. Lower point rating standard to 3 points got 77 candidates. More candidates scored 4 to 8 points, n = 162 which shows a good preparedness for the entrance exams. 13 candidates swam the standard score when swimming crawl. The average point achievement was 5,2 points. The best achievement reaching 10 points was 60,0 sec. And the worst achievement in the standard was 2:00,0 min. The total average performance in this swimming style was 1:35,1 by men. From the total amount 296 men "crawlers" 41 did not meet the given requirements.

Women

a) Crawl

The most women scored 6 points (18 women reached this). These point values represent the time frame for crawl from 1:33,0 to 2:00,0 and breast stroke from 1:53,0 to 2:10,0 which give a precondition for successful mastering of the swimming requirements after the admission to FPES CU

b) Breast stroke

The breast stroke shows similar characteristics with certain differences in the highest values 10 and 9 points which only 5 men reached, out of which only 2 for 10 points, which probably shows the difficult time limit for this swimming style. Most of them scored 3 to 7 points, which is similar to crawl, so just average values. The average point achievement at this swimming style was approximately on the same level as it was by crawl – 4,9 points. The average time achievement of the "breast-strokers" was 1:51,5 s.

The choice of a swimming style among women clearly shows that the breast stroke prevails when 101 of the candidates swam breast stroke and only 38 crawl. Crawl is chosen mainly by active or former swimmers because they achieve the necessary performance in this style.

The breast stroke clearly prevailed among women because it is more natural and easier to master for women. Out of 139 women 101 swam breast stroke. From standard up to 10 points swam 81 women. The limit did not meet or did not swim till finish 20 women which is quite a big number. By the breast stroke it is similar as by the men. The most of them scored 3 points. The most women n = 55 are on the scale from 3 to 7 points.

We can see that more women scored 6 - 7 points when swimming crawl where 13 women swam, which shows their good preparedness. 8 women scored 10 points. Only swimmers – professionals swam with these results. In this style – crawl only 2 girls did not fulfill the required limit which is substantially better than men where 41 swimmers did not meet the required limit. The average point score among women – "crawlers" was 6,7 points the highest, which was largely influenced by 8 women having the 10 point score. The average time of girls was surprising: 1:28,5 s, which is by 2,6 s better than the average performance by men. The best performance scoring 10 points was time 1:03,0 s and the worst time had the score of the standard 2:14,0 s.

The average point value is 4,8 which is by 1,9 point less than the crawlers reached. The average time for breast stroke was 2: 05,5 s, the best performance 1:46,0 s and the worst 2:30,0 s, which presupposes not meeting the credit requirements for this swimming style during the studies at the university.

The point evaluation of breast stroke and crawl – men and women: Pedagogical faculty, Constantine the Philosopher *University (PF CPU) in Nitra*

Women

a) Crawl

In crawl the women recorded favorable results, when 8 candidates reached 4 to 6 points, while 5 women scored 6 points this way.

b) Breast stroke

In the breast stroke 3 women reached the maximum of 6 points, out of the total of 28 female candidates. 2 candidates reached 5 points. The highest number was recorded in the evaluation of 0 points (10 women) and in the evaluation " did not swim till finish " – 6 women.

Men

a) Crawl

In the evaluation of crawl 18 men reached time on the level of 6 points, 5 men on the level of 5 points and 8 men on the level of 4 points. We consider this an optimal level in the relation to the point system.

b) Breast stroke

In men's breast stroke we recorded out of 39 candidates 11 on the level of evaluation of 6. points, 3 on the level of 5 points and 6 on the level of 4 points. The same as among women there was a surprising fact that as many as 9 men did not score even one point at the breast stroke and 3 did not swim till finish which shows an irresponsible approach of the candidates towards the studies and entrance exams.

Comparison of swimming results of all faculties

In the breast stroke we found the fastest and also the slowest time among women at FofH MBU. In crawl the fastest and also the slowest time was reached among women at FPES CU.

In the breast stroke we recorded the fastest time among men at FPES CU and the slowest among men at FofH MBU. In crawl the fastest time was reached among men at FPES CU, the slowest among men at FofH MBU. The fastest times swam among men and women show a good preparedness and swimming performance of some candidates for the studies at the university.

Shocking are especially the slowest times that should not appear by the candidates for the physical education studies and that show a lax and irresponsible attitude and approach to the preparation for exams from swimming and consequently the physical education studies.

On the basis of this information that we gain every year from these entrance exams we find out that the candidates for physical education studies do not have the same approach to preparing for the exams from swimming which shows in the presentation of their swimming performance. .

When evaluating the technique of the swimming styles of the physical education studies candidates we can see the biggest deficits in the mastering of the technique of flip turn (30%), body position and breathing (30%), start jump (20%), in use of arms (10%) and legs (10%)

Conclusion

By evaluating these exams we mediate information about the swimming preparedness and performance of the physical education studies candidates at selected universities in Slovakia (FofH MBU in Banská Bystrica, FPES CU in Bratislava and PF CPU in Nitra).

We record various capability and preparedness of the physical education studies candidates at each university. On the basis of the results we detect the decreasing level of the swimming ability of the physical education studies candidates in comparison to previous years while the level of the swimming preparation only approaches the national average.

For better quality choice of the candidates, we recommend attending consultations carried out before the entrance exams, during which the candidates can check their swimming preparedness.

Results of the work are a part of the solution of the scientific and educational national grant project called VEGA called "Standardization of swimming performance standards at Universities in SR and chosen countries in EU n.1/4482/07".

To resume, we have to say that the long-term observation and the results of our research prove that the physical preparation of candidates in swimming slightly decreases every year as a result of worse practice of the physical education

at secondary schools where the physical education plays an insignificant role. These trends are perceived in all sport disciplines, but especially in swimming. Lowering the criteria would consequently decrease the level of future teachers' and trainers' physical preparation and would not resolve the situation. The number of candidates remains high or slightly increases each year and there is absolutely no need to modify the criteria towards the "bottom". Worse physical preparation in swimming hardens the situation of physical education teachers who permanently try to resolve the problem. The situation is even harder when we know that a lot of European universities do not have entrance exams. The further research which we have already started should determine whether it is necessary to stick to tight "time" criteria in swimming or whether the perfect control of swimming techniques is sufficient.

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DIFFERENCE BETWEEN COUNTERMOVEMENT JUMP HEIGHTS WITH AND WITHOUT ARM SWING: IMPORTANCE FOR SELECTION AND DEVELOPMENT IN SOCCER AND BASKETBALL

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Abstract

Among many popular filed tests for the estimation of explosive power, countermovement jump with (CMASJ) and without arm swing (CMJ) have been popular among coaches in team sports such as soccer or basketball. Although the application of these tests due to their apparent face validity and specificity was not questionable, the change in height difference between this to jump modalities associated with age was not investigated.

Key words: *Tests, explosive power, countermovement, arms swing*

Introduction

The aims of the present study were (1) to asses age associated differences in CMJ and CMASJ heights of soccer and basketball players and to evaluate importance of obtained differences between CMASJ and CMJ in selection and development of soccer and basketball players.

Methods

Soccer (S; N = 1918) and basketball (B; N = 675) players were regularly tested at the Research Center of Faculty of Sport and Physical Education, Belgrade. Subjects were categorized in 5 age groups: from 9 to 12 years (S G10-12; N = 242 and B G10-12; N = 148), 13 to 14 years (S G13; N = 486 and B G13; N = 156), 15 to 16 years (S G15; N = 458 and B G15; N = 155), 17 to 18 years (S G16; N = 329 and B G16; N = 112), and over 18 years (S G>18; N = 18 and B G>18; N = 18). In addition to mass and height, two jumping tests Countermovement without, CMJ, and with arm swing, CMASJ, were applied, and absolute and relative jumping height differences obtained from CMASJ and CMJ were evaluated. In addition to descriptive statistics, two-way analysis of variance (ANOVA) was used to investigate differences in particular variables between two sport groups and among different age groups.

Results

The tested anthropometric variables and indices obtained from CMJ and CMASJ tests in both groups, demonstrated significant differences associated with age. Furthermore, CMJ and CMASJ differ significantly by sport within each age group. All B age groups except the youngest were heavier and taller than the corresponding S age groups. The CMJ and CMASJ heights were higher in S G10-12, S G13-14, S G15-16, compared with corresponding B age groups.

The absolute difference between CMASJ and CMJ heights increased with age in both groups. These differences were highest among younger groups of soccer player (S G10-12 and S G13 and 14, S G13-14 and S G15-16, as well as among older groups of basketball players (B G15-16 and B G17-18). However, the absolute difference between CMASJ and CMJ heights did not differ by sport within each age group. There were no significant differences between age matched sport groups, as well as among consecutive age groups (both sport groups).

Discussion and conclusions

Although the jumping heights (CMJ and CMAJS) increased in both groups with age, the absolute difference between CMJAS and CMJ heights, changed differently in groups of soccer and basketball players. The relative differences were stable in both group and were not affected with age change. Therefore, one can conclude that, the assessment of difference between CMJAS and CMJ heights should become a regular part of testing procedures used for sport specific profiling and early selection of young athletes in team sports like soccer or basketball.

STRENGTH AND SPEED DIFFERENTIATION ABILITIES IN YOUNG ATHLETES

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Abstract

The aim of this study was to assess the trends and the different variability of performances in 6 coordinative tests of Movement Differentiation Ability (MTA). 1470 males and 692 females, 11 to 14 years old, practising 30 different sports, were involved in the study. The performed tests were: handgrip with 2 hands and dynamometry of leg extensor muscles, standing long jump, basketball sitting throw, and 60-m speed. After determining the maximal performance, sub-maximal trials equal to the 75% of the maximal were required to the subjects. The results showed that in the dynamometric trials the subjects were more accurate, while in the speed test the actual sub-maximal performance was very different compared to the target. The trends of the 10^{th}, 50^{th} and 90^{th} percentile showed a peculiar outcome for each kind of trial. In conclusion, each MTA test presents developmental trends differing from the others, and from the other coordinative abilities.

Key words: *coordinative abilities, accuracy, development, dynamometry, field tests*

Introduction

The Movement Differentiation Ability (MTA) consists in a precise perception of the force, time and space during the execution of motor activities, enabling the achievement of technical mastery in sport disciplines (Starosta, 2001).

Many authors since the 1960s have suggested several methods to assess MTA (Meinel, 1960; Farfel, 1977). Sensitive and critical periods during the age of development have been analyzed throughout longitudinal studies (Hirtz and Starosta 2001).

A confirmation of the specificity of MTA is deduced thanks to multivariate statistics performed on subjects practising different sports (Ljach, 2001; Carbonaro and Merni, 2001). It has also been possible, through these statistics, to distinguish and characterize the strength differentiation tests from the time and space ones.

The aim of this study was to assess the trends and the different variability of performances in 6 coordinative tests of MTA.

Methods

The sample was composed by 1470 males and 692 females, 11 to 14 years old (see table 1), practising 30 different sports (in a period of 1 up to 9 years). The average training of the participants was 274 hours per year (3 sessions of about 2 hours every week).

Table 1. the experimental sample

Age	11	12	13	14
Male	84	412	652	322
Female	30	235	320	107

The limbs strength was assessed throughout appropriate isometric dynamometers. For the upper limbs, the evaluation was performed by alternating hands, with the subject freely choosing the first hand to be tested. For the lower limbs, the trial was performed with both legs at the same time.

After the determination of the maximal performance, the subject was required to express the 75% of the previously obtained maximum.

The time to cover 60 m, sprinting at the maximal velocity, was assessed throughout a photocell system. After having determined the maximal performance, a sub-maximal trial was required in which the 60 m distance had to be covered at the best time increased by the 50%. For example, if the best performance was equal to 10 s the required time was then equal to 15 s.

The number of steps was assessed during all the trials to compute the average step length and frequency.

Standing broad jump and basketball throw (sitting-two hands from chest) were used to test the speed strength. As for the other tests, after the determination of the maximal performance, a trial at the 75% of the maximum was required.

For 75% trials of all the tests, the error, i.e. the difference between the actual performance and the 75% target, was computed and expressed in absolute and percentage values.

SSPS software was used to calculate descriptive statistics and percentiles. One-way ANOVAs ($p < .05$) was used to assess the differences between the genders and age groups for the errors in the 75% trials. The percentile values (10th, 50th and 90th) were used to evaluate the developmental trends.

Results

Figure 1 shows the frequency distribution of absolute errors of the upper limbs isometric strength test for all the examined subjects, differentiating between the hand chosen for the first trial (grey columns) and the other (sketched columns).

Errors range by ±10 kg with respect to the target value. Modal (most common) values are 2 kg higher than the target; in this class the second chosen hand shows the highest frequency.

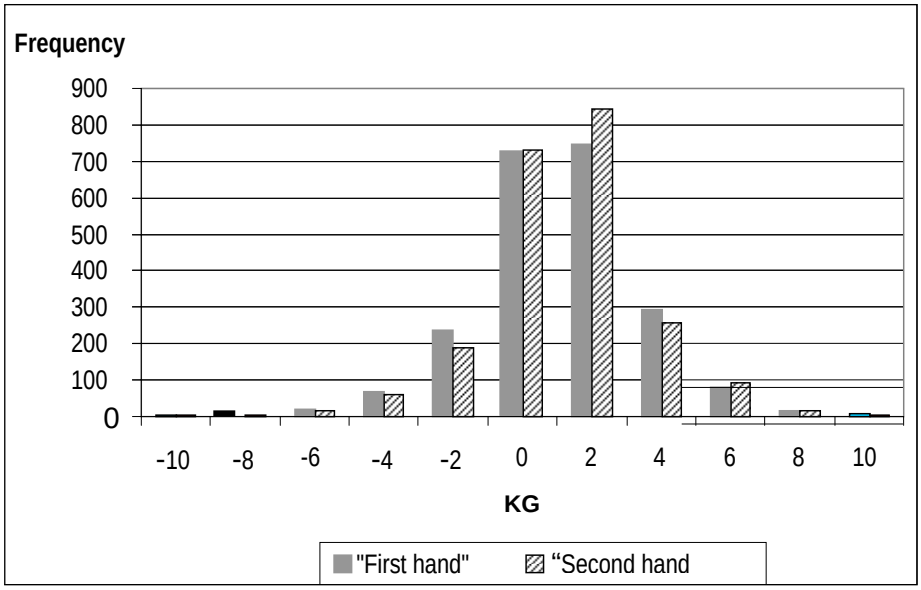

Fig. 1. Hand grip differentiation absolute mistakes

33% of sample in both cases belongs to the 0 class (i.e. it reached the target). To have a comparison among different tests it is opportune to express errors as percentages.

For the upper limbs isometric strength, the first choice hand shows a best performance (100.3 ± 18.9%), while the second choice hand shows a worse mean value of 102.5 (± 18.2%). The lower limbs extensor muscles isometric strength shows an average value of 99.0 (± 18.7%). 60 m dash sprint underlines the highest error with an average value of 92.7 ± 14.6% meaning that subjects use to run 7% faster than the target time. Standing broad jump and basketball throw show an average value of 98.7 ± 12.3% and 102.2 ± 14%.

The average value maybe is not the best statistical index to describe the gender and age differences, because it is too influenced by extreme values. Then, percentile values were used.

For the upper limb isometric strength test (hand grip), the 11 years old age group displays the highest errors at the 50th, 10th and 90th percentiles (see Fig. 2-3). Females belonging to the 10th percentile have a constant improvement vs. age symmetrically opposite to males belonging to the 90th percentile.

Second hand data have the same trend of the firstly chosen one. These data show that the 90th percentile have error values higher than first hand for both the genders.

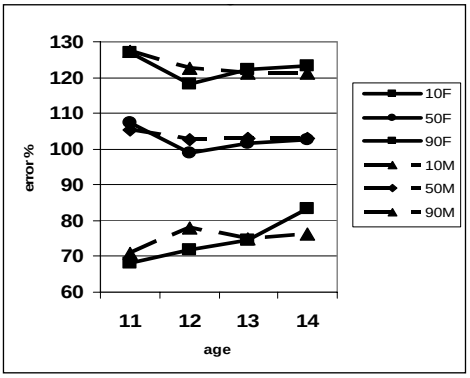

Fig. 2. Hand Grip 1

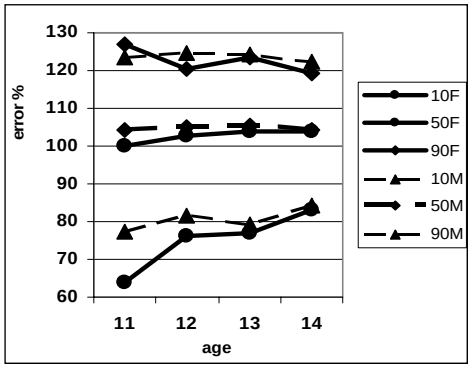

Fig. 3. Hand Grip 2

The lower limb dynamometric trial underlines the high precision for males at the 50th percentile (very close to the 100%), while females at the same percentile are less accurate (range: 99.7% - 106.5%).

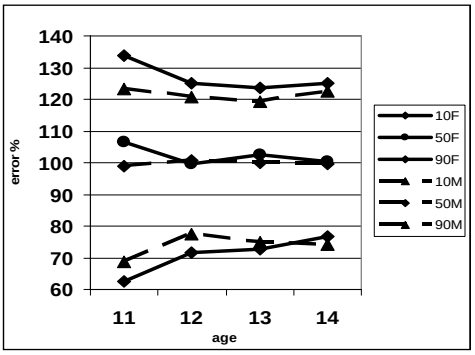

Fig. 4. Leg extensor muscles

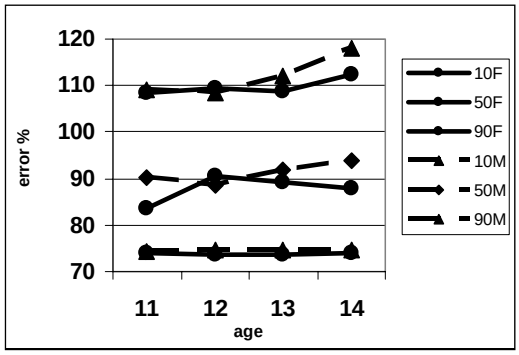

Fig. 5. Time Running

Also the 10th and 90th percentile show higher accuracy for boys (69% and 123%) than girls (62% and 134%).

In standing broad jump the 50th percentile is very close to the target in the different ages. At the 90th percentile the error values are between 112% and 115%, while in the 10th percentile the values are between 79% and 84%.

For the basketball throw, the 50th percentile displays for all the age groups values higher than 100% (from 100.5% to 104.2%); the 90th percentile ranges from 118% and 123% (with 132.5% for youngest females), while10th percentile ranges from 81% to 85%.

In the 60 m dash sprint the trend is to go faster than the target task. Older males have the lower errors. Male performances are generally better than the female performances. 90th percentile shows an error increasing with age. This doesn't happen for 10th percentile.

The way to control the run speed is by modulating frequency and/or step length. In figure 6 it's possible to distinguish these variables at the 10th, 50th and 90th percentile. To be noted (Fig.6) is the same behaviour to get the target showed by all the subjects, decreasing a little bit the step length (from 5 to 18 cm) and reducing the step frequency equally and notably (0.80 step/s).

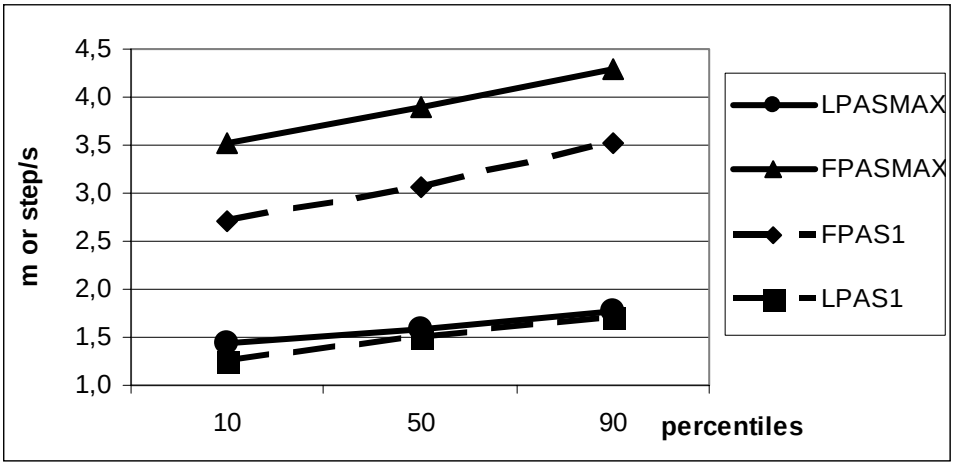

Fig. 6. Length & frequences of steps

Discussion and conclusions

The main results and the different developmental trends observed in the considered tests can be explained by the different receptors used by the athletes in the required tasks. The kinaesthetic analyser, mostly used in isometric dynamometric trials, seems the most precise when performing sub-maximal trials. The tests performed with hands are more accurate than those performed with lower limbs if values of 10th and 90th percentile are considered. These differences, higher in the 90th percentile can be explained with a better hand sensibility. The hand chosen by the subjects for their first trial is more accurate than the other, showing that the accuracy of the two hands is different. Therefore, it is important to request the subject to choose the hand he believes is the dominant one. In the jumping and throwing tests the visual analyser is used. However, while in the jumping test the performance is undervalued compared to the 75% target, the sit throwing shows oppositely an overvaluation. This discrepancy may be explained considering the point of view (that is higher in the first case) and the change of the portion of the body used for the performance (upper vs. lower limbs).

In the running, the factor playing a fundamental role is to select appropriate stride length and frequency.

Generally, the trend of these abilities shows an improvement of average values as a function of age, especially for the 10th and 90th percentiles. The 10th percentile performances in the jumping, throwing and running tests are very stable in the different age groups. Subjects with defect errors have not an improvement trend oppositely to those with excess errors. The differences between 10th and 90th percentile decrease with age increasing (except for the 90th percentile in the 60m dash sprint).

Considering the whole results, there are not relevant performance differences ($p<.05$) between the two genders. A difference is observed only for the second chosen hand in the dynamometric trial, where females perform better than their male counterparts.

The examined MTA might be very useful in precision sports (archery, bowling, golf etc.), but also in artistic and rhythmic gymnastics or middle-distance running where the muscular strength and execution velocity are subtly calibrated. Therefore, the different developmental trends, showed by the examined abilities, need to be taken into account by coaches when performing exercises and sports in which these abilities are important. In conclusion, each MTA test presents developmental trends and variability differing each from the others, and from the other coordinative abilities (Carbonaro et al. 2001).

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INTENSITY ANALYSIS OF JUNIOR TENNIS PLAYERS

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Abstract

Tennis is a game, which is characterized by the intensive short runs that are stopped by the short intervals of rest between the hits and longer pauses between the exchange and replacements of sides. (Melišová et al., 1992).

The goal of our work was to analyze the training load in the category of 14 – 15 years old boys in season 2005/2006 based on the following training units and to contribute with our findings to the expand of knowledge in the spotted category.

The experimental group was created from 4 players, which are all members of TK SLOVAN Slovenská Sporiteľňa Bratislava. We made the analysis of the training loads' in the technical – tactical (TTP) and the physical conditioning preparation (KD). The results of the analysis conducted are presented in the article.

Based on the results obtained it is obvious that by the meaningful application and planning of the training load in the mesocycle period, in which we take part, we can reach the growth of conditional readiness and the growth of player's placement efficiency. We can observe this fact by better player's placement in the tennis ranking.

From the information and evidence gained during the one-year training macrocycle, we can state that the application of the training load during the one-year macrocycle was appropriate.

Key words: *sport preparation, training load, training plan, intensity, training volume*

Introduction

Tennis is a game, which is characterized by the intensive short runs that are stopped by the short intervals of rest between the hits and longer pauses between the exchange and replacements of sides. (Melišová et al., 1992). The intensity of sports activity depends on the level of the effort in each moment of exercising. The impartial criterion of training intensity is the power disbursement in a specific time, usually in a minute, eventually in an hour in laboratory or terrain conditions. The intensity is expressed by amount, directly by speed of locomotion, the path and amount of overcome resistance, the number of repeated motions in a period of time. In connection with the knowledge about the energetic zones, we differentiate activities into many sport branches, according to the intensity, the longitude of impulse lasting and the heart rate.

Table 1. The intensity zones

Intensity zone	Load Intensity	Heart rate in min.	% max. of heart rate
Anaerobic – alactate	maximal	above 185	95 – 100
Anaerobic – lactate	submaximal	165 - 185	85 - 95
Aerobic – anaerobic	middle	140 - 165	to 95
Aerobic	low	100 - 140	...

The goal of our work was to analyze the training load in the category of 14 – 15 years old boys in season 2005/2006, based on the training units and to contribute with our findings to the expand of knowledge in the spotted category.

Methods

The experimental group was consisted of 4 players, who are all members of TK SLOVAN Slovenská Sporiteľňa Bratislava. We made the training intensity analysis on this group in the technical – tactical (TTP) and the physical conditioning preparation (KD).

Table 2. The basic information about the players of the experimental company

Name	Year of birth	Hight(cm) / weight (kg)	The longitude of ten. development	The place in v SR order
M.K	1991	163 / 45	8	2
B.K	1991	166 / 59	9	5
J. K	1992	159 / 49	8	10
T.H	1992	170 / 54	7	20

The tennis trainings in the winter months and in the bad weather were done in the NTC hall and in the summer months, we used the clay tennis fields of TK Slovan Bratislava. Training units TTP and KP always took 60 – 90 minutes, according to our resources and player's attendance.

By the training intensity test, we used the method of body reaction on load. We made this measurement on the base of the control exercises, which were chosen for the particular levels of intensity load.

During the trainings that were made in the all year cycle, we used more exercises. From these exercises we have chosen exercises for the each of three intensity levels. We used the physical record of the 5 seconds heart rate by all control exercises.

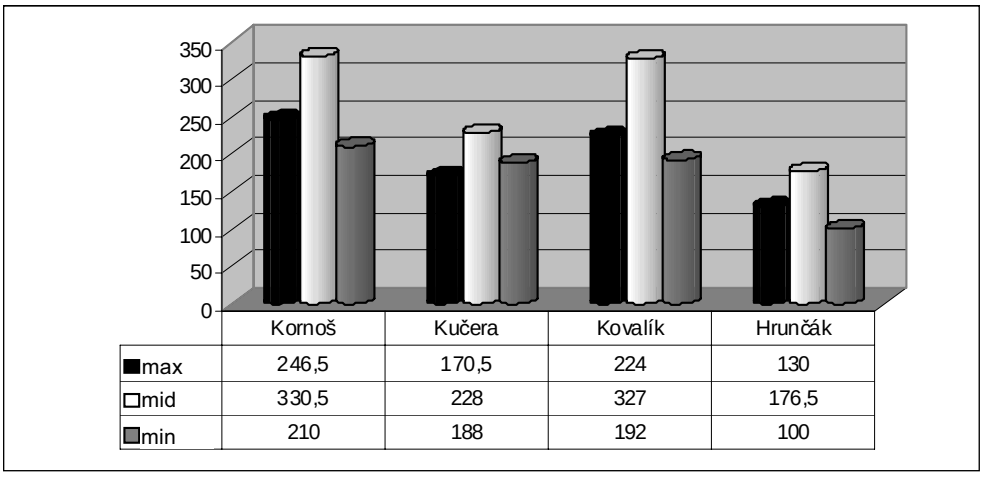
1. control exercise of maximum intensity (above 180 bpm)
2. control exercise of the middle intensity (in the scope of 155 – 180 bpm)
3. control exercise of the low intensity (to 155 bpm)

For conclusion we used logical methods and we used mathematic and statistic methods for our results.

Results

Concerning the fact that players did the TTP together for the most of the time and their absence out of the tournament period were minimal, the percentage of the particular hour's representation are very resemble in the intensity. In the maximal intensity: 31% Kornoš, 18% Kučera, 30% Kovalík and 32% Hrnčák from the total time.

In the model intensity in the same order, it is 42%, 45%, 44% and 43%. The time that was spent in the moderate intensity is 27% Kornoš, Kučera 37%, Kovalík 26% and Hrunčák 25% from the total time.

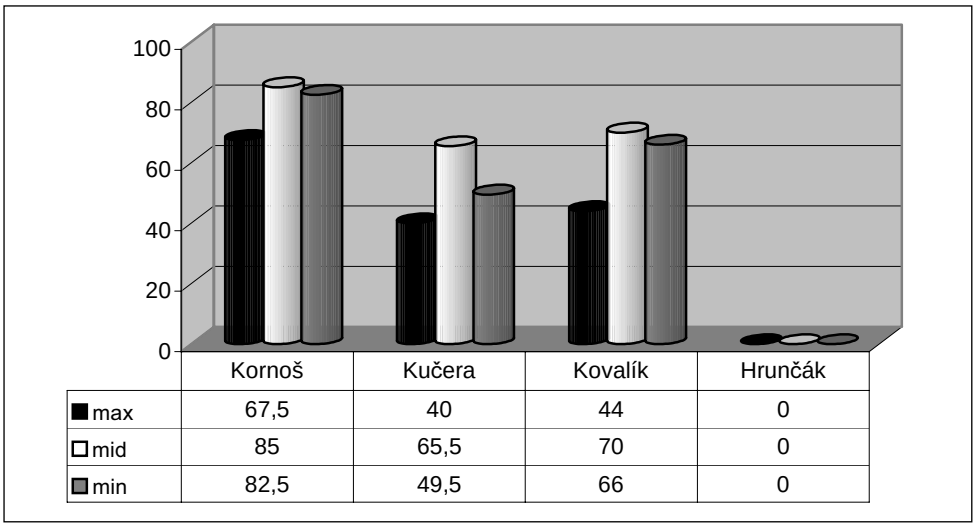


	Kornoš	Kučera	Kovalík	Hrunčák
max	246,5	170,5	224	130
mid	330,5	228	327	176,5
min	210	188	192	100

Picture 1. Intensity of an annual cycle

The intensity of the all year trainings changed according to the season in which we were. In the preparation period, the TTP was dominant and mostly conducted by the exercises with the moderate or middle intensity. The biggest attention was paid to the drill of the hitting technique and the failure corrections. In that period, the coach has more time for corrections and the technique improvement in the particular hits. In the phase of correcting the hitting technique and the drill of new playing exercises is very important to begin in the lower levels of intensity.

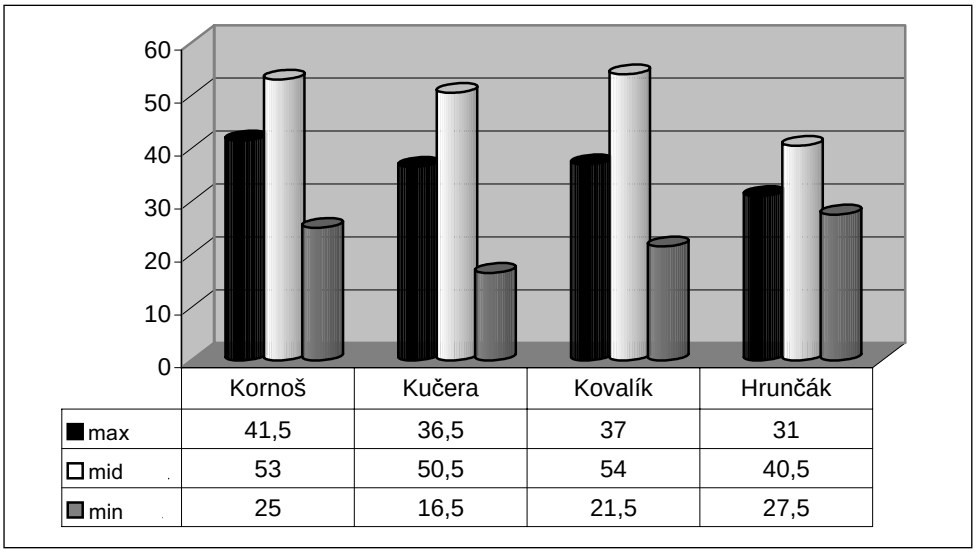
During this period, we had 2 trainings in a week just for service, which was in the level of moderate load. In KD, we paid attention to the short sprints and to exercises with maximal intensity and to the aerobic condition in the heart rate levels of middle load.



	Kornoš	Kučera	Kovalík	Hrunčák
max	67,5	40	44	0
mid	85	65,5	70	0
min	82,5	49,5	66	0

Picture 2. Intensity in the development period

In the load intensity during the main season, we accomplished the biggest number of training units in the middle intensity. The maximal intensity was used in the specific exercises. Those exercises were conducted only in short working intervals but more often (2-3times in a week in TTP and 2 times in KP). The players played some preparation matches, in middle and maximal intensity. In KP, we mostly conducted exercises in anaerobic training zones (table 2).

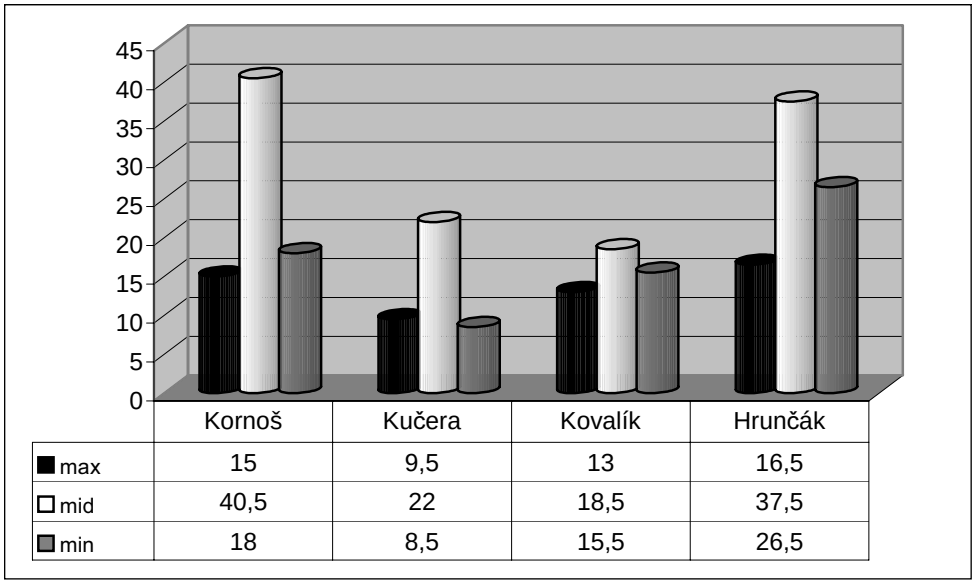


	Kornoš	Kučera	Kovalík	Hrunčák
max	41,5	36,5	37	31
mid	53	50,5	54	40,5
min	25	16,5	21,5	27,5

Picture 3. Intensity in the season I

From the view of the training load in the developing period II, the middle and moderate intensity prevailed. Most of these exercises were conducted on the tennis court, and were used for hitting accuracy improvement, corrections of small failures in techniques and the tactical preparation for the summer season.

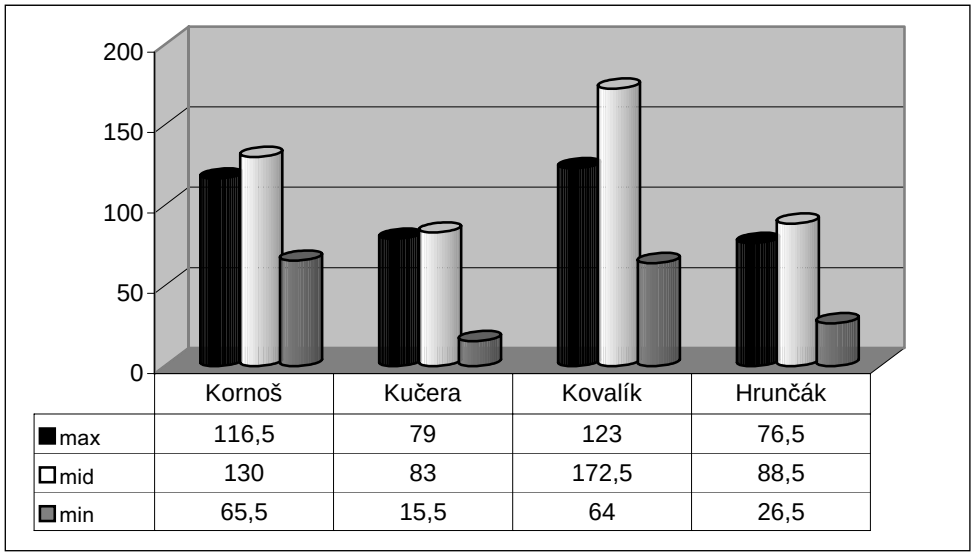
We conducted maximal intensity exercises mostly during the main conditional preparation period, in the form of short sprints and interval exercises. Service was the part of moderate load, which was inserted to the training program in this period.



	Kornoš	Kučera	Kovalík	Hrunčák
max	15	9,5	13	16,5
mid	40,5	22	18,5	37,5
min	18	8,5	15,5	26,5

Picture 4. Intensity in the developing period II

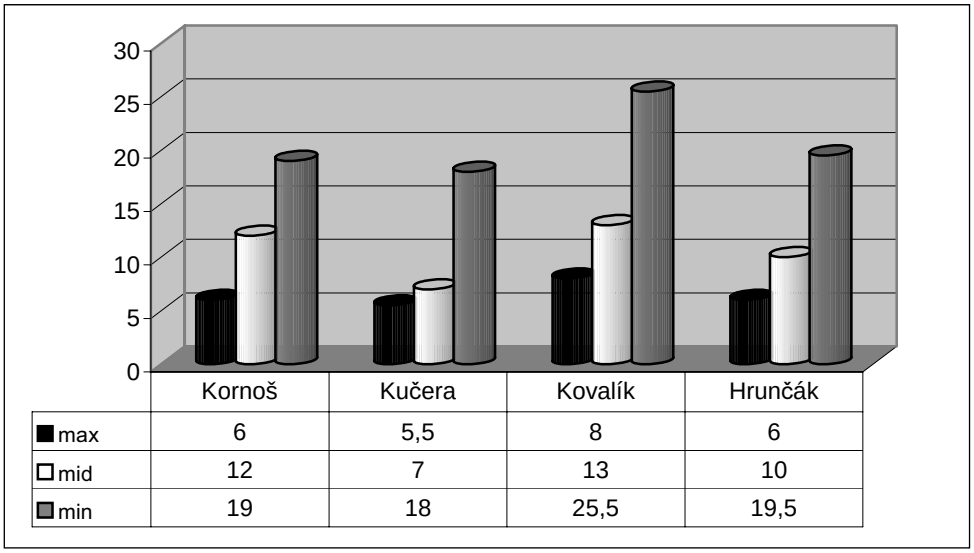
In the main period II, we mostly used short sprints on the tennis courts with the maximal intensity, but those exercises were not conducted shortly before the because after the speed training, it takes a longer period of time to rebuilt the energetic sources. Therefore, we did not want to handicap the players and we have chosen training with the middle or moderate intensity. In the period between the tournaments, we addict ourselves to the playing exercises, which were created in a way to lead the players to the tactical thinking. We have chosen the middle intensity load.



	Kornoš	Kučera	Kovalík	Hrunčák
max	116,5	79	123	76,5
mid	130	83	172,5	88,5
min	65,5	15,5	64	26,5

Picture 5. Intensity in the main period II

The intensity in the temporal period mostly consisted of the moderate intensity. In KP we repeatedly faded on the short speed trainings which were focused on the frequency speed and cadenced abilities. Besides this, trainings were mostly consisted of the aerobic exercises.



	Kornoš	Kučera	Kovalík	Hrunčák
max	6	5,5	8	6
mid	12	7	13	10
min	19	18	25,5	19,5

Picture 6. Intensity in the temporal period

Conclusions

From the results obtained during the one-year training macrocycle, we can state that the application of the training load during the one-year macro-cycle was appropriate. By the meaningful application and planning of the training intensity of the mesocycle we can achieve the improvement of physical conditioning readiness and the improvement of the players' placement efficiency. Those statements are corroborated with improvement in players' ranking.

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KINESIOLOGY AS AN IMPORTANT ELEMENT OF PHYSICAL FORCE USED BY POLICE OFFICERS

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Abstract

Many police tasks connected with movement efficiency require mastering specific kinesiological patterns, fast decisions, timely reactions, and a high level of movement abilities. In carrying out these tasks, police officers use powers, among which the use of coercive measures (physical force) certainly stands out. In this way, the police upholds personal freedoms on the one hand (the attacked, the victim) and, at the same time, interferes with rights and freedoms on the other hand (the perpetrator – deprivation of liberty). Therefore, the use of coercive measures and their efficiency, which in many cases depends on motor abilities and the level of mastering the specific kinesiological patterns, is often the subject of sharp polemics both in the lay and in the expert public, and in politics.

Key words: *motor abilities, human rights, coercive measures, police*

Introduction

The need for safety is a strong characteristic of human nature since without safety, neither the development of the personality nor its creative activity is possible (Rifkin 1986:16). Thus, every society needs, for its proper functioning, an organized service that protects it. One of such services is the police, which is integral part of all societies in the world. The monopoly over physical coercion is given only to these services; only they are allowed to use physical coercion. Owing to that, the use of force by the police is a sensitive field of police work since by the use of force, the police interferes, to a greater or lesser extent, with personal freedoms and rights of those against whom force is being used. In this respect, the research in the field of kinesiological science – which enables us to determine the factors significantly affecting the movement efficiency in police officers, and as a consequence their successfulness in the use of force − is particularly interesting for police practice. In addition to physical predispositions, it is also important that the police officer posses normative knowledge of the conditions and procedure for the use of force, because the law requires that the police officer shall use coercive measures − physical force − in a lawful, professional and humane way.

In order to ensure that the use of physical force is as humane as possible, correct and that it takes due account of respect for human rights, it is necessary to know the factors which affect its efficiency. Among these factors, movement abilities are, certainly, very important as they are closely associated with motor efficiency in the use of force. Therefore, the use of coercive measures and their efficiency, which in many cases depends on motor abilities and the level of mastering the specific kinesiological patterns, is often the subject of sharp polemics both in the lay and in the expert public, and in politics. In this context, specific skills, fast decisions, timely reactions and a high level of movement abilities are required of the police officer in order to successfully carry out operational tasks. In turn, movement abilities and the motor patterns mastered largely determine the movement efficiency in police officers. This is precisely why movement abilities have a special place in the theory and practice of police work and law enforcement – because specific movement efficiency largely depends on them (Čoh & Zorec, 2001).

In accordance with legal provisions, the police officer is allowed to use only such coercive measures as are provided for by the law (numerus clausus) and only in such a way as provided for by the law or implementing regulations (the principle of legality). The police officer must use coercive measures in a professional way (the principle of professionality) and must also be properly trained in order to do so. The police officer must decide to use the mildest possible coercive measure which, in the given circumstances, still allows him/her to carry out the respective police task (the principle of proportionality). The aggregate of the combined knowledge and skills means also that the risk of injuries is kept to a minimum, both as regards the police officer and the citizen against whom physical force is used.

Discussion and conclusions

The objective of kinesiology is not only to determine suitable general and specific abilities in sports activities; especially important is, in fact, kinesiological analysis of an individual sports discipline or branch of sport. These realizations allow us to understand the specifics of an individual sport from the aspect of the selection of suitable

candidates, planning of the training process, methodology, technique, physiological principles and other dimensions of training processes (Haimer, 1996).

Furthermore, the police practice applies biomechanical analysis in order to explain more complex cases of the use of physical force, which, on the basis of objective physical methods, enables the technical appropriateness and movement efficiency to be assessed in practical police procedures. Even small changes in the technique of the execution of self-defense actions in the use of coercive measures can be crucial in terms of the consequences of the use of force in practice. This aspect will become even more important in the future, when also experts in the field of biomechanics will give their expert opinions on the characteristics and structure of movement actions both on the part of the attacker and on the part of the police officer in legal proceedings initiated to seek compensation for damages.

The biomechanical complexity of the execution of individual technical elements requires, by its very nature, a large number of repetitions in the process of motor learning. Even better mastering of the said elements, and consequently an even larger number of repetitions, is required for the use of physical force in practical procedures. It is almost impossible to imagine more aggravated conditions for the application of a motor program than the practical enforcement procedure. To a certain extent always unpredictable situation with numerous circumstances and conditions on the one hand and a police officer with limited motor abilities and a certain level of technical competence on the other hand inevitably results in a considerable number of unsuccessfully performed practical procedures.

From the aspect of motor learning, the goals of the educational process for imparting knowledge and skills of self-defense techniques and practical procedures can be unrealistic. It is also unrealistic and uncritical to expect later that police officers in the field will successfully perform individual biomechanically and technically very demanding self-defense elements in extremely aggravated circumstances. This is especially true in view of the fact that the scope of training provided by the educational process does not include an adequate strategy of motor learning.

There are two possible ways of solving this problem. One is to preserve the existing educational programme, but significantly increase the extent of training - which is, however, impossible to do taking into account the production process as such. Another way is to decrease technical elements to those that are indispensable for the use of physical force in carrying out practical procedures. This decrease should, above all, take into account the biomechanical complexity and real applicability of individual technical elements on the basis of a model of operational performance. An objective result on the police officer's successfulness in the use of physical force can be obtained only by taking into account all dimensions of the psychosomatic space.

In training processes for special police units, the requirements as regards movement efficiency are much greater than for other police officers. Since the assessment of the motor status of special unit police officers does not alone provide sufficient information during the intervention, the monitoring of functional abilities is also included in this field of diagnostics. This monitoring includes: measurement of vital capacity, evaluation of aerobic and anaerobic abilities, lactate and alactate threshold and maximum oxygen uptake of the organism. An important segment of diagnosing motor abilities is also determining the structure of the muscular system (tensiomiography), which provides an insight into basic neural and bioenergetic capacities. As regards the duration of movement actions, both anaerobic abilities in the duration of up to two minutes (practical use of physical force) - in which alactate and lactate processes dominate -, and aerobic abilities - which depend on the maximum oxygen uptake – are important for the police officer. Aerobic abilities are important for all activities which last longer than three minutes (observation, field inspection, etc.) and are a practical indicator of physical fitness.

For kinesiology as a scientific discipline it is thus of paramount importance that movement abilities and the level of mastering specific motor patterns can be evaluated by checking and that these abilities and motor patterns can be significantly modified by subsequent quality training processes, taking into account the operational performance model (Milanović, 1996).

The latter findings, i.e. that the principles of kinesiological science in the fields of the planned training process, methodology, technique, physiological laws and other dimensions of training process in the police are an important factor in respecting human rights, represent for the police an obligation to provide quality planning and directing of specific and demanding motor programmes.

These realizations enable us to understand the specifics of an individual sport from the aspect of the selection of candidates, planning of the training process, methodology, technique, physiological laws and other dimensions of training processes (Haimer, 1996).

The successfulness of police officers in a wider or narrower working environment depends on numerous factors, important among which are, no doubt, those which define his/her psychosomatic status. This status is defined by morphological, motor, functional, psychological, psycho-soial characteristics and abilities. Man as a bio-psycho-social being is a complex and complicated biological system that constantly exchanges information and energy with the environment. Any change in external circumstances requires appropriate responses of the human organism. The process of training is exerting a planned and systematic influence on the development of motor and functional abilities which, consequently, have a strong influence on the efficiency in exercising professional tasks of police officers in a constantly

changing working environment. The selection of future police officers should thus be selective and directed towards the selection of those who will, with their motor, intellectual and behavioural characteristics, meet those requirements which the police officer must fulfill in the modern civilisational society. Therefore, the strategy of the minimum use of physical force can be identified as an ideal of the operation of the state administration and in particular of the police work (Reiner, 1085; 54); that is the strategy with the smallest possible extent of the use of special methods and measures employed by the police in exercising its tasks. This, in particular, applies both to the present and to the future, as repressive methods are giving way more than ever to more humane approaches and thus raising the standard of respecting human rights.

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DIFFERENCES IN THE FINAL TESTING RESULTS OF PUPILS BETWEEN THE TWO RELATIVELY CLOSE TIME INSTANTS

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Abstract

The objective of this study was to determine optimal time interval needed for the final testing of pupils. The sample consisted of 230 pupils (from 5 th to 8 th grade) in the Primary School of Zagreb. Anthropological characteristics were measured in 11 variables between the two relatively close time intervals. The first final measurement was conducted in April, and the second in June. Results between the time intervals were different, and analyses of differences has shown a great variability in accordance with continuous changes in anthropological characteristics in pupils of different age. On the basis of noticed variability in anthropological changes between the two time intervals, we have concluded that the most important for the final testing is, that **it most always be conducted in the same time of the school year**, and the accurate time can depend on the other factors.

Key words: *anthropological chacteristics, final testing, primary school pupils*

Introduction

In every human activity, knowledges of objective condition are postulate for analyses and strategic thinking with purpose of conducting the same activity further (Maud & Foster, 1995). That also refers to educational area of physical education , in which the objecive of anthropological characteristics testing of pupils is, to determine the results of realised educational programme in that area for the certain class. Namely, on the basis of results comparison, which are obtained by the initial and final testing, we can define the changes in pupils anthropological area (Findak, 2004).

In physical education, the final testing is always preformed in the end of school year, what means in June. It has certain disadvantages, like, adverse atmospheric and climate conditions in that time of year in the Republic of Croatia, not to mention tests in other subjects. When we take under consideration the facts of hypothermia and stress level of children under above mentioned conditions (Bruckner & Khan, 2005), we must think of option for shifting the final testing term. That is the reason why this study was conducted; to take under consideration what the optimal time for final testing really is.

Considering the objective of this study, following postulates can be formulated:

P1: there are no statistically significant differences between the two close time intervals in the area of pupils anthropological characteristics,

P2: there are no statistically significant differences between the two close time intervals in the area of pupils motorical abilities,

P3: there are no statistically significant differences between the two close time intervals in the area of pupils functional abilities.

Methods

The sample consisted of 230 pupils (from 5 th to 8 th grade) in one Primary School of Zagreb. The subjects were divided in four groups, regarding the grade. They were all healthy and attending the classes of PE regulary. Standard measures and tests for evaluation of anthropological characterictics were applied (Mraković, M., Findak V., Gagro i., Juras V., Reljić J., 1986) in the two relatively close time intervals. The first final measurement was conducted in April, and the second in June. Anthropological characteristics were determined by the mesurement of the body height (ATV), body weight (ATT), upper arm length(ANN) and forearm girth (AOP). Motorical abilities were measured by the tests: hand tapping (MTR), long jump (MSD), sit-ups (MPT), bending foward (MPR), polygon backwards (MPN) and hang hold (MIV). Functional abilities were measured by the test of aerobic endurance (F6). Datas were analysed till normal distribution showed, and the differences between the two final testings were determined by Student t-test for depended samples.

Results and discussion

Results of t-test for depended samples are presented in tables 1-4. At first, the distribution of results was calculated, and distribution was normal. That theorem was proved by the fact that values of the curve symmetry (Skewness), curve saliency (Kurtosis) and Kolmogorov-Smirnov test, did not vary significantly.

Values of the results in pupils from 5 th grade differed in the two time intervals, which is seen at the first look. That refers on values in tests regarding anthropological characteristics (ATV & AOP) and motorical abilities (MTR, MSD, MPT, MPR, MIV) and functional ability test F6. That differences are due to growth and development characteristics of pupils in that age (Malina, 1994), and to the influence of programme contents of PE which is preformed in the open area in that time of year. It is possible that the cause of differences was also influence of the other physical exercising contents, preformed by extracurricular activities, and activities in the free time preformed on the open in April and May. It is also important to say that, in the three variables there were no statisticaly significant differences between the two final testing results (ATT, ANN, MPN). Statistical significance was set at P=0,05.

Table 1. Results of depended t-test for pupils in 5 th grade

5 r. N=68	X	S.D.	Diff.	t	p
ATV1	148,73	8,27			
ATV2	149,88	8,64	1,14	-4,55	0,00
ATT1	42,97	10,81			
ATT2	43,30	10,76	0,32	-1,46	0,14
AOP1	21,27	2,13			
AOP2	20,98	2,15	-0,28	5,22	0,00
ANN1	11,3	0,46			
ANN2	11,4	0,46	0,01	-0,46	0,64
MTR1	20,97	3,27			
MTR2	23,29	2,83	2,32	-5,35	0,00
MSD1	147,42	20,06			
MSD2	152,10	20,10	4,67	-3,09	0,00
MPT1	29,76	8,40			
MPT2	34,72	9,57	4,95	-5,98	0,00
MPR1	48,79	8,24			
MPR2	54,00	8,25	5,20	-8,96	0,00
MPN1	15,87	5,06			
MPN2	15,53	4,41	-0,33	1,06	0,28
MIV1	26,19	18,07			
MIV2	31,44	20,91	5,25	-3,08	0,00
F61	1178,16	141,37			
F62	1240,07	154,97	61,91	-3,99	0,00

In the pupils of 6 th grade, there were statistically significant differences in 6 of 11 variables (ATV, ANN, MSD, MPT, MPR & F6). Subjects from that group are in the age of boyhood in which growth and development is in process, and it was the reason for statistically significant differences in the two measurements (Malina, 1994). It is the best seen in variable body height, which differed in two measurements for 1,32 cm. In other 5 variables for anthropological characteristics of pupils (ATT, AOP, MTR, MPN,MIV), there were no statistically significant differences in the two testings, and the testing values from April can hypothetically be taken as a final values.

Table 2. Results of depended t-test for pupils in 6 th grade

6 r. N=52	X	S.D.	Diff.	t	p
ATV1	155,72	7,70			
ATV2	157,04	7,92	1,32	-4,19	0,00
ATT1	45,87	9,94			
ATT2	45,41	9,45	-0,45	1,08	0,28
AOP1	21,45	1,95			
AOP2	21,37	1,83	-0,08	0,83	0,40
ANN1	11,7	0,63			
ANN2	10,2	0,46	-0,15	2,52	0,01
MTR1	23,09	3,41			
MTR2	24,19	3,86	1,09	-1,85	0,06
MSD1	165,50	22,68			
MSD2	170,44	20,70	4,94	-4,26	0,00
MPT1	33,76	6,66			
MPT2	38,26	8,17	4,50	-6,89	0,00
MPR1	52,30	7,53			
MPR2	60,30	7,34	8,00	-9,39	0,00
MPN1	14,64	4,94			
MPN2	15,24	4,41	0,60	-1,30	0,19
MIV1	42,92	26,82			
MIV2	45,11	25,18	2,19	-0,92	0,36
F61	1242,88	189,64			
F62	1314,03	191,14	71,15	-5,33	0,00

In the pupils of 7 th grade, there were at least individual changes, and statistically significant differences were determined in four variables (AOP, MPT, MPR & MPN). In other 7 variables for anthropological characteristics assessment (ATV, ATT, ANN, MTR, MSD, MIV, F6), there were no statistically significant changes between the two measurements, and the testing values from April can hypothetically be taken as a final values.

Table 3. Results of depended t-test for pupils in 7 th grade

7 r. N=54	X	S.D.	Diff.	t	p
ATV1	160,97	7,49			
ATV2	162,07	7,53	1,10	-1,89	0,06
ATT1	54,26	12,94			
ATT2	54,77	11,15	0,50	-0,52	0,60
AOP1	23,17	1,96			
AOP2	22,75	1,93	-0,41	2,68	0,00
ANN1	12,9	0,63			
ANN2	12,4	0,62	-0,05	1,07	0,28
MTR1	24,46	3,26			
MTR2	24,96	2,95	0,50	-1,25	0,21
MSD1	170,64	25,12			
MSD2	171,94	25,48	1,29	-0,69	0,49
MPT1	33,59	7,40			
MPT2	36,90	8,34	3,31	-4,85	0,00
MPR1	58,92	9,85			
MPR2	65,11	9,36	6,18	-5,00	0,00
MPN1	14,52	3,74			
MPN2	13,60	3,93	-0,91	2,67	0,00
MIV1	29,72	24,56			
MIV2	31,27	22,66	1,55	-0,56	0,57
F61	1251,57	191,94			
F62	1277,59	163,02	-26,01	-1,86	0,06

In the pupils of 8 th grade, there were statistically significant differences in 6 variables (ATV, MSD, MPT, MPR, MPN, F6), while in the other 5 anthropological variables, there were no statistically significant differences (ATT, AOP, ANN, MTR, MIV) and the testing values from April can hypothetically be taken as a final values.

Table 4. Results of depended t-test for pupils in 8 th grade

8 r. N=56	X	S.D.	Diff.	t	p
ATV1	167,72	8,22			
ATV2	169,12	8,04	1,40	-10,24	0,00
ATT1	56,90	11,44			
ATT2	57,52	11,25	0,61	-1,62	0,11
AOP1	23,23	2,12			
AOP2	23,18	1,98	-0,05	0,61	0,53
ANN1	8,9	0,45			
ANN2	9,3	0,43	0,03	-0,82	0,41
MTR1	27,25	4,37			
MTR2	27,87	3,52	0,62	-1,17	0,24
MSD1	197,32	20,58			
MSD2	200,00	18,90	2,67	-1,94	0,05
MPT1	42,55	6,89			
MPT2	47,33	6,37	4,78	-6,73	0,00
MPR1	61,51	8,93			
MPR2	68,10	8,59	6,58	-6,59	0,00
MPN1	12,16	2,87			
MPN2	11,57	2,02	-0,59	2,63	0,01
MIV1	47,92	26,92			
MIV2	49,21	24,90	1,28	-0,59	0,55
F61	1419,10	136,70			
F62	1468,92	138,52	-49,82	-5,10	0,00

On the basis of the whole sample of subjects, difference analyses between the two close time intervals, showed higher number of statistically significant differences between the variables. So, of 44 possible analyses iteration of anthropological characteristics in the whole sample, 24 changes and 20 statistically identical states were obtained. Higher number of morphological measurements were unchanged, while motorical and functional abilities were significantly different.

Conclusion

An experiment was conducted on the sample of 230 pupils in the Primary School in Zagreb, with objective of determining the optimal time interval for final testing the pupils anthropological characteristics. Subjects were measured by 11 standardised variables for estimating the anthropological characteristics in two relatively close time intervals. The first final testing was conducted in April, and the second in June. On the results bases, it can be concluded:

Only in one variable referring anthropological characteristics, from the 5 th to 8 th grade there were no statistically significant changes between the two final testings (ATT); body weight. It was due to high energy exercising level of pupils between the two time intervals. So, on the bases of above mentioned, all three postulates referring there are no significant differences between the two close time intervals in the area of pupils anthropological characteristics, motorical and functional abilities, are rejected.

So, it can be claimed that in Primary School PE classes exists a great variability of significant changes in the time interval of two months. So, on the basis of this statements, it is obvious that during PE classes there are continuous changes in the area of anthropological characteristics. It persumes that measuring the anthropological characteristics **in different time intervals, enters into register different state of pupils**. So, moving the time interval of final testing to earlier period of school year, for example in May, seems to be reasonable, because of the climate conditions which are better and the final testing can be conducted with difference in quality. In that time interval there is also less of other disordering factors, like: tests in other subjects, stress situations because school year is ending, etc. The time interval without stress factors directly influences motivation level of pupils during the final testing.

For making the final decision on possible changing the time interval for final testing in the area of anthropological characteristics, there is a need for further researches on bigger and more representative samples.

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INFLUENCE OF SPECIALLY PROGRAMMED PE LESSONS ON MORPHOLOGICAL CHARACTERISTICS CHANGES OF 7-YEAR-OLD PUPILS

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Abstract

In this research the effect of specially programmed PE lessons on morphological characteristics of 7-year-old pupils is being considered. The control group (140 boys and 138 girls) attended regular PE lessons while the experimental (185 boys and 172 girls) attended specially programmed PE lessons in duration of 9 months. Morphological characteristics are estimated by means of 14 measures at the beginning and at the end of treatment. Significant differences have been noticed among experimental groups in relation to control groups and that is in higher values of stature and body mass, leg length, biacromial and biiliocristal diameter, and in lower values of abdomen and subscapular skinfold. More expressed transversal skeleton measures, chest circumference, total arm length and stature have been evidenced at boys while at girls more expressed measures are those of adipose tissue and lower leg circumference.

Key words: *physical education, first graders, morphological dimensions*

Introduction

Fundamental biological characteristic of a child organism are growth and development, whereat under the influence of dispositional factors and of environment, as well as of self-activity, it develops into a more mature organism. Age in which child starts elementary school is relatively quiet phase of growth and development. Stature and body mass demonstrate an insignificant, but constant progress. Child bones are soft and elastic, because soft cartilaginous tissue is gradually being replaced by bone tissue. Musculature gains on weight and muscular fibres are being reinforced.

Beginning of the institutional education is a crucial phase in child life. Game, which dominated by that point, cedes its place to learning. Long and systematical educational commitment, decline of motor activity and increased static load represent great difficulties to first graders. Reduced physical effort and insufficient movement impoverish motor function which has negative influence on child development and health, since movement is positive stimulus for development of the organism as a whole. When it is good organised, physical activity has positive effect on body growth, and especially on skeletal muscle and circular system growth as well as on the body composition (Katić et al., 1997). Body composition changes occur during the growth and ageing, connected to health, nutrition and body activity (G. Russo et al., 1992). Positive effect of PE lessons on health status improvement of general population is nowadays very important (Sallis and McKenzie, 1991). There is a great number of clues which indicate that PE lessons in Croatia do not stimulate sufficiently the development of basic morphological dimensions or the development of motor abilities. PE lessons should be institutionally conducted with more quality, which includes the increasement of lessons number as well as the improvement of work conditions. There are numerous opinions according to which PE lessons during the first years of education should be conducted by qualified PE lessons pedagogues, which would also lead to significantly better effects.

Aim of this research are the effects analysis of specially programmed PE lessons in morphological characteristics transformation of first graders from elementary schools in relation to lessons, realized according to the official curriculum.

Methods

Sample of 635 pupils was constituted by 325 boys and 310 girls, 7-year-old first class attendants of elementary schools in Split. Boys sample was divided into control (N = 140) and experimental group (N = 185), while the girls sample was divided into control (N = 138) and experimental group (N = 172). All examinees were without expressed cognitive, morphological, motor or other aberations, capable of following the anticipated first grade elementary school curriculum. Control groups of examinees attended PE lessons according to the current curriculum, conducted by the primary education teachers, while experimental groups attended specially programmed PE lessons realized by the PE lessons teachers.

The official curriculum of physical education is realized by the use of teaching topics from the following teaching units: walking and running, jumping, throwing and catching, climbing, crawling, lifting and carrying, rolling, hanging and

pushing, dancing structures, games, general preparatory exercises. The experimental program was consisted of elements from athletics, sports gymnastics, games, competitions and general preparatory exercises (Table 1). Both programs were conducted within the framework of a year fund (105 lessons).

With a view to data collection, a group of 14 morphological measures which estimate virtual four-dimensional morphological area has been applied in the following order: stature (mm), leg length (mm), total arm length (mm), biacromial diameter (mm), biiliocrista diameter (mm), wrist width (mm), biocondylar femur diameter (mm), body mass (dkg), forearm circumference (mm), lower leg circumference (mm), chest circumference (mm), triceps skinfold (1/10 mm), subscapular skinfold (1/10 mm) and abdomen skinfold (1/10 mm). Measurements were conducted at the beginning and at the end of the eksperimental treatment by the use of standard anthropometric techniques as recommended by IBP.

Descriptive statistics parameters were defined on the obtained results, and the results differences of the first and the second measurement were tested by the application of SSDIF algorithm, which analyses quantitative changes in two time periods under the differences model.

Table 1. Year plan of the physical education lessons experimental program.

		Months										
Contents		IX	X	XI	XII	I	II	III	IV	V	VI	Total
Measurements		4									4	8
Track-and-field	Walking and running	1	2	1	1	1	1	1	2	1		11
	Jumping	1	2	1	1	1	1	1	1	1		10
	Throwing		2	1	1	1	1	1	1	1		9
Sport gymnastics	Floor exercises	1	2	2	1	1	1	1	2	1		12
	Apparatus exercises		1	2	1	1	1	1	1	1		9
	Jumps		1	2	1	1	1	1	1			8
Games	Basic sp. games tech.s		1	1	1	1	1	1	1	1		8
	Elementary games	1	1	1			1		1		1	6
	Relay games	1		1	1	1		1	1	1		7
	Team games				1	1	1	2	1	2	1	9
Competitions	Sp. gymnastics						1			1		2
	„Between two fires“						1			1		2
	Track-and-field							2			2	4
General preparatory exercises		On every PE lesson										
Total		9	12	12	9	9	11	12	12	11	8	105

Annotation: Plan demonstrates the duration of certain lesson contents of school classes that was obtained by the multiplication of frequencies and durations for each single lesson content in particular.

Results

Variance analysis of morphological measures between boys and girls of the total examinees sample (Table 2) demonstrated that the boys had at the beginning of academic year more expressed diameters, chest circumference, stature, total arm length and body mass, while the girls had more expressed measures of adipose tissue and lower leg circumference.

On the level of variables means and standard deviations, in both measurements, for each subsample of examinees it can be assumed it came to significant changes in morphological characteristics of both male and female subjects (control and experimental groups) (Table 3 and 4). Changes from the initial to the final condition imply on the development of morphological characteristics. Some more expressed changes refer to the increase of body mass and of the skeleton dimensionalities measures as well as to the decrease of adipose tissue.

Variance analysis of variable differences among the groups demonstrated that the programmed PE lessons, conducted by the PE lessons teachers, had positive influence on the development of pupils of both sexes. This way there are significantly more expressed changes of stature, leg length, biacromial diameter, biiliocristal diameter, body mass, subscapular and abdomen skinfold at experimental groups in relation to control groups. Although seemingly it did not come to significant

changes in the measures of circumference (muscular mass), it is a fact that it came to the reduction of adipose tissue (especially on the abdomen), which means that the muscular mass increased at the examinees of the experimental groups on the account of adipose tissue, which witnesses the characteristics restructuring. The differences of body mass changes which is significantly more saturated with muscular tissue at the experimental groups indicate the same conclusion.

Discriminative function of differences variables at both sexes demonstrates that at the examinees of the second measurement, in relation to the first, came to significant changes, especially in stature and body mass, following in measures for the assessment of transversal skeleton dimensions and body volume. Positive changes of adipose tissue are expressed to a smaller extent (negative sign is the reflection of adipose tissue reduction). Changes of experimental group male i.e. female pupils are primarily responsible for the obtained discriminative function structure inside each sex. Discriminative functions among two periods of measurement in relation to the sexes also demonstrate to a certain extent specificity in the development of transversal skeleton dimensionalities i.e. biacromial diameter at boys and biiliocristal diameter at girls. Also faster development of lower extremities, as well as more harmonious development, can be perceived at girls in relation to boys.

Table 2. Mean values (±SD) of morphological indices measured twice in boys and girls

	Boys (n=325)		Girls (n=310)	
Measurement:	**1**	**2**	**1**	**2**
Stature (cm)	128.4 ± 5.4	131.9 ± 5.5	127.0 ± 5.4 [b]	130.6 ± 5.6 [b]
Leg length (cm)	71.4 ± 3.7	73.6 ± 3.8	71.2 ± 3.9	73.6 ± 4.2
Total arm length (cm)	53.0 ± 3.0	54.1 ± 2.9	52.2 ± 2.9 [b]	53.3 2.9 [c]
Biacromial diameter (cm)	27.2 ± 1.5	28.3 ± 1.5	26.9 ± 1.5 [a]	28.0 1.4 [a]
Biiliocristal diameter (cm)	20.3 ± 1.4	21.4 ± 1.3	19.9 ± 1.4 [b]	20.9 1.4 [c]
Wrist width (cm)	4.2 ± 0.3	4.3 ± 0.3	4.0 ± 0.2 [c]	4.2 ± 0.2 [c]
Biocondylar femur diam. (cm)	7.7 ± 0.5	7.9 ± 0.5	7.4 ± 0.5 [c]	7.6 0.5 [c]
Body mass (kg)	27.0 ± 4.4	29.8 ± 4.5	26.1 ± 4.6 [b]	28.9 ± 4.8 [a]
Forearm circumference (cm)	17.8 ± 1.5	18.6 ± 1.5	17.6 ± 1.6 [a]	18.4 1.6
Lower leg circumference (cm)	25.8 ± 2.2	26.8 ± 2.2	26.3 ± 2.2 [b]	27.2 2.3 [a]
Chest circumference (cm)	60.8 ± 4.1	62.1 ± 4.0	59.4 ± 4.7 [c]	60.9 4.7 [c]
Triceps skinfold (mm)	11.5 ± 3.7	10.6 ± 3.5	12.9 ± 4.0 [c]	12.2 4.2 [c]
Subscapular skinfold (mm)	7.0 ± 3.0	6.6 ± 2.7	8.2 ± 3.9 [c]	7.7 3.7 [c]
Abdomen skinfold (mm)	7.6 ± 5.0	6.4 ± 4.0	8.6 ± 5.7 [a]	7.8 5.3 [c]

Significant differences between boys and girls: [a]P<0.05; [b]P<0.01; [c]P<0.

Table 3. Mean values (SD) of morphological indices measured twice at boys from the control and experimental groups and the structure of the discriminant function (F)

	Control group (n=140)		Experiment. group (n=185)		
Measurement:	**1**	**2**	**1**	**2**	**F**
Stature (cm)	128.2 ± 5.8	131.4 ± 5.7 [d]	128.5 ± 5.2	132.3 ± 5.3	0.52
Leg length (cm)	71.3 ± 3.9	73.3 ± 3.8 [d]	71.5 ± 3.5	73.9 ± 3.7	0.38
Total arm length (cm)	52.5 ± 3.2	53.8 ± 3.2	53.4 ± 3.2 [a]	54.4 ± 2.6	0.19
Biacromial diameter (cm)	27.1 ± 1.7	28.0 ± 1.6 [d]	27.3 ± 1.4	28.5 ± 1.4	0.37
Biiliocristal diameter (cm)	20.5 ± 1.5	21.3 ± 1.2 [d]	20.2 ± 1.5	21.4 ± 1.4	0.33
Wrist width (cm)	4.2 ± 0.3	4.3 ± 0.3	4.2 ± 0.3	4.3 ± 0.3	0.43
Biocondylar femur diam. (cm)	7.7 ± 0.5	7.9 ± 0.5	7.8 ± 0.5	7.9 ± 0.5	0.42
Body mass (kg)	26.0 ± 4.5	29.2 ± 4.5 [d]	27.2 ± 4.4	30.2 ± 4.4 [a]	0.47
Forearm circumference (cm)	17.3 ± 1.5	18.1 ± 1.5	18.2 ± 1.6 [b]	18.9 ± 1.5 [b]	0.35
Lower leg circumference (cm)	25.7 ± 2.4	26.6 ± 2.3	25.9 ± 2.2	26.9 ± 2.2	0.28
Chest circumference (cm)	59.6 ± 3.8	60.8 ± 3.7	61.7 ± 4.0 [b]	63.1 ± 4.0 [b]	0.29
Triceps skinfold (mm)	11.4 ± 3.5	10.7 ± 3.6	11.5 ± 3.7	10.5 ± 3.4	-0.12
Subscapular skinfold (mm)	6.8 ± 2.8	6.6 ± 2.5 [c]	7.2 ± 3.2	6.6 ± 2.9	-0.08
Abdomen skinfold (mm)	6.7 ± 4.1	6.6 ± 4.0 [d]	8.3 ± 5.5 [a]	6.2 ± 4.0	-0.13

Significant differences between boys and girls: [a]P<0.05; [b]P<0.01; [c]P<0.001

Table 4. Mean values (±SD) of morphological indices measured twice at girls from the control and experimental groups and the structure of the discriminant function (F)

	Control group (n=140)		Experiment. Group (n=170)		
Measurement:	**1**	**2**	**1**	**2**	**F**
Stature (cm)	127.2 ± 5.4	130.4 ± 5.7 [d]	126.9 ± 5.4	130.8 ± 5.6	0.56
Leg length (cm)	71.4 ± 4.0	73.2 ± 4.0 [d]	71.1 ± 3.9	73.9 ± 4.3	0.44
Total arm length (cm)	51.7 ± 2.8	53.0 ± 2.8	52.6 ± 3.0 [a]	53.6 ± 2.9 [a]	0.38
Biacromial diameter (cm)	27.0 ± 1.5	27.9 ± 1.4 [d]	26.9 ± 1.5	28.2 ± 1.4 [a]	0.27
Biiliocristal diameter (cm)	20.2 ± 1.2	20.9 ± 1.3 [d]	19.8 ± 1.6 [a]	20.9 ± 1.4	0.36
Wrist width (cm)	4.0 ± 0.2	4.2 ± 0.2	4.0 ± 0.3	4.1 ± 0.2	0.42
Biocondylar femur diam. (cm)	7.4 ± 0.5	7.5 ± 0.5	7.4 ± 0.5	7.6 ± 0.5	0.38
Body mass (kg)	26.3 ± 4.5	28.7 ± 4.7 [d]	26.0 ± 4.8	29.1 ± 4.9	0.44
Forearm circumference (cm)	17.1 ± 1.4	18.0 ± 1.5	18.0 ± 1.6 [c]	19.0 ± 1.7 [c]	0.30
Lower leg circumference (cm)	25.9 ± 2.1	26.9 ± 2.2	26.6 ± 2.3 [a]	27.4 ± 2.4 [a]	0.34
Chest circumference (cm)	58.4 ± 4.4	59.8 ± 4.4	60.3 ± 4.7 [c]	62.0 ± 4.7 [c]	0.34
Triceps skinfold (mm)	12.7 ± 3.4	12.2 ± 4.0	13.0 ± 4.4	12.2 ± 4.3	-0.08
Subscapular skinfold (mm)	8.1 ± 3.7	7.9 ± 3.6 [d]	8.4 ± 4.0	7.5 ± 3.9	-0.07
Abdomen skinfold (mm)	7.8 ± 5.2	8.1 ± 5.3 [d]	9.2 ± 6.0 [a]	7.5 ± 5.4	-0.08

Significant differences between boys and girls: [a]P<0.05; [b]P<0.01; [c]P<0.001

Discussion and conclusion

Results indicate the moderate development of morphological characteristics at elementary school first graders. Morphological characteristics development at eight takes place almost identically at boys and at girls. At experimental groups, in relation to the control groups, came to greater morphological changes, which is evidence that specially programmed PE lessons of higher work volume, conducted by PE lessons teachers, have positive effects on skeleton development, adipose tissue reduction and muscular tissue incensement. These differences imply on the influence of differently programmed physical exercises on the development variability of morphological characteristics (Katić et al., 1994).

It is obvious that nine month treatment has significant repercussions on the total morphological children status. Namely, more complex and higher body engagement, at this age, will aspire firstly to optimize somatic-biomechanical demands within the meaning of limiting factors elimination and that is equally of somatic bars and of their vertexes, adipose tissue reduction and quality of firm points of support i.e. joints. Without embedding nutritive substances into supporting and other tissue, it is not possible to achieve adequate base for more complex and more demanding movements and activities. This process is simplest to support with quality kinesiological stimuli as well as quality programmed and realized treatment, with sufficient load which provokes adaptation.

The obtained results in morphological measures among first grade elementary school pupils should be respected in programming of PE lessons. So, boys, in relation to girls, have more expressed transversal skeleton measures i.e. thicker bones, more muscular and less adipose tissue, which enables them to master greater loads. As opposed to this, gracious skeleton constitution (thinner bones) and significantly more expressed adipose tissue with insufficient muscular tissue at girls, in relation to boys, will reduce their motor efficiency, especially in motor tasks in which dominates strength (Katić, 1996). The research especially implies the importance of forming qualitative educational programs as preconditions to optimal development of morphological characteristics in primary education pupils.

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THE INFLUENCE OF VISUAL DEMONSTRATION AND VERBAL INSTRUCTION ON LEARNING A COMPLEX MOTOR SKILL

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Abstract

This experiment tested the influence of the different sources of instructions on efficiency in learning one motor task. 33 1st year female students of the Faculty of Kinesiology, divided into three groups, were learning a complex skill of rhythmic gymnastics through 48 trials organised in 8 series, on the basis of different learning instructions (the verbal, visual or combined). The 3x8 repeated measures ANOVA results showed that the amount of information a beginner has at disposal is important in learning a complex motor skill. Learning is more effective if an instruction is either visual or combined. A simultaneous presentation of visual and verbal instructions had no distractive effect; participants who were learning according to combined instructions learned faster, especially in the beginning. This type of instruction can be recommended as a part of learning strategy when sport instructors have no enough time available.

Key words: *modelling, skill acquisition, rhythmic gymnastic*

Introduction

Motor skill acquisition is a part of adaptive human behaviour. Each individual is daily engaged in countless activities that require voluntary head, body and/or limb movement to achieve some goal. Motor skill acquisition is also a specific goal of sport training process. Motor learning is an internal process that enables new motor competencies. It includes forming and storing of new dynamic stereotypes (motor programmes) of movement and their combination, and reflects individual's performance capability that may be estimated by performance demonstration. Individual's capacity for learning a new motor skill depends on many different factors, e.g. motor abilities, age, previous motor knowledge and experience, task characteristics etc., but initial instructions are certainly one of the most important factors that contribute to successful learning and movement production. The use of demonstration as a means of conveying information about how to perform a skill is one of the most popular way of instructions in sport and PE environment. Coaches and PE teachers usually demonstrate to a class or athletes how to perform a skill, verbally describe what to do or use some combinations of both approaches. A common belief is that demonstration is always effective in conveying information to the learner, but Williams and Hodges (2005) showed that practitioner should use demonstration only after determining that the instructional situation warrants it. The observer perceives from demonstration invariant information about coordination pattern and uses it as a base to produce the action (Magill, 2007). Verbal instructions facilitate skill acquisition if it is of rational quantity (1-2 for the beginner) because focuses attention on features of skill or environment that will enhance the performance. Another important factor is that verbal instruction directs attention to outcome of performance and goals of the skill (Schmidt and Wrisberg, 2000). PE practice accentuates possible distractibility of simultaneous verbal explanation and visual demonstration in learning a new skill that may have negative effect on motor learning (Findak, 1989). Based on Baddly's model of working memory, Zarevski (1994) cites some experiments that prove separate functioning of short-term memory for visual images and words which eliminate possible interferention when inputs are assigned in different sensory modalities. We wanted to test this hypothesis and presumed that there is no distraction when individual receives simultaneous verbal and visual instruction when learning a new motor task. In this case a practitioner retains and actively works with larger amount of information in working memory, reaches better elaboration and deeper level of information processing that altogether enlarges a possibility for building better connections between new information and already stored (motor) knowledge. The goal of this study was to investigate how different sources of initial information (demonstration, verbal instruction, and a combination of them) influence a learning of a complex motor skill.

Methods

Participants. 33 female 1st year students form Faculty of Kinesiology from Zagreb (M_{age}=19.42, SD=0.825) volunteered in the study. All participants had previous sport experience, but they had no experience or knowledge from rhythmic gymnastics (RG).

Procedure. The participant's task was to learn to correctly perform an intermediate level rope skill used in RG competition, which involved manipulating the rope with in a specific manner while simultaneously moving the body and limbs. Girls were randomly assigned into three groups, one observed a videotaped expert model performing the skill, other listened recorded verbal instruction that described a skill *(Hold both knots at the ends of the rope in one hand so that the rope hangs down on the outside of your hand beside you. Circle the rope forward two times in the sagittal body plane. When a second circle is about to be finished and the rope points vertically down, make a half turn while letting on of the knots go. Continue moving your hand and arm up to shoulder's height, when rope slides far enough so it is in one straight line in front of you, pull the rope back so that the knots flies back toward you. Catch the knot on the other hand of the rope with your free hand. Perform the movement continuously and guide the rope softly.)*, and third group observed the model with simultaneous verbal instructions. All participants received their instruction two times before first trial and then two times after each six trial (total: 48). The experiment was recorded by digital video camera, mounted on a 130 cm high tripod, 5 m from performer. All trials were evaluated by three RG referees (1: a movement sequence is missing - 5: completely correct performance). The 8 mean scores for each block of practice was calculated based on all grades of all referees, finally representing a learning curve for each participant's learning process.

Results

Objectivity of referees' evaluation was calculated as average intercorrelation between grades (r=.96, p>.001).Descriptive parameters (Table 1) show that the biggest range of grades had participants who learned on the base of demonstration, and the smallest range of grades had those who learned according to verbal instructions only. The means obtained show that girls who learned according to combined instructions reached slightly better level of efficiency of performance in comparison to those who had learned based on visual demonstration only, but both groups reached significantly better grades in comparison to girls who learned based on verbal instructions, whose performance was worse.

Table 1. Descriptive statistics for different groups of participants

Group (instruction)	M	SD	min	max	K-S z	p	N
Combined	3.44	.498	2.44	4.08	.838	.484	11
Visual demonstration	3.24	.699	1.58	4.14	.744	.637	11
Verbal	1.80	.543	1.00	2.84	.842	.477	11

To investigate if there is any statistical differences in efficiency of learning rhythmic gymnastics skill and how the type of instruction influence learning process, the repeated measures ANOVA 3 (instruction) X 8 (block) was performed. The analysis of block effect, corrected for Greenhouse-Geisser epsilon value was significant (F=33.203, p>.000), meaning that participants improved in learning a complex motor skill as progressed in trials. Also a significant main effect of type of instructions was obtained (F=25.544, p<.000). It indicated that participants from different groups learned a motor skill differently; Scheffe post-hoc tests identified significant difference between those girls who learned according to verbal instructions to others, who were much better than them, and mutually similar. The interaction between blocks and type of instructions was not significant, meaning that all groups progressed in learning similarly, but the efficiency level was different, as it may be seen on Figure 1 which represents learning curves for all groups.

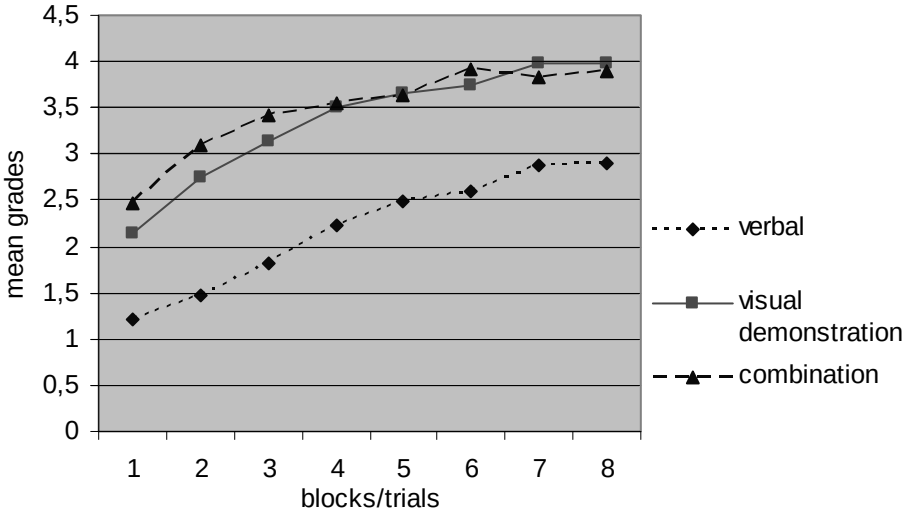

Figure 1. Learning curves obtained in different learning conditions

Disscussion and conclusion

Information facilitates the changes in motor performance that reflect learning. Skill improvement is a consequence of improved cognitive representation of a movement, formed on the base of information which specifies characteristics of particular movement sequence and its dynamic (Newell, 1991). Changes in motor performance are enabled by different information, and one of the main questions is which information is important and how they are used when one is learning a new motor skill. This study brings some answers. Taken together, our analyses indicated that all groups progressed in learning a complex motor skill, but the final effects were different. Learning curves showed that girls who learned according to combined instructions progressed faster, but achieved the same level of final skill acquisition as girls who had learned according to visual demonstration only. It indicates that there was no distraction between verbal and visual instruction, on the contrary, this combination helped beginners to progress easier and to perform the skill more accurately. These results are congruent to some previous investigation (e.g. Magill and Schoefendler-Zhodi, 1992; Magill, 1993). Our findings clearly proved, what is commonly understood in the sport practice, that verbal instruction only is not enough if we want somebody to learn a complex motor skill. Also, according to the results obtained it can be concluded that if a PE teacher, or a coach has enough time available, it is recommended to simplify the instruction (e.g. to use only clear demonstration) and to explain only main moments during pupils' practice, if necessary, because the final efficiency of learning on the basis of demonstration or demonstration combined with verbal instructions is the same. This experiment showed also that if time for learning is limited, the combination of demonstration together with verbal instruction and explanation will result with the best effects, i.e. the progress will be faster in comparison to visual demonstration only. It seems natural to explain and to demonstrate the skill if a model does not have to speak. On the contrary, it would be difficult, sometimes even impossible to do it simultaneously because some complex motor skills have long explanation but short performance duration. Today the new technology enables utilisation of new approaches to sport instructors and results from the present experiment are a contribution to clarification of some myths and encourage some changes in motor learning process.

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INFLUENCE OF SPECIALLY PROGRAMMED PE LESSONS ON THE STRUCTURE OF RELATION BETWEEN MORPHOLOGICAL-MOTOR AREA AND BASIC KINESIOLOGICAL MANIFESTATIONS OF 7-YEAR-OLD PUPILS

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Abstract

The influences of the official and experimental PE lessons program on the structure of relation between morphological-motor area and basic kinesiological manifestations were compared on the sample of 325 7-year-old subjects. The increase of the number of significant canonical roots as well as the higher partial canonical coefficient were evidenced at the control group (N=140) after the nine months treatment. More expressed canonical coefficients were also detected at the experimental group (N=185), but with holding the number of extracted roots.

Key words: *morphological dimensions, motor mechanisms, kinesiological treatments*

Introduction

Period in which child starts school is marked with the intensive growth and development of all anthropological dimensions. Differential and integration processes of morphological, motor and functional characteristics are in active phase, which enables their positive direction towards forming the optimal structures. Therefore, it is extremely important to create preconditions in order to ensure sufficient quantity of quality kinesiological stimuli and all this with the aim of improving the general anthropological status (Babin et al., 2001).

In this age a child manifests a number of basic i.e. undifferentiated motor activities which, according to their biomechanical parameters, represent precursor to the latter possibility of manifesting specific movement structures, characteristic for concrete kinesiological activities. Hence, it is important within the planning and programming of kinesiological activities and especially of PE lessons, to take into account the development of mechanisms which enables the manifestation of basic kinesiological activities (Katić, 2003). Boundaries and ranges of phylogenesis of specific motor mechanisms will be dependent on the degree of their development. It is especially important to determine the relations between morphological and motor dimensions on the one side and basic kinesiological manifestations on the other, in order to direct positively the process of their development.

The aim of this research is to establish the differences of the two educational kinesiological treatments on the structure of relation between morphological-motor area and basic kinesiological manifestations.

Methods

The research is pursued on the sample of 325 first grade 7-year-old (±2 months) pupils from elementary schools from the area of the city of Split, Croatia. Two subsamples were formed. The control group of subjects (N=140) attended regular PE lessons according to the official curriculum, while the experimental group (N=185) was submitted to the experimental kinesiological treatment, based on the elements from track-and-field, sport gymnastics, games and general preparatory exercises. The experiment lasted 9 months.

At the beginning and at the end of the treatment the estimation of morphological area dimensions was carried out by the following measures *AVIS – stature* (cm), *ADN – leg length* (cm), *ADR – total arm length* (cm), *ASR – biacromial diameter* (cm), *ADRZ – wrist width* (cm), ADK – *biocondylar femur diameter* (mm), *ATT – body mass* (kg), *AOPL – forearm circumference* (cm), *AOPK – lower leg circumference* (cm), *AKNN – triceps skinfold* (mm), *AKNL – subscapular skinfold* (mm) and *AKNT – abdomen skinfold* (mm). On the other hand the structure of motor area is estimated by the tests *MKUS – side steps* (sec), *MPOL – polygon backward* (sec), *MP20 – standing on the equilibrium bench transversely on both feet with open eyes* (sec), *MPRR – forward bow* (mm), *MTAP – hand tapping* (number of repetitions), *MTAN – foot tapping* (number of repetitions), *MSDM – standing jump* (cm), *MDTS – sit ups* (number of repetitions) and *MVIS – bentarm hang* (sec). Basic kinesiological manifestations are estimated by the following three motor tests *MBLD – distance ball throwing* (m), *M20V – 20m high start run* (sec) and *FT3M – 3 minutes run* (m).

Parameters of the descriptive statistics have been calculated on the data and the theoretical morphological and motor dimensions have been obtained by the reduction of manifest area by factor analysis according to the principal component model. Relation analysis of morphological and motor area was determined by the canonical corelational analysis.

Results

Using the factor analysis under the model of principal components, the area of manifest morphological variables was reduced to four theoretical latent dimensions especially for control and experimental group during the initial and final measurement. Thus, the following dimensions were formed: *longitudinal skeleton dimensionality (LDS), transversal skeleton dimensionality (TDS), body volume and mass (VMT) and subcutaneous adipose tissue (PMT).* The group of motor variables was also reduced by the mentioned methodology to four theoretical latent dimensions, defined as *body coordination* (KOT), *mechanism for synergic regulation and tonus regulation* (MSRRT), *velocity of movement frequency* (BEF) and *general strength factor* (GFS). Variables, submitted to the reduction procedure of each above mentioned morphological and motor dimension, are quoted in the tables 1 and 2.

Basic kinesiological manifestations are represented by the means of three variables which, at this age, represent motor and biomechanical precursors for the latter development of the basic movement structures. The *distance ball throwing* test represents general theoretical predictor of kinesiological contents which include throws, *20m high start run* is the predictor of the sprint base activity, while the test *3 minutes running* is the predictor of contents which include endurance running (table 3).

Table 1. Descriptive statistics and factor structure of latent morphological dimensions

	Control group				Experimental group			
	Initial state		Final state		Initial state		Final state	
Var	$\overline{X}$ ± SD	F	$\overline{X}$ ± SD	F	± SD	F	± SD	F
Longitudinal skeleton dimensionality								
AVIS	128,37±5,52	-0,95	131,37±5,71	-0,95	128,48±5,22	-0,95	132,32±5,30	-0,95
ADN	71,45±3,78	-0,93	73,28±3,82	-0,96	71,45±3,50	-0,94	73,91±3,71	-0,94
ADR	52,48±3,10	-0,92	53,79±3,19	-0,92	53,28±2,68	-0,90	54,43±2,63	-0,92
		λ=2,61 σ^2=86,97		λ=2,66 σ^2=88,75		λ=2,58 σ^2=86,10		λ=2,63 σ^2=87,56
Transversal skeleton dimensionality								
ASR	27,14±1,52	-0,85	28,04±1,63	-0,80	27,32±1,41	-0,70	28,55±1,39	-0,76
ADRZ	41,81±2,36	-0,90	42,92±2,56	-0,89	42,10±2,67	-0,86	43,17±2,59	-0,87
ADK	76,91±4,31	-0,87	78,55±4,71	-0,83	77,57±4,57	-0,86	79,24±4,62	-0,88
		λ=2,29 σ^2=76,24		λ=2,13 σ^2=70,98		λ=1,97 σ^2=65,69		λ=2,10 σ^2=69,94
Body volume and mass								
ATT	26,82±4,49	-0,95	29,25±4,56	-0,93	27,19±4,36	-0,90	30,24±4,37	-0,92
AOPL	17,35±1,45	-0,94	18,08±1,49	-0,93	18,23±1,59	-0,88	18,92±1,51	-0,89
AOPK	25,67±2,40	-0,92	26,59±2,28	-0,94	25,94±2,16	-0,93	26,95±2,15	-0,93
		λ=2,62 σ^2=87,37		λ=2,62 σ^2=87,17		λ=2,43 σ^2=81,12		λ=2,51 σ^2=83,66
Subcutaneous adipose tissue								
AKNN	11,44±3,50	-0,92	10,73±3,57	-0,91	11,49±3,69	-0,91	10,47±3,37	-0,91
AKNL	6,82±2,83	-0,93	6,58±2,47	-0,93	7,20±3,18	-0,93	6,57±2,88	-0,95
AKNT	6,74±4,09	-0,92	6,60±4,03	-0,94	8,24±5,46	-0,92	6,24±3,96	-0,95
		λ=2,55 σ^2=85,06		λ=2,57 σ^2=85,78		λ=2,53 σ^2=84,46		λ=2,63 σ^2=87,64

Legend: $\overline{X}$ – mean, **SD** – standard deviation, **F** – factor loading, **λ** – eigenvalue, **σ^2** – percentage of the interpreted variance.

Table 2. Descriptive statistics and factor structure of latent morphological dimensions

	Control group				Experimental group			
	Initial state		Final state		Initial state		Final state	
Var	$\overline{X}$ ± SD	F	± SD	F	$\overline{X}$ ± SD	F	± SD	F
Body coordination								
MKUS	16,11±2,03	0,81	14,29±1,75	0,83	16,42±2,14	0,82	14,15±1,58	0,84
MPOL	23,25±7,12	0,81	17,47±4,39	0,83	22,75±5,48	0,82	16,47±3,67	0,84
		λ=1,30 σ^2=64,84		λ=1,39 σ^2=69,25		λ=1,35 σ^2=67,59		λ=1,42 σ^2=71,21
Mechanism for synergic regulation and tonus regulation								
MP2O	18,45±8,03	0,71	20,03±7,76	0,72	16,87±6,96	0,72	22,21±7,37	0,77
MPRR	363,75±81,18	0,71	373,35±69,99	-0,72	372,20±87,84	0,72	423,92±84,40	0,77
		λ=1,02 σ^2=50,76		λ=1,04 σ^2=52,10		λ=1,04 σ^2=52,02		λ=1,17 σ^2=58,59
Velocity of movement frequency								
MTAP	19,81±3,00	0,81	20,82±2,33	0,84	18,70±2,50	0,88	21,68±2,67	0,89
MTAN	15,94±1,87	0,81	17,09±1,79	0,84	15,47±1,98	0,88	17,59±1,92	0,89
		λ=1,31 σ^2=65,31		λ=1,41 σ^2=70,67		λ=1,57 σ^2=78,23		λ=1,57 σ^2=78,58
General strength factor								
MSDM	111,50±18,68	-0,74	127,63±18,87	-0,77	114,30±16,29	-0,75	130,70±15,57	-0,80
MDTS	21,96±7,00	-0,72	25,11±6,58	-0,72	21,44±5,84	-0,69	28,22±5,45	-0,73
MVIS	12,68±11,72	-0,65	14,00±9,98	-0,76	9,57±7,21	-0,71	22,45±13,03	-0,71
		λ=1,47 σ^2=49,03		λ=1,69 σ^2=56,33		λ=1,54 σ^2=51,18		λ=1,67 σ^2=55,73

Legend: $\overline{X}$ – mean, **SD** – standard deviation, **F** – factor loading, **λ** – eigenvalue, **σ^2** – percentage of the interpreted variance.

Table 3. Descriptive statistics of basic kinesiological manifestations

	Control group		Experimental group	
	Initial state	Final state	Initial state	Final state
	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD	$\overline{X}$ ± SD
MBLD	10,78±3,23	11,97±3,57	10,40±2,95	12,65±3,16
M20V	4,98±0,44	4,72±0,38	4,91±0,43	4,48±0,34
FT3M	449,58±50,66	474,79±61,62	434,59±65,64	531,11±61,99

Legend: $\overline{X}$ – mean, **SD** – standard deviation

Table 4. Canonical corelational analysis between latent morphological-motor area and variables of basic kinesiological manifestations

	Control group			Experimental group					
	Initial st.	Final state		Initial state			Final state		
	CAN1	CAN1	CAN2	CAN1	CAN2	CAN3	CAN1	CAN2	CAN3
LDS	-0,30	-0,14	-0,25	0,43	-0,19	0,08	0,26	0,09	0,13
TDS	0,32	0,04	0,30	-0,12	0,42	1,04	-0,16	-1,29	-0,27
VMT	0,21	0,18	-0,31	0,05	-1,16	-0,38	0,28	1,19	-0,91
PMT	-0,14	0,08	-0,26	-0,10	0,10	-0,30	-0,23	-0,19	0,10
KOT	0,13	0,24	0,13	0,36	0,09	0,18	0,40	0,27	0,28
MSRRT	-0,08	-0,13	0,89	-0,24	-0,27	0,52	-0,13	-0,21	-0,16
BFP	-0,28	0,02	-0,43	-0,19	-0,38	-0,23	-0,17	0,28	-0,08
GFS	0,68	0,83	-0,15	0,49	-0,30	-0,27	0,49	-0,30	-0,28
MBLD	-0,39	-0,68	0,39	-0,55	0,69	-0,60	-0,47	0,36	0,96
M20V	0,57	0,51	-0,02	0,72	0,27	-0,67	0,75	0,49	0,55
FT3M	-0,37	-0,01	-1,02	-0,14	-0,96	-0,40	-0,06	0,74	-0,79
R	0,67	0,65	0,42	0,63	0,40	0,29	0,71	0,40	0,34
	χ^2=93,52 p=0,00	χ^2=107,69 p=0,00		χ^2=135,85 p=0,00			χ^2=176,80 p=0,00		

Legend: **CAN1**, **CAN2**, **CAN3** – canonical roots, **R** – canonical corelation, χ^2 – hi-square test for testing the significance, **p** – significance threshold.

During the initial measurement one significant canonical root (R=0,67) was extrapolated at control group, and it was defined by the positive relation of *transversal skeleton dimensionality* and *general strength factor* to the *20m high run* test. During the final measurement two significant canonical roots were isolated. In the basis of the first measurement (R=0,65) a positive relation of *general strength factor* to the *20m high start run* test was detected as well as the negative one to the *distance ball throwing* test. The other significant root (R=0,42) is defined by the positive relation of the *distance ball throwing* test to the *mechanism for synergic regulation and tonus regulation* and *transversal skeleton dimensionality,* as well as the negative relation to the dimension *body volume and mass.*

During the initial measurement three significant roots were isolated by the canonical analysis at the experimental group. The first is defined by the positive relation of *longitudinal skeleton dimensionality* and *general strength factor* to the *20m high start run* test (R=0,63). The second root is defined by the positive relation of *3 minutes running* test to the *velocity of movement frequency* as well as to the *body volume and mass*, and by the negative relation to the *transversal skeleton dimensionality* (R=0,40). The third root is isolated on the basis of the negative relation of *transversal skeleton dimensionality* and *mechanism for synergic regulation and tonus regulation* to the *20m high run start* test (R=0,29). During the final measurement three canonical roots were extrapolated. The first is defined by the positive relations of the *20m high start run* test to *body coordination, general strength factor, body volume and mass*, and to *longitudinal skeleton dimensionality* (R=0,71). The second root is defined by the positive relation of the *3 minutes running* test to *body volume and mass*, and by the negative relations to *transversal skeleton dimensionality* and *general strength factor* (R=0,40). The third root is defined by the positive relation of the *distance ball throwing* test to *body coordination*, and by the negative relation to *body volume and mass* and *general strength factor* (R=0,34).

Discussion and conclusion

The obtained results imply on increasing complexity and relation integration between morphological-motor area and basic kinesiological manifestations in the function of time at both groups of subjects. The mentioned processes are possible to assign partially to the growth and development (Vlahović et al., 2007), but it raises the question to which extent and how certain kinesiological activities affect this phenomena.

The increase of the number of significant canonical roots was evidenced during the final measurement at the control group, as well as the higher partial coefficients of certain dimensions in the model. At the experimental group of subjects the number of extrapolated canonical roots is equal in both measurements. It is possible to detect by the detailed analysis

higher partial coefficients at final measurement differentiation roots, which implies on the increase of corelational relations between morphological-motor area dimensions and results of basic kinesiological manifestations.

It can be concluded that the analysed kinesiological treatments contribute to the increase of relation of observed anthropological areas. The mentioned changes were achieved with smaller structural changes at experimental group. This implies that the program of intensive and more complex character contribute to the increase of relation of the observed anthropological fields, along with the minor violation of their internal structure.

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INFLUENCE OF MINI HANDBALL ON THE INDICATORS OF BASIC AND SPECIFIC MOTOR ABILITIES OF YOUNGER SCHOOL AGE GIRLS

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Abstract

The paper is oriented on the evaluation of the contents of mini handball programmes. The goal was to determine the transformation effects of a three-month mini handball (MH) programme on changes in basic motor abilities of girls aged 8 years. The sample of 43 girls (25 experimental and 18 controls) was measured with 15 motor ability tests. Discriminant analysis and t-test for dependent samples were used for data processing. The statistically significant differences between two groups were obtained between the initial and the final measurement in: *10 m sprint, front support, zigzag running,* and *figure-of-a-star running*. In the experimental group the significant differences were obtained in 12 variables between the two measurements. Positive influence of the MH programme on strength endurance of core muscles must be underlined here, as well as on coordination and agility improvement.

Key words: *mini handball, experimental programme, girls, 8 years*

Introduction

Mini handball, as a sports game aimed for children of younger ages, has been promoted eagerly last decade in Croatia and central Europe. The paper is oriented on the evaluation of the contents of mini handball programmes and their effects on transformations of motor abilities in children of a younger school age. The goal was to determine the transformation effects of a three-month mini handball (MH) programme on changes in basic motor abilities of girls aged 8 years.

Methods

The *sample of subjects* embraced 43 girls, pupils of the second elementary school form, aged 8 years. Two classes (N=25) were involved in the MH experimental programme, whereas two classes (N=18) made up the control group, which exercised according to the official Physical Education curriculum. Each group of the subjects exercised separately in the sports hall, which was well equipped for the experimental programme application.

The *sample of variables* consisted of the following 15 motor ability tests: **9** assessing **basic motor abilities:** *10 m sprint* (SPR10M), *20 m sprint* (SPR20M), *standing long jump* (MFESDM), *sit-ups in 30 s* (TRB30S), *back extension* (LED30S), *front support* (UPPRED), *figure-of-eight with ducking* (MAGOSS), *zigzag running* (MAGSLA), *figure-of-a-star running* (ZVIBLO), and **6** assessing **specific motor abilities:** *10 m sprint with the ball* (SP10ML), *20 m sprint with the ball* (SP20ML), *figure-of-a-star running with the ball* (ZVILOP), *zigzag running with the ball* (SLALOP), *throwing the ball for a distance* (BALOUD), *accuracy with the ball* (PRELOP).

Both groups had 36 PE classes lasting 45 minutes. The first class was introductory; the following and the last four classes were dedicated to the initial and final anthropological testing, respectively. The experimental group exercised according to the MH programme 27 classes, and the controls had regular PE teaching contents.

The differences between the experimental group and the controls in the initial and the final state were determined with discriminant analysis contained in the programme STATISTICA 5.0. Also t-test for dependent samples was used to establish the general significance of the differences between the initial and final state assessed with the variables of the basic and the specific motor abilities separately in the experimental group.

Results and discussion

The differences between two groups in motor abilities in the initial testing

Table 1. Testing the significance of the discriminant function with χ^2-test of the initial measurement

Discriminant function	λ	Rc	W λ	χ^2	df	p-level
1	1.13	0.73	0.47	24.62	15	**0.10**

Legend: eigenvalues (λ), canonical correlations (Rc), Wilks' lambda (W λ), results of χ^2-test, degrees of freedom (df), significance level (p-level)

Canonical discriminant analysis (Table 1) did not show any differences in the basic and the specific motor abilities between the girls in the experimental and control group.

The differences between two groups in motor abilities between the initial and the final state

The statistically significant differences (Table 2) were obtained between the initial and the final measurement in: *10 m sprint* **(SPR10M)**, *front support* **(UPPRED)**, *zigzag running* **(MAGSLA)** and *figure-of-a-star running* **(ZVIBLO)**. The test ***10 m sprint (SPR10M)*** assesses the ability of maximal velocity running. The significant differences can be attributed to PE curriculum contents, the area of *running,* which prescribes adoption of correct running technique and predicts positive influence on cardio-vascular system. Also, a lot of relay games, applied in PE classes, positively influenced short distance running speed. The variable ***front support*** **(UPPRED)** assessed strength endurance of arms and shoulders. The differences can be also attributed to the PE curriculum contents of climbing, crawling and passing through, which have goal to incite the muscular development of arms, torso, legs and to underpin the correct body posture, as well as of hanging and climbing, the goal of which is strengthening of arm and shoulder muscles, joints, tendons and ligaments. Their goal is also to enhance flexibility of spine and joints.

Table 2. The differences between two groups in motor abilities of girls between the initial and the final state

	AS		Std.Dv.		N		t-tEGt		df		p	
	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG	CG	EG
SPR10M – I	2.94	3.03	0.32	0.35								
SPR10M – F	2.39	2.77	1.24	0.25	18	25	2.17	6.11	17	23	**0.04**	**0.00**
SPR20M – I	4.98	5.07	0.49	0.46								
SPR20M – F	5.00	4.83	0.42	0.32	18	25	-0.26	3.55	17	23	0.79	**0.00**
MFESDM - I	125.10	118.88	17.64	10.86								
MFESDM_F	122.89	126.36	20.53	12.11	18	25	0.48	-4.62	17	24	0.64	**0.00**
TRB30S – I	18.37	16.46	4.22	2.99								
TRB30S – F	17.37	20.79	5.11	3.34	18	25	0.81	-8.64	17	24	0.42	**0.00**
LED30S – I	32.68	34.88	6.92	8.04								
LED30S – F	32.21	41.67	8.40	5.68	18	25	0.23	-5.36	17	24	0.82	**0.00**
UPPRED – I	88.05	99.67	66.48	77.99								
UPPRED - F	130.85	158.33	45.67	85.97	18	25	-2.82	-3.18	17	24	**0.01**	**0.00**
MAGOSS - I	23.86	23.95	6.56	1.80								
MAGOSS - F	25.26	22.45	4.28	1.69	18	25	-0.66	6.59	17	24	0.52	**0.00**
MAGSLA - I	9.72	13.40	0.91	18.47								
MAGSLA - F	9.01	12.83	0.94	18.58	18	25	2.62	0.11	17	24	**0.02**	0.92
ZVIBLO – I	8.19	8.18	1.10	0.86								
ZVIBLO – F	6.61	7.74	3.10	0.58	18	25	2.23	3.45	17	24	**0.04**	**0.00**
SP10ML – I	5.40	4.70	2.40	1.85								
SP10ML – F	5.14	3.83	2.07	0.67	18	25	0.43	2.61	17	24	0.67	**0.02**
SP20ML – I	9.80	8.87	3.35	2.33								
SP20ML – F	9.28	7.15	2.34	1.49	18	25	0.60	4.79	17	24	0.56	**0.00**
ZVILOP – I	19.14	18.33	20.42	17.55								
ZVILOP – F	14.96	14.81	4.76	17.82	18	25	0.86	0.69	17	24	0.40	0.50
SLALOP – I	22.13	20.26	19.77	6.08								
SLALOP – F	18.06	15.05	4.03	3.13	18	25	0.82	4.39	17	24	0.42	**0.00**
BALOUD – I	3.95	3.48	0.77	0.94								
BALOUD - F	4.09	4.15	0.91	1.25	18	25	-0.79	-4.75	17	24	0.44	**0.00**
PRELOP – I	44.44	55.74	16.06	29.51								
PRELOP – F	43.34	46.33	24.67	23.83	18	25	0.20	1.83	17	24	0.84	0.08

CG – control group **EG** – experimental group **I** – initial state **F** – final state

The differences between the initial and the final state of motor abilities of girls in the experimental group

The significant differences (Table 2) were obtained between the initial and the final state of girls in the experimental group in: *10 m sprint and 20 m sprint* **(SPR10M, SPR20M)**, *standing long jump* **(MFESDM)**, *sit-ups in 30 s* **(TRB30S)**,

back extension **(LED30S)**, *front support* **(UPPRED)**, *figure-of-eight with ducking* **(MAGOSS)** and *figure-of-a-star running* **(ZVIBLO)**; *10 m sprint with the ball* and *20 m sprint with the ball* **(SP10ML)**, **(SP20ML)**, *zigzag running with the ball* **(SLALOP)**, and *throwing the ball for a distance* **(BACLUD)**.

The tests 10 m sprint and ***20 m sprint*** from the standing start ***(SPR10M, SPR20M) assessed maximal running velocity.*** Speed is genetically determined (hereditary). Therefore, the improvement is the result of running technique work at the beginning of PE classes: correct and coordinated leg work, lifting of the swinging knee, correct arm work and trunk posture. Athletic "ABC of running" contents: low skip, high skip, lower leg throwing forwards and backwards, running forwards and backwards, should be applied at least once a week in PE classes.

Test standing long jump assessed leg power (MFESDM). Leg power, and power in general is highly hereditary, so the improvement is attributable to the adoption of correct technique of the test *standing long jump* and the contents in which jumps (two- and one-legged). In the MH programme fundamental throws at the goal were very important, among them the jump shot. Besides the adoption of one of the most important technical elements, meaning the development of handball specific skills, girls also developed power of a jumping type. Various obstacle courses and jumping over boxes, usually applied in the principal A and B parts of PE classes, also contributed considerably to jumping ability improvement.

The ***tests sit-ups in 30 s*** and ***back extension assessed dynamic strength endurance of abdominal and back muscles (TRB30S) and (LED30S), respectively.*** Due to the age of the subjects (8 yrs) and the importance of the body core muscles, which are in the phase of growth and development under paramount stress, in the MH experimental programme we accentuated the exercises aimed at strengthening abdominal and back muscles. From the initial three series with ten repetitions, at the end of the programme the girls came to four series with 20 repetitions for all groups of abdominal (upper, lower, oblique) and back muscles (upper and lower). Also, in ball work (throwing, passing and catching) abdominal and back muscles are engaged, and the girls performed paramount number of repetitions, thus improving dynamic strength endurance.

The ***variable front support (UPPRED) assessed strength endurance of arms and shoulders.*** The differences are primarily the result of the application of exercises aimed at strengthening arms and shoulders, that is, which prevails in obstacle courses circular forms of work in MH programme. Due to the phase of growth and development of girls, loads were not long-lasting, but they were still optimal to produce significant influence.

Tests figure-of-eight with ducking (MAGOSS) and ***figure-of-a-star running (ZVIBLO) assessed coordination***. Coordination exercises with and without the ball prevails in the MH programme: passing through, running over obstacles, movements with direction changes, jumping over obstacles, running across benches and gymnastic beams. The girls overwhelmed their fear of unknown movements, motions and exercises, thus improving their coordination and agility.

Zigzag running with the ball (SLALOP) assessed coordination with the ball. In the experimental programme of MH the following contents prevail: passing and catching the ball, bouncing and dribbling, ground and jump shots, feints with and without the ball. These contents develop coordination in movements with the ball, therefore the finding is expected. The girls found all the contents with the ball more interesting and their attention span was much longer than when working without the ball. The authors suggest the introduction of the mentioned contents in the PE curriculum earlier than the fifth grade since 8-year girls can easily adopt them.

The tests 10 m sprint (SP10ML) and ***20 m sprint (SP20ML) with the ball assessed running velocity.*** All the contents of the MH programme had the influence on that motor ability, especially the ones applied in the principal B part of the PE class, where various relay games with and without the ball prevail and playing mini handball.

In the variable throwing the ball for a distance (BALOUD), assessing power of the predominant arm, statistically significant differences were obtained at the level of $p<0.05$. Power of the arm is correlated significantly with hereditary predisposition, but it can be improved by correct passing, especially release technique adoption and muscle strengthening of arms, shoulders, as well as abdominal and back muscles, which was done in the experiment.

The differences between two groups in motor abilities in the final testing

Table 3. Testing the significance of the discriminant function with χ^2-test of the final measurement

Discriminant function	λ	Rc	W λ	χ^2	df	p-level
1	0.70	0.64	0.59	19.83	9	**0.02**

Legend: eigenvalues (λ), canonical correlations (Rc), Wilks' lambda (W λ), results of χ^2-test, degrees of freedom (df), significance level (p-level)

The results of canonical discriminant analysis of **basic motor abilities** (Table 3) show the statistically significant differences between the girls in experimental group and the controls in the final testing. The obtained discriminant function differentiated between the two groups significantly (p=0.02). The coefficient of canonical correlation is 0.64.

The variables with the greatest contribution to the difference (Table 4) are those with the highest correlation with the factor that can be defined as: **dynamic strength endurance**. Dynamic strength endurance of abdominal and back muscles, assessed with the tests *back extension* **(LED30S)** and *sit-ups in 30 s* **(TRB30S)**, significantly contributed to better achievements in the task *figure-of-eight with ducking* **(MAGSS)**, assessing coordination.

Table 4. Correlation of the variables with the discriminant function (structure matrix)

	Factor 1
SPR10M_F	0.39
SPR20M_F	-0.30
MFESDM_F	0.10
TRB30S_F	**0.45**
LED30S_F	**0.76**
UPPRED_F	0.21
MAGOSS_F	**-0.55**
MAGSLA_F	0.13
ZVIBLO_F	-0.34

During the experiment, primarily in the principal b part of the class, a lot of attention was paid to strengthening abdominal and back muscles. In a few first PE classes with MH programme, the subjects performed three series and 15 repetitions or 20 s holds, and afterwards the number of series and repetitions grew to four series with 20 repetitions of exercises aimed at strengthening abdominal and back musculature. The PE curriculum for the 2nd form does not include any specific strengthening exercises, the better scores of the experimental group was expected.

Also, since the MH programme accentuated agility and coordination exercises (passing through, obstacle courses, running with direction changes and various tasks, jumping over obstacles) in the principal A and B parts of the classes, the statistically significant differences were expected in the variable *figure-of-eight with ducking* between the experimental and control group.

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INFLUENCE OF DIFFERENT PHYSICAL EDUCATION CURRICULA ON THE FIFTH-GRADE PUPILS' MOTOR ABILITIES

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Abstract

The research was conducted on the sample of 300 fifth-grade primary school pupils from the County of Međimurje in the school year 2006./2007. The sample of pupils was divided into three groups: experimental groups **A** (N= 100) and **T3** (N=100) and a control group **T** (N=100). All three groups attended the physical education classes regularly but with different programmes and different number of PE classes. The classes conducted in experimental groups were intensified with the teaching contents from athletics. After a year period, the pupils were measured with 17 motor tests and 1 functional ability test.

The obtained results indicate that there are statistically significant differences between the experimental groups, as the groups that achieved better results as related to the control group, whereas there the experimental groups were also statistically significantly different from each other.

Key words: *motor ability, physical education, track and field, pupils*

Introduction

PE teaching is one of very important factors for the growth, development and maintenance of health of children. Therefore, the importance of achieving the tasks, as well as the aims in PE classes primarily refers to preservation and improvement of health, creation of positive children's attitude towards physical exercises and sport as the way of acquiring habits and needs for regular physical activity and active way of life. The development of motor abilities and functional abilities as well as acquiring basic motor knowledge is one of the ways how to influence the optimal growth and development in children and youth.

The research of how different PE classes influence motor and functional abilities in pupils is an essential direction of research in kinesiological science, with the aim of improving PE classes as well as the pupils' attitude towards physical exercising. Having examined the assumptions the conclusion imposes itself that different PE classes (content, intensity and frequency), i.e. exercising processes differently influence a child's organism provoking different transformation effects. (Babin at all 2001; Neljak, 2002; Breslauer, 2002; Morbitzer, 2005).

Consequently, the basic purpose of this paper is to establish the efficacy of three different one-year PE classes on motor abilities of children - fifth-grade primary school pupils.

Methods

The sample consisted of 300 male pupils aged 11, divided into three groups: a group of 100 pupils attended the prescribed 45-minute PE classes twice a week (T), and another group of 200 pupils, 100 pupils of which attended modified 45-minute PE classes twice a week intensified with athletics (A) and 45-minute PE classes three times a week (T3).

The modified programme included at least two topics from the field of athletic movements, in which, apart from the athletics prescribed by HNOS (*Croatian National Education Standard*) the topics from athletic schools level I and II were used: running techniques (? start, run), medium-length running, cross-country running, hurdles, relay run, basic techniques of high and long jump, triple long jump, pole vault, basic throwing techniques, obstacle courses and relay games.

Apart from the differences in class contents, the differences in programmes included the weekly and yearly number of classes, as well as the number of teaching topics at a particular class and during a year. (Table 1).

Table 1. Basic PE classes parameters per groups

TEACHING PROGRAMME PARAMETRES	TEACHING GROUPS		
	Control **T**	Experimental **A**	Experimental **T3**
Number of classes per week	2	2	3
Number of classes per year	70	70	105
Total number of teaching topics	31	42	42
Number of teaching topics during a period	3	3	3

With the aim of checking efficacy of the implemented programmes the pupils were measured with 18 motor tests: standing long-jump (MFESDM), throwing the medicine ball from supine position (MFEBML), 20-meter run from the standing start (MFE20V), sit ups in 60 seconds (MRSDTL), hang time with flex (MSCVIS), obstacle course backwards (MREPOL), crawling through and jumping over (MBKPOP), climbing up and down the bench and wall bars (MBKPIS), hand tapping (MBFTAP), foot tapping (MBFTAN), foot tapping against the wall (MBFTAZ), touch-toe with feet spread (MFLPRR), circumduction backwards with a bar (MFLISK), sit-and-reach (MFLPRK), rectangular run (MAGTUP), figure–of-eight with bending (MAGOSS), side steps (MAGKUS), 6-minute run (F 6).

To establish the differences in motor and functional ability between the groups a canonic discriminant analysis was applied.

Results

By the analysis of descriptive indicators (table 2) the normal distribution of results in the majority of analysed variables in final measuring has been confirmed. Only in the MBKPIS variable normal distribution has not been established at any of the measured groups.

The differences between the groups in the manifested area, established by a canonic discriminant analysis indicate that the groups statistically significantly differ, mostly in favour of the experimental group A, then experimental T3 group compared to the control group T. Discriminant function showed to the existence of statistically significant differences between experimental groups as groups with better results compared to the control group, while similarly, experimental groups were also statistically significantly different from each other.

The results in Table 3 indicate that the first discriminant function is mostly defined by the variables as follows: MFESDM, MFEBML, MFE20V, MBKPOP, MBKPIS, MBFTAP, MBFTAN, MBFTAZ, MAGTUP, MAGKUS, MAGOSS, F6. According to the centroid projection (Table 4) of groups on the first discriminant function, in the previously mentioned variables control group (T) more significantly differs from the experimental group (**A**), and a little less from another experimental group (**T3**) which comes in between the first two groups. It is obvious that the pupils from the first group have better results only in the variable REPOL whereas in other variables the results are worse compared to the experimental groups. In other motor tests and a functional ability test the modified programmes caused significant improvement of results compared to the control group.

The second discriminant function is best defined by the variables MFE20V, MBKPIS, MBFTAZ, MAGOSS. The mentioned variables most significantly differentiate one experimental group from the other (**T3** from A), and a little less from the control group. In variables MFE20V, MSCVIS, MREPOL, MBKPOP, MFLISK i MAGTUP, better results were achieved by the experimental group **T3**, whereas in other variables better results were achieved by the experimental group **A** and in less extent (three tests) the control group.

Discussion and conclusion

Based on the obtained results it can be concluded that the modified PE classes intensified with the teaching contents from athletics have led to differences between the analysed groups at the end of the implementation period of one year. They indicate that the groups mostly differ in explosive strength, agility, alternate movements frequency, coordination and endurance, and less in flexibility, repetitive strength and static strength endurance, as well as the functional ability test. By application of additional contents from athletics with children aged 11, motor abilities have been mostly improved, which has been proved by this research, as well as by the previous ones (Breslauer 2002). These are the motor abilities that in this period of growth and development of pupils have the largest number of development abilities.

As far as the static strength and flexibility tests are concerned there is a progress noticed with the experimental group T3, which might be justified by the fact that at these two motor abilities a significant stagnation in improvement has been noticed in the period from the age of ten to thirteen (Kondrič, 2000). Another reason for this might be the fact that during the implementation of modified classes these exercises were not especially paid attention to, only to the extent required by particular movement structures.

Based on the conducted analyses it can be concluded that it is necessary to improve the PE classes both quantitatively and qualitatively, striving for the larger number of teaching contents that will influence the development of basic motor and functional abilities such as: speed, coordination, agility, explosive strength and endurance. Athletic movements, which use natural forms of moving such as jumping, throwing and running, are the fundamental movement forms in all other sports, therefore they should be more practiced with the children at the age of 11 due to their utilitarity in every day life.

Being aware of the dangers of hypokinesis at children and people in general, many countries have been introducing various measures which would enable daily systematic and programmed exercising, especially of school population. The primary aim of the educational area of physical education is that physical exercising become the everyday way of life for an individual since the earliest period of his/her life. Therefore, the efforts should be directed towards the Ministry of Science, Education and Sport to introduce more PE periods into schools, at least three periods a week, which are necessary to bring to a more significant improvement of children's motor and functional abilities, which is extremely important and needed, primarily significant for pupils who outside PE classes do not practice any kind of physical activity.

Based on the obtained results it can be surely proved that the modified PE classes intensified with the teaching contents from athletics with two or three periods a week, significantly contributed to the pupils aged 11, to bigger changes of their motor abilities than the officially proscribed PE classes. Knowing this, the basic and differentiated PE curricula suggested by the Ministry of Science, Education and Sport should be optimally used, although only a small number of schools use them for improving health and motor and functional abilities of children. By all means, we should strive to implement additional PE classes because this research has proved that even in difficult conditions, under which this research was conducted, significant differences in all motor abilities have been established, which is obvious compared to the pupils who attended only regular PE classes.

Table 2. Basic descriptive parametres of motor variables for all three groups

	MODIFIED CLASSES A					MODIFIED CLASSES T3					OFFICIAL CLASSES T				
Varijable	**AS**	**MIN**	**MAX**	**SD**	**Max D**	**AS.**	**MIN**	**MAX**	**SD.**	**Max D**	**AS.**	**MIN**	**MAX**	**SD.**	**max D**
FESDM F	168,54	121,25	213,75	20,53	,067	171,33	123,75	205,50	16,57	,076	160,25	118,25	196,25	18,13	,076
FEBML F	**577,07**	380,00	872,50	90,63	,128	560,32	335,00	820,00	90,41	,060	551,56	377,50	790,00	88,34	,060
FE20V F5	**4,05**	3,36	5,16	0,32	,102	4,17	3,70	5,23	0,29	,115	4,18	3,71	5,40	0,25	,115
RSDTL F	37,09	25,50	47,00	5,22	,065	**38,53**	23,00	52,00	5,98	,067	35,22	21,00	50,00	6,17	,067
SCVIS F	25,91	2,36	89,82	15,85	,103	**31,91**	4,17	87,28	17,54	,087	25,74	1,17	71,08	15,77	,087
REPOL F	13,95	9,03	21,10	2,49	,112	13,83	8,93	22,56	2,62	,093	**13,66**	9,31	23,23	2,76	,093
BKPOP F	15,64	10,34	24,34	2,87	,123	**15,59**	11,55	22,10	2,39	,091	17,10	9,75	29,24	3,83	,091
BKPIS F	24,27	18,23	35,73	4,13	**,135**	**21,41**	17,90	36,99	3,29	**,206**	29,04	22,25	55,86	6,10	**,206**
BFTAP F	**28,84**	22,33	38,66	2,61	,071	28,27	21,00	36,66	3,35	,083	26,49	19,00	32,66	2,40	,083
BFTAN F	**19,04**	16,00	22,75	1,53	,080	18,50	15,25	22,75	1,77	,117	17,84	15,25	22,25	1,39	,117
BFTAZ F	**19,54**	15,00	23,50	1,68	,120	18,96	15,00	22,50	1,94	,065	18,25	14,75	22,75	1,59	,065
FLPRR F	**52,00**	34,66	83,66	9,21	,058	51,36	30,66	69,66	8,48	,082	50,39	30,33	64,66	8,06	,082
FLISK F	72,33	34,33	102,33	12,35	,079	**69,53**	30,33	106,66	12,75	,049	72,97	38,66	104,33	13,00	,049
FLPRK F	**38,98**	21,33	53,00	6,71	,073	37,90	24,33	54,66	5,79	,092	37,89	23,66	51,33	5,39	,092
AGTUP F	12,85	10,17	17,21	1,45	,087	**12,80**	10,78	17,36	1,08	,091	14,16	10,23	21,94	1,47	,091
AGKUS F	11,53	9,29	15,00	1,15	,082	**10,66**	8,35	14,20	1,10	,073	11,90	9,01	17,04	1,31	,073
AGOSS F	10,15	8,19	13,55	1,03	,080	**9,30**	7,98	11,54	0,66	,068	10,99	8,94	14,04	1,03	,068
F6 F	1163,3	800	1400	136,55	,111	**1182,0**	750,0	1470,0	153,01	,102	1093,8	718,00	1380,0	138,95	,102

Legenda: AS – arithmetic mean, MIN – minimum result, MAX – maximum result, SD – standard deviation, Max D- Kolmogor–Smironov test of normality distribution
KS test value =0,134

Table 3. Discriminant function structure

Variables	**Root 1**	**Root 2**
FESDM_F_	**0,516**	0,167
FEBML_F_	**0,323**	0,032
FE20V_F_	**-0,329**	**-0,290**
RSDTL_F_	0,128	-0,008
SCVIS_F_	0,173	-0,013
REPOL_F_	0,052	-0,014
BKPOP F	-0,301	-0,020
BKPIS_F_	**-0,600**	**0,330**
BFTAP_F_	**0,404**	0,074
BFTAN_F_	0,319	0,153
BFTAZ_F_	0,233	**0,217**
FLPRR_F_	0,044	0,167
FLISK_F_	-0,035	-0,008
FLPRK_F_	0,108	**0,266**
AGTUP_F_	**-0,493**	-0,084
AGKUS_F_	**-0,348**	0,146
AGOSS_F_	**-0,598**	**0,458**
F6_F_	0,294	0,048

Table 4. Centroid position in disrciminant area

	Root 1	Root 2
T	-0,902	0,137
A	0,673	0,351
T3	0,230	-0,488

Table 5. Variables that mostly define discriminant functions in final measuring

	DF1	DF2
1	AGOSS -0,59*	AGOSS 0,45*
2	BKPIS -0,60*	BKPIS 0,33*
3	FESDM 0,51	FE20V -0,29*
4	AGTUP -0,49*	FLPRK 0,26
5	BFTAP 0,40	BFTAZ 0,21
6	AGKUS -0,34*	FLPRK 0,16
7	FEBML 0,32	FESDM 0,16
8	FE20V -0,32*	BFTAN 0,15

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THE EPISTEMOLOGICAL FRAME OF THE EDUCATIONAL FRONT OF THE MOTOR-SPORTING ACTIVITIES FOR AN INNOVATIVE VISION OF THE DIDACTICS

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Abstract

In a bioeducational perspective, the scientific paradigm of the educational field within the motor-sporting sector is referable to a reference picture that puts into relationship the survey fields of the learning mechanisms and those of the corporeal experiences which necessarily re-enter in an interdisciplinary field in which we can graft and confront the various theoretical pictures and the experimental searches which were realized in several scientific fields.

The definition of an epistemological frame of the motor and sporting sciences cannot leave out of consideration the analysis of the contributions of various disciplinary sectors and that one of the discoveries in the neuro-scientific sector which have contributed to a revaluation of the body and the activities connected to it.

Key words: *body, movement, learning processes, memory*

Introduction

The long route of the scientific development of motor and sporting sciences epistemology with an educational nature, even if it has started from the bases of the classical philosophy, preliminarily it has required the recognition, by the pedagogy, of the educational dynamic and the flexible value of doing and acting, answering to a scientific model of knowledge that has spread starting from XVII century and that has accepted the revolutions which have modified his arrangement during the years, making it dynamic and flexible (Kuhn, 1962).

Starting from an epistemological and interdisciplinary review of the play-motor and sporting activities, it is possible to increase the value of the extraordinariness and of the wealth of the individual in its being as mind and pathos, body and movement, emotion and knowledge, biological entity and social dimension and to create that "Unitas Multiplex" (Morin, 1977, p. 105), that "cum-plexus" process which is centred on the search of connections and relations which are present within every system (social, cultural, educational, etc.) where it is necessary to recognize the educational and formative value of the body and the movement.

The epistemological frame of motor and sport activities

The consideration of the corporeal dimension "not considered as an object of the world any more, but as an equipment of our communication with it" (Merleau Ponty, 2002, p. 144), goes with the idea of a body which sends us beyond his visible materiality.

The feelings and the states of mind are, as a matter of fact, invisible but they can be rendered manifest to the others through the corporeal language that is more important in determining the meaning of the message than its oral content: "the language is remarkably dependent and closely interlaced to the not verbal communication and there are many things that cannot be expressed with words (Argyle, 1988, p. 2). Through the not verbal communication the body concurs to the de-codification and to the understanding of the intentions of our interlocutors, a kind of acknowledgment of the dynamics which are often unconscious and at the base of our language, if we consider that "the whole behaviour has a message value in an interactive situation, it is worth to say it is communication, and it achieves that, however we try, we cannot keep off the communication" (Watzlawick et al., 1967, p. 41).

From the first manifestations of the child (the cry and the smile) it emerges the centrality of the sense-perceptive system and of a kind of corporeity which is able to support the psychical development of the child in the different phases of the growth through a progressive development, passing from one phase of less equilibrium to one of advanced equilibrium and manifesting a constant relation between action and cognition. The movement corresponds to a sense-practical intelligence which is based on the manipulation of the objects and the perception: "the fact that the intelligence drifts the action has as result that even in its manifestations of advanced order, when it is proceeds only thanks to the thought instruments, the intelligence consists in an execution and in a coordination of the actions, even if it is presented in interiorized and reflecting shape" (Piaget, 1971, pp. 26-27).

The natural push to make and to do that characterizes the childhood demands one scientific knowledge which is able to address the processes of teaching/learning in a didactic way and to bring out the function of the corporeal-kinaesthetic dimension when one builds a sensory educational relationship, as "when the senses explore the environment, they open the way to the knowledge." (Montessori, 1952, pp. 180-184). The connexion between motor action and intellective development is confirmed in the studies on the methodologies of the search, on the evidence of the circular relationship between action-experience-knowledge as "in any case the thought comes from one directly experienced situation. Nobody can simply think in a generalized manner, neither the ideas can rise from nothing… it is a situation which has been effectively experienced to arise the inquiry and to evoke the reflection" (Dewey, 1910, p. 170). In particular the motor games, the various shapes of play-sport and motor activities can be original and effective instruments for the development, they can originate effective instruments for the formation and they can supply meaningful occasions in order to learn ethical and moral rules and principles which are fundamental in the process of socialization and democratization (Dewey, 1916).

The full valorisation of the corporeity as an active in the educational-formative processes subject, needs an interdisciplinary search on the definition of human nature and it invites to a reflection on the educational praxis in the perspective of a plurality of learning styles and "formae mentis". It considers the intelligence not as a lonely and exclusive manifestation of the human cognitive potential any more, but as a modality of the problem-solving which is able to use perceptive channels, different instruments and approaches and it locates in the corporeal-kinaesthetic intelligence that shape of the cognition that enters in game in a prevailing or in a concurrent way in many human activities: "the person can learn using kinaesthetic or spatial performances" (Gardner, 1983).

The studies and the searches on the more and more sophisticated and less invasive techniques, like PET and fMRI, have concurred to the functional imaging (to observe the brain when it is in activity, when it is alive) which is able to supply a key of biological reading of the theories on learning. They have demonstrated the importance of the perceptive and motor systems in the formation of structures from which "global functions" are generated; these functions are those activities that originate the categorization, the memory, and all those behaviours that concur to the adaptation of the person" (Edelman, 1987). As a matter of fact, acting is the true sculptor of the cognitive systems that are modelled in connection with the ability to integrate

genetic identity with the demands of the environment (Kandel et al., 2000) and with the emotional dimension that characterizes corporeal-motor experience. Many typical of the sport-practice behaviours confirm the existence of one low and fast cortical way which excludes the neocortex when the emotional stimulus comes and sends back whichever aware elaboration only in one posthumous phase, and sends back whichever aware elaboration only in a posthumous phase. It is able to determine answers in short times and allows some memories and emotional reactions to be formed without some aware participation" (LeDoux, 1996, p. 170).

The studies on the cerebral plasticity and on its relationships with the investigated corporeity as a possible key of access to the cognition have inspired and oriented the search of new didactic approaches in the formative processes. They implicitly speed up the exploration of new interdisciplinary fields as that sporting-motor one which uses the body in its globality as subject and tool to learn. The searches on the neurobiological mechanisms of the memory and of learning (Hebb, 2002) and on the relationship between motor experience and mnemonic processes, beyond evidencing the essential role of some cerebral structures, they have allowed to trace the possible relationships between learning mechanisms, corporeal experience and emotion. If it is true that the sensorial inputs which come from the external world, leave traces in the MBT (short term memory), in this phase the motor-kinaesthetic experience can help to consolidate the mnemonic traces, when it connects the emotional participation of the corporeal action for a possible stabilization of the information as "when the emotion is connected to our efforts, it could be revealed as a powerful motor which is capable to give them great efficacy" (Goleman, 1997, p. 123).

These scientific premises concur to reflect on the borderline between that part which in every man is genetically determined and his adaptability, using body and movement as the expression of a "sixth sense", able to anticipate the actions through one proactive function. Before moving and acting, the brain calculates the position of the body, completes operations of relation with the space and compares itself with the circumstances and it demonstrates itself much most similar to a simulator than to a calculator: "the brain is not a reactive machine, it is a proactive machine that projects his own queries on the world"(Berthoz, 2002, p. XI).

Through play-sporting and motor activities the didactics is potentially able of a wide and pluri-sensorial involvement, as the body concurs to place side by side the cold and repetitive information which are indispensable for the construction of knowledge, with stimuli which are capable to permeate and to involve at an emotional level, while it conditions the cognitive system and the memory as "the weft of our mind and our behaviour is woven around continuous cycles of emotions which are followed by feelings of which we become aware and which, on their turn, generate new emotions" (Damasio, 1999, p. 60). Beyond contributing to the construction of a epistemological frame of the educational level of the motor-sporting activities, these studies evidence the possible leading part of the body in the didactics and, starting from the indissoluble binomial body-emotions, they help the construction of integrated path for the differently-able people also. The sport dimension and the play-motor activities get ready to the challenge for the integration and they place themselves as extraordinary social containers, privileged environment for human relations, fertile land for the development of the

cognitive potential and of the vicarious system. Therefore, also in presence of a deficit, it is widely demonstrated by the extraordinary discovery of the neurons to mirror also that the individual can generally use adapted in shape and personalized neural structures. These can be found in the areas which are generally deputed to the movement and able to activate themselves not only in the moment in which we act, but also when we see others to do an action. "The neurons to mirror system codifies transitory and not transitory motor actions into the human being; it is capable to select both the type of data and the sequence of the movements that compose it; finally, it does not need a real interaction with objects, because it activate itself also when the action is simply mimed" (Rizzolatti, 2006, p.121).

Conclusions

These considerations evidence the necessity of a multiple searching approach that exceeds the border between the disciplines that is to the advantage of a complex method which is capable to develop in the researchers an attitude to study the possible relationship between motor activities, sports and educational processes, meanwhile it draws from the variety of knowledge which could refer to sciences with their own independent but potentially integrable statutes (anthropology, biology, psychology, sociology, philosophy, neuro-physiology).

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STUDY ABOUT THE DESIGNING OF KNOWLEDGE TESTS IN PHYSICAL EDUCATION AND SPORTS

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Abstract

In this paper we try to propose a new perspective of the students' evaluation process which uses the information technology and offers new possibilities to increase the students' interesting for study. The focus of this research is to create a standardized test for computer evaluation of student's theoretical knowledge in physical education and sports, as an alternative method to traditional forms of evaluation. The results of this study (after the items' analyze) showed that the final tests, which contains 61 items, have fidelity and validity, with a 0,899 Cronbach alpha coefficient. Finally, the program calculates the scores, teachers' time for preparing, administering and correcting the test is decreased and each student has his own mark of evaluation.

Key words: *evaluation, information technology, item, score, correlation, computerized evaluation*

Introduction

In this research, we try to suggest a new perspective of accomplishing the students' evaluation process which, by using the information technology, offer new possibilities of increasing the students' interesting for study.

Taking into account the increasing number of students in the first stage of faculty learning, we believe it is necessary to use some ways of knowledge evaluation, within the exams, to create certain advantages for teachers and students, at the same time, thus, without overlooking the quality of the evaluation practices.

In order to help us, there are the knowledge tests, which, designed for the computerized alternative, offer some advantages to classical, oral or written evaluation: the increasing of testing speed, the distribution of subjects is almost instantaneous, quick feed-back, the objectivity and neutrality of the examination, the elimination of subjective issues of the examiner and examinees, etc., saves teachers' time for preparing, administering and correcting the test; calculating the scores; there can be tested, at the same, time more persons than at an oral exam; it is tested a big volume of knowledge; some statistics can be immediately obtained concerning the students' results; it is possible to make items, analyze and calculate the fidelity and validity coefficients; the results of the exam can be immediately known.

Methods

For this research we proposed the next hypothesis:

1. Using the knowledge tests at the theoretical subject matters from physical education and sports' area improves the quality of evaluation practices, by increasing the objectivity in giving a mark and by decreasing the time of test evaluation.
2. If the information technologies in the evaluation process of theoretical knowledge in physical education and sports are applied, then:
   - the time of experimenting and validation of evaluation tests with the help of the computer is decreased, in comparison with the traditional tests;
   - the development of competences of using the computer in evaluation process are assured, both for the students and for the teachers.

In the first stage of items' testing we have built a knowledge test containing 100 items (multiple choice questions). This test was applied to 35 subjects, students in the last year of study, at the Faculty of Physical Education and Sports, University of Craiova, Romania, with the aim of verifying the degree of the items' adequacy, at the knowledge level, the curriculum's demands, clarity and scientific errors, as well.

To draw up this test, we have used the corresponding analytical programs for the following subject matters: The Theory of Physical Education and Sports, The Didactics of Physical Education and Sports, and The Theory of Sports Training, as well as the selected bibliography, recommended by the teacher.

In the next stage, the knowledge test containing 95 items was applied to 67 subjects - who voluntarily agreed to participate at the test, using the computer (Sphinx Plus^2 software). After this application, a part of the items was reviewed

and other eliminated, according to the results of the statistic calculations. This experiment is very useful in the hereby research because the major mistakes appearing in the elaboration of the items can be eliminated.

As for the knowledge test applied by computer, there was an indication for each item of the test: the type of the item, the objective, the text of the item (good answers, wrong answers, options), the total score of the item and the score for each answer.

Results

We have measured the consistency of the test with the Cronbach alpha coefficient, being an indicator of the precision measurement of the test, and its fidelity.

We have calculated the coefficient of correlation between the items and the total score, as well as the corrected item total correlation (correlation between each item and total score, the item being eliminated). The evaluation of the relations between the items was successful. On the basis of these links between the items and the total score the selection was made. After the inadequately items were eliminated from the test, we recalculated the Cronbach alpha coefficient (0,879). At the end, all the items had a positive correlation. The final test contains 61 items.

We have calculated the matrix correlation between the results obtained by the students during the years of study (the average for the 3 disciplines used in the test), the results of the knowledge test and the results of the graduation test.

Table 1. The matrix of correlation

r	The average of the 3 disciplines	The mark of the test	The mark of the graduation test
The average of the 3 disciplines	1,000	0,675**	0,631**
The mark of the test	0,675**	1,000	0,961**
The mark of the graduation test	0,631**	0,961**	1,000

** Significant correlation at level 0,01

After the calculation of the correlation coefficient between the scores obtained by the subjects at the knowledge test and the graduation exam, we have concluded that the coefficient value is very high (r = 0,96), which shows there is a strong link between the two rows of data.

According to this link, we have calculate the regression equation with the help of the SPSS program, as **y = 6,5539 + 0,0687 * x,** where y stands for the values of the marks and x stands for the values of the scores.

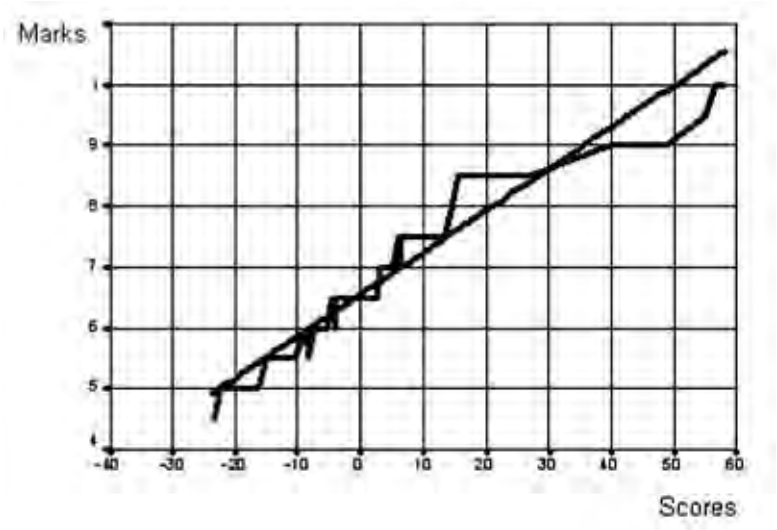

Figure 2. The regression line

With the help of this equation, we can automatically calculate the mark obtained by the subject. At the end of the test, the subject learns the mark shortly, the feed-back being rapid. Also, the computer makes the correction of the answers and the evaluation, increasing, this way, the objectivity and impartiality of the evaluation.

The distribution of the values has a positive asymmetry, the research data being grouped around the small values. We see that the majority of the values are between 6 and 7 (on the Romanian scale, the marks are between 1 and 10), which gives the test a medium degree of difficulty, being thus accessible to the majority of the students.

Discussion and conclusions

Concerning the technical qualities of the test, we can say the followings:

- the test has concurrent validity – the correlation coefficient between the score test and the score of the graduation exam is r = 0,961;
- the test has construct validity – the clarity of the instructions given to the students, the difficulty level of the items contained in the test, the construction of the items, and their adequacy to the knowledge level of the students.
- the test has high fidelity – after the calculation of the fidelity coefficient for the entire test, we concluded this is higher than the coefficient calculated for the half of the test.

The feasibility of the test is high because of the easy administration, of the short time for application and calculation of the scores with the help of information technology, without high investments.

Our research tries to offer teachers and students an evaluation method using a knowledge test applied by computer, so that a student might answer the exigencies of the nowadays informational society.

The improvement of the evaluation process of the theoretical knowledge, in physical education and sports, through the implementation of the knowledge test, designed in the present research, gives flexibility and efficiency, which proves to be superior to traditional evaluation.

We believe the computerized knowledge test can especially improve the quality of the sport tests applied to students. The practice of this quality improvement, in the developing of the university exams, is difficult to realize without a methodological guide for teachers, put together within this research.

At the end of the computerized knowledge test, the subject can learn his mark in a very short time, the feed-back is quickly, and the correction and evaluation is made by the computer, increasing the objectivity and the impartiality of the examination.

The structure and the presentation manner of information on the display, the quality of the graphics, the colors chosen for background or text, the possibility to reconsider the missing items or the ones wrongly done, represent some facilities of the computerized version, in comparison to the classic one, on the paper.

We can conclude that the obtained results allow us to say that the knowledge test- forwardly perfected (especially, with different types of items, according to students' level) will further increase the efficiency of the evaluation process.

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THE EFFECTS OF MOVEMENT CREATION EDUCATION ON IMPROVEMENT IN MULTIPLE INTELLIGENCES

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Abstract

Creation education is education through movements, and movement creation education can enhance not only potential abilities and creativity but also various intellectual abilities. Therefore, the present study purposed to examine how movement creation education should be executed in order to improve the eight types of intelligence in Gardner's multiple intelligence theory as follows:

First, linguistic intelligence – Express or describe in word what is imagined or felt;

Second, logical-mathematical intelligence – Essential in geometrical movements and the combination of motions, and use thinking power, analytic power, etc;

Third, musical intelligence – Music is an essential element of creation education as movements should be made to rhythm and dynamics;

Fourth, body motion – Movement creation education demands harmonious movements of the body parts or the whole body;

Fifth, spatial intelligence – For movements, spaces should be recognized and various patterns of movement should be identified;

Sixth, interpersonal intelligence – Coordination and agility are improved through the connection and separation of movements among the members within a group;

Seventh, intrapersonal intelligence – Movements should be created through imagination rather than being copied;

Eighth, environment-friendly ability – Induce to take interest in surrounding environment and find themes in it for creation.

Key words: *movement creation education, multiple intelligences*

Introduction

The recent flow of creation education is evolving into integrated creation education based on various media, and in this phenomenon movements are used as instruments for all types of expressions. Movements are the most elementary experiences in daily life.

Movement creation education was initiated by Laban in the U.K. in around 1940. The concept of movement creation education pursued by Laban was the development of kinesthetic abilities through movements. Through expressive movements and physical movements, learners can express functional movements, and from the process of moving, they express their thoughts and emotions physically and even improve creating thinking. Therefore, the present study examined movement creation education as an integrated program for developing various areas of intelligence in connection to Gardner's multiple intelligence theory, which explained the concept of intelligence not as a part of human intellectual abilities but as the whole of them.

Movement creation education

Movement is a basic element of human life that is made even by unborn babies. Movement is an important means for humans to maintain their life, communicate with others and express their emotions, and at the same time it is used for people to enhance the quality of life by expressing their thoughts and feelings more efficiently and making more effective conversations with others. In this sense, movement education is highly valuable. Here, the contents of movement include both expressive movements and functional movements using the body (Yoo Hye-jong,2003).

Rudolf von Laban attempted to explore the value of education through movements. Around 1940, he suggested a new concept and theory called 'human movements' and emphasized education centering on the concept of movement.

According to Laban (1963), a motion is a movement made using the body as an instrument, and knowledge of effective methods can be derived from each individual's smooth and natural movements, and it is motion education to pursue overall development through various motion activities based on the concept of movement.

As movement creation education uses the body as an instrument, it can refine the functional aspect of the body, and furthermore it promotes all-round human development in the physical, intellectual, emotional and social aspects through the processes of moving, thinking, creating and feeling while expressing emotions and feelings in a creative way using the body.

Movement is the source of life, and at the same time is in a direct and close relation with psychological development. As it contributes directly and indirectly to the development of all aspects, namely, physical, motor, cognitive, social-emotional, linguistic, creative, and problem-solving abilities, learners should learn various basic motions for more effective movements and explore their surrounding domains through the medium of motions.

Laban divided human movements into qualitative and quantitative aspects, and suggested that the elements determining the quality of movements are time, weight, space and flow (Laban, 1971).

First, in human movements, time means abilities to move each part of the body at different speeds.

Second, weight means the degree of muscular contraction when the body changes its position or maintains balance in movements.

Third, space means how the body uses space. Each part of the body can move in different directions (forward, backward, sideways), along different tracks (straight, around), and at different stages.

Fourth, flow means the continuity of movements. There are movements that can be stopped easily and those that are more continuous.

In 1975, Laban also suggested the quantitative elements of human movements, which are body, effort, space and relationship. That is, a human movement is composed of body parts to make the movement, force or effort to move the body parts, space for the movement, and relation formed among the elements by the movement, and therefore, movements should be analyzed based on these elements (Han Gyu-ryeong, 1988).

By moving their body, people can understand the relation among space, form, size, time, speed, etc., express their personal emotions, and communicate their intentions to others. In this way, movements are indispensable for humans as living beings to communicate and to confirm the meaning of their lives.

Laban's concept of movement provides a new way of understanding human beings through the life activity of movement, and helps people enrich and refine their movements.

The characteristics of movement education explained by Laban are as follows.

First, in research on physical education, the phenomenon of human movement was chosen as the key object of academic approach.

Second, movement education provided a base for the settlement of movement research and the discovery teaching method in elementary school so that learners could abandon physical activities emphasizing competition or cramming physical education and experience various and many movements by themselves.

Third, movement education applied the concept of movement derived from existentialism to dance education. Laban's stands like 'Dance is life,' 'Dance is the experience of life,' 'Only moving humans are whole' and 'Humans come to know themselves through their own movements' certainly contain existential ideas through movement (Yook Wan-soon, 1996).

Multiple intelligence theory

The multiple intelligence theory gives us many implications, but the most important one among them is that human intelligence is not a single attribute but is composed of several different types of attributes. Here, intelligence is defined as "biological and psychological potentials for processing information that may be useful in the culture to create culturally valuable things or to solve problems" (Gardner, 1999). That is, intelligence is not visible or countable but is believed to be something that can be developed and changed according to the environment of individuals. Based on the definition, Gardner suggested eight criteria for distinguishing those to be considered intelligence from those not, by giving biological and cultural anthropological evidence.

The eight functions suggested by Gardner are as follows.

First, linguistic intelligence includes sensitivity to spoken language and written language, language learning ability, ability to use languages to attain specific goals, etc.

Second, logical-mathematical intelligence is abilities to analyze problems logically, to carry out mathematical manipulations, and to inquire into problems by scientific methods.

Third, musical intelligence is abilities to play music, to understand musical styles and to write music.

Fourth, bodily-kinesthetic intelligence is abilities to use the whole body or body parts such as the hands and the mouth in order to solve problems or to make things.

Fifth, spatial intelligence is abilities to recognize, adjust and use spatial domains and potential for recognizing and handling not only narrow spaces but also roomy spaces.

Sixth, interpersonal intelligence is abilities to understand others' desires, motives and intentions and to work together with others effectively.

Seventh, intrapersonal intelligence is potential for understanding oneself, dealing with his own desires, fears, talents, etc. properly, and consequently leading an efficient life.

Eighth, naturalist intelligence, which was added most recently, includes expert knowledge and abilities to recognize and classify the extensive number of species including animals and plants living together in the environment (Jeong Min-woo, 2005).

The characteristics of the multiple intelligence theory proposed by Gardner as above are:

First, most people are born with all of the eight types of intelligence, but the composition of the intelligences is different from person to person and therefore each person is strong in a certain type of intelligence or another.

Second, the multiple intelligences work independently from one another.

Third, the intelligences are equally important.

Fourth, the eight types of intelligence interact with one another.

Fifth, intelligence is not fixed but can be developed and improved.

Sixth, within each type of intelligence, the levels of its sub-types are not uniform (Kim Ju-hyeon, 2005).

Conclusions

Movement contributes to the development of all aspects – physical, motor, cognitive, social, emotional, linguistic, creative, and problem-solving abilities – and people realize the potential of their body and establish a harmonious relation with nature through the movements of their body. Furthermore, movements are not mere motions of the limbs and the trunk but are connectors expressing people's intentions and behaviors, and conflicts in emotional demands and rational needs. Movement is recognized as an important element of creation education to draw out students' potentials latent in their inside.

Therefore, for the development of the eight types of intelligence according to Gardner's multiple intelligence theory, movement creation education should be as follows.

First, linguistic intelligence – Express or describe in word what is imagined or felt;

Second, logical-mathematical intelligence – Essential in geometrical movements and the combination of motions, and use thinking power, analytic power, etc;

Third, musical intelligence – Music is an essential element of creation education as movements should be made to rhythm and dynamics;

Fourth, body motion – Movement creation education demands harmonious movements of the body parts or the whole body;

Fifth, spatial intelligence – For movements, spaces should be recognized and various patterns of movement should be identified;

Sixth, interpersonal intelligence – Coordination and agility are improved through the connection and separation of movements among the members within a group;

Seventh, intrapersonal intelligence – Movements should be created through imagination rather than being copied;

Eighth, environment-friendly ability – Induce to take interest in surrounding environment and find themes in it for creation.

As presented above, movement creation education can implement and refine the multiple intelligence theory, and is considered an efficient education method for developing Gardner's eight types of intelligence. Therefore, we expect that various programs would be developed for different age groups and used to improve intelligence in various areas.

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EVALUATION OF OBJECTIVITY AND HOMOGENEITY OF SKIING KNOWLEDGE GRADING PROCESS

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Abstract

The aim of this investigation was to determine objectivity and homogeneity of judges involved in the skiing knowledge grading process of college students. The knowledge of alpine skiing of 126 students was determined by five independent judges, by attributing grades from one to five for the demonstration of five representative elements of alpine ski technique. The obtained correlation coefficients between the grades on each element of ski technique were high, thus confirming the objectivity of judges as well as confirming that they all graded the same item, i.e. the alpine ski knowledge. Finally, we conclude that used grading protocol and demonstration of elements of ski technique are the objective way to determine knowledge of alpine skiing of college students.

Key words: *alpine skiing, college students, evaluation of alpine skiing*

Introduction

Motor skills are being constantly evaluated by kinesiologists, especially those involved in education process and teaching. Motor skills can be best described as the different level of adopted motor activity (Findak, 1999). The individual's level of alpine skiing, or any kind of motor skill, is mostly affected by training (exercising), especially by constant repeating of specific motor action. When alpine skiing is evaluated, then motor skills are best improved by repeating specific elements of ski technique. During skiing lessons and training, each student accepts not only physiological but also intellectual components of the elements (Mraković, 1997). The amount of the mentioned two components varies according to the level of students' knowledge of alpine skiing. Ski knowledge is based on particular elements of ski technique, which are best evaluated through grading of students' demonstration of the chosen representative ski technique elements. Grading process is extremely demanding, and to be valid it must be carried out by previously determined criteria (Grgin, 2001, Mejovšek, 2003). It has to be objective, and depend only on demonstrated knowledge of alpine skiing and not be influenced by judges or circumstances in which evaluation is being done (Dizdar, 2006). This investigation will try to determine objectivity and homogeneity of judges involved in grading of college students at Faculty of Kinesiology.

Methods

Acquired ski knowledge for 126 ski naive college students of Faculty of Kinesiology University of Zagreb was evaluated by five previously educated judges, all experts in the field of teaching and alpine skiing. They graded student's demonstration of alpine skiing by grades one to five on Lickert scale (Mejovšek, 2003, according to Supek, 1981). Before the investigation start all the judges were informed in detail about the grading by previously determined criteria. The judges were independent from one another, and the grading process was held simultaneously for all participants. The conducted investigation included 126 college students of Faculty of Kinesiology University of Zagreb, who had no previous knowledge of alpine skiing. 96 of the subjects were of male and 30 of female sex. Mean age of the participants was 23.3±1.66 years. The best way to determine learned alpine skiing would be to grade each element of the ski technique, but this would be time consuming and almost impossible to organize with large number of the participants, so the chosen representative elements of ski technique for the purposes of this investigation included traversing, uphill turn, basic turn, short turn and parallel turn. Statistical analysis included Pearson's correlation coefficients between the given grades for each element of the ski technique and factor analysis for the determination of judges' homogeneity. The number of statistical important factors was determined by Guttman-Kaiser criterion. The level of significance was at $p<0.05$.

Results

Descriptive statistics gives information about mean success of all the participants in alpine skiing during demonstration of five chosen elements.

Table 1. Descriptive statistics for five elements of ski technique used to evaluate alpine skiing knowledge

Element of ski technique	Min	Max	M	SD	Skew	Kurt	KS- Z	p
traversing	1.4	4.7	3.39	0.7	-0.25	-0.43	0.87	0.43
uphill turn	1.3	4.9	3.34	0.75	-0.19	-0.36	0.65	0.80
basic turn	1.1	5	3.08	0.76	-0.039	-0.13	0.48	0.98
short turn	1.1	5	3.13	0.79	-0.05	-0.15	0.48	0.97
parallel turn	1.1	4.5	2.84	0.83	0	-0.68	0.84	0.48

Minimal result (Min), Maximal result (Max), Mean (M), Standard deviation (SD), Coefficient of asymmetry (Skewness-Skew), Coefficient of curve (Kurtosis-Kurt), Kolmogorov-Smirnov test (KS-Z), level of significance (p)

To determine judges' objectivity it is important that different judges give similar grades to participants for the demonstration of particular elements. To test the objectivity correlation coefficients between grades for each element were calculated. The greater degree of similarity implies the greater objectivity of the judges (Mejovšek, 2003; Dizdar, 2006).

Table 2. Correlation coefficients between participants' grades on element traversing

	judge 1	judge 2	judge 3	judge 4	judge 5
judge 1		**0.77****	**0.76****	**0.69****	**0.72****
judge 2			**0.85****	**0.85****	**0.83****
judge 3				**0.77****	**0.79****
judge 4					**0.75****
judge 5					

* p<0.05; ** p<0.01

The obtained correlation coefficients (ranging from r=0.69 to r=0.85) between the five judges for the element traversing are statistically significant.

Table 3. Correlation coefficients between grades for element uphill turn

	judge 1	judge 2	judge 3	judge 4	judge 5
judge 1		**0.80****	**0.80****	**0.80****	**0.81****
judge 2			**0.80****	**0.83****	**0.86****
judge 3				**0.86****	**0.84****
judge 4					**0.84****
judge 5					

* p<0.05; ** p<0.01

All the calculated coefficients in table 3 (r=0.80 to r=0.86) are statistically significant.

Table 4. Correlation coefficients between the grades for element basic turn

	judge 1	judge 2	judge 3	judge 4	judge 5
judge 1		**0.83****	**0.77****	**0.81****	**0.78****
judge 2			**0.86****	**0.91****	**0.87****
judge 3				**0.87****	**0.86****
judge 4					**0.83****
judge 5					

* p<0.05; ** p<0.01

Calculated coefficients in table four range from 0.77 to 0.91 and are statistically significant.

Table 5. Correlation coefficients between grades for short turn

	judge 1	judge 2	judge 3	judge 4	judge 5
judge 1		**0.75****	**0.80****	**0.77****	**0.72****
judge 2			**0.79****	**0.79****	**0.88****
judge 3				**0.82****	**0.82****
judge 4					**0.78****
judge 5					

* p<0.05; ** p<0.01

Correlation coefficients between the five judges for the element short turn are all statistically significant.

Table 6. Correlation coefficients for the element parallel turn

	judge 1	judge 2	judge 3	judge 4	judge 5
judge 1		**0.81****	**0.80****	**0.81****	**0.83****
judge 2			**0.83****	**0.84****	**0.85****
judge 3				**0.83****	**0.84****
judge 4					**0.83****
judge 5					

* p<0.05; ** p<0.01

All the calculated correlation coefficients between the judges for the parallel turn range from r=0.81 to r=0.85, and are statistically significant. Correlation matrices show positive correlation between the judges, and their objectivity during evaluation process of alpine ski knowledge. According to statistically significant correlation coefficients on each ski technique element it could be concluded that determined objectivity is satisfactory and that grades given truly represent the new knowledge of alpine skiing and is not under judges' or circumstantial influence.

This investigation was conducted in order to determine the homogeneity of judges involved in the alpine skiing knowledge grading process of college students. In order to analyze the mentioned data, factor analysis was used. This enabled the homogeneity evaluation and showed the extent of participants' results depend upon the same instrument. Important issue for factor analysis to be considered appropriate are correlation coefficients (given in tables 2 to 6), which showed the statistically significant correlation between five judges on each of the five elements of alpine ski technique as well as (Kaiser-Meyer-Olkin) KMO measure which was 0.92 and Bartlett's test, which was statistically significant (p=0.0).

Table 7. Results of first components of judges during grading of five chosen elements of alpine ski technique

Element of ski technique	Components (factors)	Eigenvalue	% variance
traversing	1	4.12	82.31
uphill turn	1	4.30	86.01
basic turn	1	4.35	87.06
short turn	1	4.17	83.38
parallel turn	1	4.31	86.23

Guttman-Kaiser criterion was used to determine the number of factors needed for the analysis. In Table 7 are eigenvalues of the principal components which fulfil the criterion, i.e. whose results are greater than one (λ=4.12; λ=4.30; λ=4.35; λ=4.17; λ=4.31). According to the obtained results it can be concluded that principal component in this investigation is knowledge of alpine skiing. Table 7 also shows the calculated percentage of variance. For all five elements of alpine ski technique percentages of variance are high, leading to conclusion that principal components participate significantly in the variance of all results. Principal component during grading process of basic turn explains the 87.06% of variance,

followed by parallel turn 86.23%, uphill turn 86.01%, 83.38% short turn and traversing 82.31%. According to GK criterion, these were the only significant components in the investigation. Results suggest that all judges participating in the investigation graded the same item, i.e. alpine ski knowledge.

Discussion and conclusions

The estimation of one's motor skills and knowledge is the aim of many sport scientists. Often used grading system is based on good and poor demonstrations of the particular motor activity (Eggert and Schock, 1997, Kintscher et al., 2001), in order to determine how much the demonstration of the evaluated element varies from the ideal demonstration and to implement the learned and improve the future practice. On the other hand, in schools and universities, Likert's five degree scale is used, which can not be implemented properly in all the learning stages or determination of the final success. This is the reason for the need of homogeneity and objectivity evaluation as basic metric characteristics of judges involved in the grading process of alpine ski knowledge in college students. For the purposes of evaluating alpine ski knowledge it would be best that each student demonstrates the learned knowledge of all ski technique elements. Due to large number of students involved in the investigation and limited duration this would be time consuming and virtually impossible to organize, so analyzed results enable the conclusion that used grading protocol for the purposes of this investigation is objective way of determining knowledge of alpine skiing in college students. It was determined that all the participating judges evaluated the same item in all the chosen elements of alpine ski technique, i.e. the obtained knowledge of alpine ski, so after the performed statistical analysis it is possible to value the grades given by judges as criteria for evaluating the knowledge of alpine ski in college students.

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THE LEVEL OF SPORT ACTIVITY OF STUDENTS FROM THREE INSTITUTIONS OF HIGHER EDUCATION

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Abstract

The purpose of this study was to establish difference in the level of sport activity of students before and after enrolment to the Faculty, and their attitude to participate in their teams. The research was conducted on a sample of 1358 students (encompassing both male and female gender) from three Zagreb's institutions of higher education with majors in humanities and social sciences, and natural sciences and engineering. The results show that about one forth of students never participated in any type of sport activity before the Faculty. On the other hand those who have, where either active in team sports (typically male students) or in sport-recreational activities (typically female students). After enrolment to the Faculty this level of sport activity changes significantly. With less than 10 % of initially inactive male students, this number grew up to 41,53 %, meanwhile in female students this percentage grew from 15,52 % up to 66,45%. The difference among female students is not the reflection of institution they attend or their major, however this is not the case with male students. Participation in recreational sports in three examined institutions of higher education is essentially the same, but differences are noticeable by gender in favor of male students. The percentage of both female and male students that want to compete in team sports and participate in sports union of higher education differs by gender in favor of male students, with no relevant differences among different institutions of higher education.

Key words: *level of sport activity, students, gender difference, higher education institution*

Introduction

Sedentary lifestyle has become, in essence, a global public health problem, especially in developed countries. Many jobs are performed by sitting or with very limited accompanying physical activity and the little free time we have many tend to spent passively in front of the television, computer or in the car. Students, in order to meet their requirements, typically spend more time sitting or being still than the most of working people. Hypokinesis (abnormally decreased muscular movement) has become one of the ten leading causes of disease, invalidity and death (World Health Organization, 2006). Regular, continuous and moderate physical activity is crucial for contemporary men, and it significantly prevents diseases, improves health and positively affects all other aspects of everyday life.

The level of physical activity changes during our lifetime. It significantly drops while studying, especially in urbane areas. Young people spend less and less time participating in activities that require muscle work meanwhile the activities associated with sitting and spending free time passively increases (Casperssen at al., 2000). Reduced physical activity along with inadequate and unbalanced nutrition may often lead to overweight and obesity in puberty and adolescence (WHO Europe, 2004). The fact that among Croatian juniors and seniors every forth female is physically active less than once a week, while overweight and obesity is getting more common among male students, is very worrying (Jureša at al., 2005.). The problems of locomotory system, and others health issues, which were once only the problems of adults, are more and more manifested in puberty and adolescence (Andrijašević at al., 2005).

The institutions of higher education are the best place for promoting the significance of regular physical activity and accepting healthy lifestyle.

Methods

Purpose of the research

The goal of this study was to establish whether there is a significant difference in the level of sport activity among students of three selected institutions of higher education with different majors before enrolment and during their first year of the Faculty, and their aspiration to participate in sport competitions.

The sample of subjects

The research was conducted during winter semester 2007-08 on a sample of first year male and female students of three institutions of higher education in Zagreb. Participants were students from Faculty of Humanities and Social Sciences (FF) with majors in humanities and social sciences, students from Faculty of Science (PMF) with majors in mathematics and natural sciences, and students from The Polytechnic of Zagreb (TVZ) with majors in technical sciences and engineering.

Table 1. Number of male and female students that participated in research differentiated by gender and institution of higher education

	FF	PMF	TVZ	TOTAL
	frequency	frequency	frequency	frequency
male students	220	73	150	443
female students	674	199	42	915
TOTAL	894	272	192	1358

The sample of variables

The data was obtained from student volunteers through an anonymous questionnaire (Prot at al., 2001.) that contained several question groups; general information, past and present sport activities, competing motivations and membership in sport unions of institutions of higher education.

Data processing methods

In processing of data we used standard methods of descriptive and inferential statistics. All obtained data were processed with academically and professionally designated statistical software package, today very well established the Statistical Package for the Social Sciences (SPSS).

Results and discusions

Table 1 and Table 2 show the levels of sport activities of male and female students of three selected institutions of higher education before and after enrolment.

Table 2. The past sport activities of male and female students of three different higher education institutions

What is your current sport activity?	HIGHER EDUCATION INSITUTION- male (M) & female (F) students								
		FF		PMF		TVZ		TOTAL	
		N	%	N	%	N	%	N	%
Never practiced sports	M	28	12,7	5	6,8	8	5,3	41	9,25
	F	114	16,9	26	13,1	2	4,8	142	15,52
Periodical recreational active in sports	M	119	54,1	31	42,5	51	34	201	45,37
	F	410	60,8	107	53,8	20	47,6	537	58,68
Actively practiced sports in school	M	22	10	10	13,7	23	15,3	55	12,42
	F	67	9,9	27	13,6	8	19	102	11,15
Actively practiced sports on regional l.	M	36	16,4	19	26	44	29,3	99	22,35
	F	51	7,6	25	12,6	6	14,3	82	8,96
Actively practiced sports on state level	M	10	4,5	5	6,8	18	12	33	7,45
	F	28	4,2	10	5	4	9,5	42	4,59
Actively practiced sports on international level	M	5	2,3	3	4,1	6	4	14	3,16
	F	4	0,6	4	2	2	4,8	10	1,1

In Table 2 we can see that about 25% of male and female students never practiced in sports throughout their prior education. Altogether, it is noticeable that male students were much more active in competitive sports than their female colleagues, but female students participated more in sport-recreational activities.

Table 3. The present sport activity of male and female students

Do you practice any sport now?		HIGHER EDUCATION INSITUTION - male (M) & female (F) students							
		FF		PMF		TVZ		TOTAL	
		N	%	N	%	N	%	N	%
No	M	115	52,3	28	38,4	41	27,3	184	41,53
	F	454	67,4	129	64,8	25	59,5	608	66,45
Yes - recreational	M	98	44,5	38	52,1	85	56,7	221	49,89
	F	196	29,1	65	32,7	14	33,3	275	30,05
Yes - active	M	7	3,2	7	9,6	24	16,0	38	8,58
	F	24	3,6	5	2,5	3	7,1	32	3,5

The level of sport activity has changed significantly after enrolment to the Faculty. This can be explained with the change of lifestyle that comes naturally when coming to a new environment and the changes that study at a university brings. With less than 10% of inactive students the number went up to 41,53%, meanwhile that percentage among female students went up from 15,52% to 66,45%. The differences among female students did not represent emphasize given at a different institution of higher education or a major, but on the other hand the differences among male students was significant. Recreational participating in sport at all of selected institutions of high education is essentially the same, but the differences are noticeable by gender in favor of male students. Active practicing of sports differs significantly based both on gender and institution of higher education in favor of students of The Polytechnic of Zagreb.

Table 4. The aspiration to participate in the work of the university's sport union

Do you want to be a member of a sport union at your faculty?		HIGHER EDUCATION INSITUTION - male (M) & female (F) students							
		FF		PMF		TVZ		TOTAL	
		N	%	N	%	N	%	N	%
No answer	M	10	4,5	5	6,8	2	1,3	17	3,84
	F	40	5,9	4	2	1	2,4	45	4,92
No	M	151	68,6	50	68,5	101	67,3	302	68,17
	F	493	73,1	175	87,9	36	85,7	704	76,93
Yes	M	59	26,8	18	24,7	47	31,3	124	17,99
	F	141	20,9	20	10,1	5	11,9	166	18,15

Table 5. The aspiration to compete in the sports team of an institution of higher education

Do you want to compete for your institution's sports team?		HIGHER EDUCATION INSITUTION - male (M) & female (F) students							
		FF		PMF		TVZ		TOTAL	
		N	%	N	%	N	%	N	%
No answer	M	5	2,3	7	9,6	1	0,7	13	2,93
	F	41	6,1	11	5,5	1	2,4	53	5,79
No	M	160	72,7	47	64,4	99	66,0	306	69,07
	F	545	80,9	171	85,9	36	85,7	752	82,19
Yes	M	55	25,0	19	26,0	50	33,3	124	28,0
	F	88	13,1	17	8,5	5	11,9	110	12,02

Table 4 and Table 5 show a great aspiration to participate in the work of the institution's sports union and to compete in a sport team of an institution of higher education. In accordance with Sports Act (Official Gazette no.71/06) many sports union of institutions of higher education were founded in order to promote sport and recreational activities. Student sports competition is well organized in all Zagreb's higher education institutions. A number of students engaged in the University's sport competition is increasing over the past few years (Bagarić, Špehar & Zvonarek, 2005.). Organization

of the student University sports competition is managed by the Union of the University Sports Zagreb, Physical education professors and students, Student Core of the University of Zagreb, leaders of the sports, leaders of the Faculty teams and other necessary staff.

The percentage of male and female students who want to compete in team sports and participate in the work of their institution's sports union differed by gender in favor of male students, with little differences between different institutions of higher education.

Conclusions

This study shows the level of sport activity in female and male students of three different Zagreb's institutions of higher education before and after enrolment. By examining their sports history until their college enrolment it can be inferred that male students participated in sports activities in grater numbers than their female colleagues. Sport activity nowadays is increasingly low especially among female students and differences among high education institutions are also noticeable. Participation in higher education institution's sports team is a challenge for almost one third of male students and only one tenth of female students. It should be taken under consideration that this research involved only first year male and female students and that appertaining to their college will likely increase in the following years along with their desire to participate in competing for their team.

A similar research on a large sample of subjects involving a greater number of colleges would likely further confirm and improve study results that could be used to show with higher certainty that there is a statistically significant difference between genders and students of different institutions of higher education.

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DIFFERENCES IN SOME ANTHROPOMETRIC CHARACTERISTICS AND MOTOR SKILLS IN BOYS FROM GREAT BRITAIN AND CROATIA

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Abstract

The research was carried out on a sample of 133 boys aged 14 and 15 from the Republic of Croatia and Great Britain. The aim of the research was to establish potential differences in some anthropometric characteristics and motor skills of the boys who live in these two countries. Six anthropometric measures were taken (height, body weight, body mass index, forearm scope, lower leg scope, and waist size) and five motor tests (bend forward, sit up, chin up, long jump, and polygon backwards). The results have pointed out the differences in the morphological status between Croatian and British boys. These differences can be accounted for by some exogenous and endogenous factors.

Key words: *anthropometric characteristics, motor skills*

Introduction

The development of the morphological characteristics and motor skills is mostly defined by the biotic regularities of growth and development. Conversely, there are certain factors of non-biotic origin which influence that development to a lesser or greater extent. These are a number of various exogenous factors (way of living, diet, living conditions, etc.) which inevitably have a positive or negative effect on particular anthropologic dimensions. Studies carried out on a wider geographical area may enable the acquisition of certain insights about possible differences which are more or less influenced by different internal or external factors. Such studies allow us to estimate the effect of specific factors on the development of specific anthropometric dimensions.

The results of this research are part of the scientific project "Kinesiological Education in Pre-School Education and Primary Education" carried out under the patronage of the Ministry of Science Education and Sports of the Republic of Croatia.

Research aim

To establish the differences in some anthropometric characteristics and motor skills between Croatian and British boys aged 14 and 15.

Hypotheses

H_1 - there are significant differences between Croatian and British boys in some anthropometric characteristics

H_2 - there are significant differences between Croatian and British boys in some motor skills

Methodology

The research was carried out on the sample of 133 boys aged 14 and 15 attending XIII Grammar School in Zagreb, Croatian and Worksop College in Great Britain. Anthropometric and motor measurements have been performed in the morning, upon the pupils' arrival to school.

Six variables were used to assess anthropometric characteristics: LDV-height, VMT-body weight, BMI - Body Mass Index, VMP - forearm scope, VMPOT - lower leg scope, and VMS – waist size. Motor skills were assessed on the basis of five variables: MPR – bend forward (measure for flexibility), MPT – sit up (measure for repetitive strength), MIV – chin up (measure for stamina), MSD – long jump (measure for explosive strength), and MPOL – polygon backwards (measure for coordination).

The performance on all motor skills tests was measured three times. Anthropometric characteristics were measured once. Body Mass Index (BMI) was obtained from the results of body weight and body height. The formula suggested by the CDC (Centre for control and prevention diseases) was used to calculate the Body Mass Index.

$$BMI = ((VMT / LDV) / LDV) * 10000$$

The standard procedure was used to calculate the basic descriptive parameters of every measuring instrument: the Mean and the Standard deviation. Kolmogorov-Smirnov procedure was used to test distribution normality; "t" test and "U" test were used to find the level of significance (p) and the difference in the Mean values; linear and canonical discriminative analyses were used to find the structure differences. The statistics program Statistika 7.1 licensed for the University of Zagreb was used for data analysis.

Results

The anthropometric characteristics and motor skills of boys aged 14 and 15 were assessed in the space of anthropometric characteristics. Descriptive analysis was used to check the basic central and descriptive indicators. The data analysed have shown the distribution abnormality BMI - (max D=0,25 and p<0,01), and MSD – long jump (max D=0,21 and p<0,05) in the subsample of the British boys aged 14. The distribution is negatively asymmetric (-2,48 and -2,98) which points to the grouping of results in the zone of the higher values on the x-axis. Significant differences have been displayed in the anthropometric variable MPR – bend forward as well as the motor variables MPT – sit up, MIV – chin up and MSD – long jump. Croatian boys aged 14 have performed better than the British boys of the same age.

Fifteen-year-old boys displayed great difference in anthropometric variables LDV-height and VMPOT – lower leg scope as well as the motor variables: MPR – bend forward, MSD – long jump, and MPOL – polygon backwards. In this sample Croatian boys have also achieved better results.

Table 1. Basic descriptive parameters of the anthropometric characteristics and motor skills in fourteen-year-old Croatian and British boys

Age: 14	Croatia (N=19)		England (N=53)		p
Variables	Mean	Std.Dev.	Mean	Std.Dev.	(t or U* test)
LDV - Height	171,42	6,73	163,38	33,58	0,3055
VMT- Weight	59,86	11,27	60,32	10,44	0,8728
BMI- Body Mass Index	19,30	5,92	19,47	5,53	*0,5479
VMP- Forearm Scope	24,53	2,01	24,91	2,24	0,5141
VMPOT- Lower Leg Scope	35,32	2,65	35,03	3,35	0,7364
VMS- Waist Size	74,00	7,85	71,55	5,66	0,1494
MPR- Bend forward	50,79	11,08	38,61	9,38	0,0000
MPT- Sit Up	16,44	2,50	14,83	2,78	0,0326
MIV- Chin Up	48,31	29,16	30,79	10,04	0,0009
MSD- Long Jump	201,16	20,69	185,87	35,80	*0,0490
MPOL- Polygon Backwards	10,95	2,90	11,08	2,56	0,8547

Table 2. Basic descriptive parameters of the anthropometric characteristics and motor skills in fifteen-year-old Croatian and British boys

Age: 15	Croatia (N=22)		England (N=39)		p
Variables	Mean	Std.Dev.	Mean	Std.Dev.	(t ili U* test)
LDV- Height	180,77	5,35	174,90	7,88	0,0029
VMT- Weight	71,39	6,75	66,13	12,35	0,0702
BMI- Body Mass Index	21,86	2,01	21,51	2,92	0,6177
VMP- Forearm Scope	25,80	1,27	25,47	2,01	0,5021
VMPOT- Lower leg Scope	37,34	2,29	35,18	3,17	0,0068
VMS- Waist Size	76,93	4,96	77,00	10,74	0,9778
MPR- Bend forward	60,32	13,07	38,44	7,44	0,0000
MPT- Sit Up	16,14	2,62	15,79	3,51	0,6927
MIV- Chin Up	42,46	30,47	34,34	16,23	0,2230
MSD- Long Jump	212,63	25,80	191,38	32,52	0,0123
MPOL- Polygon Backwards	9,77	2,15	11,91	3,65	0,0188

Linear discrimination analysis was used to find the significance differences in anthropometric variables for the subsample of fourteen and fifteen-year olds. The results of both analyses are presented in Table 3. Motor variables are presented in Table 4.

Table 3. Results of the linear discrimination analyses of the anthropometric characteristics in subsamples of fourteen and fifteen-year olds, defined on the basis of the place of residence either in the Republic of Croatia or Great Britain

	Eigen- value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
14-year-olds	0,21	0,41	0,83	11,96	5	0,0353
15-year-olds	0,32	0,49	0,76	14,69	5	0,0117

Factor structure of the linear discrimination functions

	14	15
LDV- Height	-0,30	0,69
VMT- Weight	0,04	0,38
VMP- Forearm Scope	0,14	0,11
VMPOT- Lower Leg Scope	-0,09	0,60
VMS- Waist Size	-0,40	-0,01

Centroids of the discrimination functions

	14	15
G_1:0	-0,72	0,71
G_2:1	0,28	-0,43

The discrimination of the system of morphological variables defined on the basis of belonging to the British or Croatian subsample is significant in both age groups (14 and 15-year-olds). A greater discrimination coefficient has been found in the age of 15, while the discrimination at the age of 14 VMS is mostly contributed by the waist size which is more dominant in the Croatian subsample as well as LDV – body height. LDV – height mostly correlates with the discrimination function at the age of 15. The projection of the centroid points to the domination of LDV – height in the Croatian subsample.

Table 4. The results of the linear discrimination analyses of the motor skills in subsamples 14 and 15-year-olds, defined on the basis of the place of residence in Croatia or Great Britain

	Eigen- value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
14-year-olds	1,02	0,71	0,50	35,43	5	0,0000
15-year-olds	1,51	0,78	0,40	35,43	5	0,0000

Factor structure of the linear discrimination functions

	14	15
MPR- Bend Forward	-0,57	-0,96
MPT- Sit Up	-0,42	0,07
MIV- Chin Up	-0,47	-0,20
MSD- Long Jump	-0,21	-0,24
MPOL- Polygon Backwards	-0,09	0,32

Centroids of the discrimination functions

	14	15
G_1:0	-1,42	-1,29
G_2:1	0,69	1,12

The discrimination of the system of the motor variables defined on the basis of belonging to either English or Croatian subsample is significant in both age groups (14 and 15-year-olds). A greater discrimination coefficient is found in the age of 15, while the discrimination among boys of both age groups is mostly contributed to by MPR – bend forward. It is more dominant in the Croatian subsample as can be seen from the projection of the centroid.

Conclusion

On the basis of the results obtained, the hypotheses H_1 and H_2 are accepted:

H_1 - there are statistically significant differences between Croatian and British boys in the measured variables of anthropometric characteristics

H_2 - there are statistically significant differences between Croatian and British boys in the measured variables of motor skills

This research allows us to conclude that there are differences in some anthropologic characteristics between Croatian and British boys. In the sample of 14-year-old boys, we have found significant differences in the motor skills variables measured (MPR – bend forward, MPT – sit up, MIV – chin up, and MSD – long jump). In the anthropometric characteristics, these differences were not found to be significant. However, in the sample of 15-year-old boys, apart from the differences in motor skills (MPR – bend forward, MSD – long jump, and MPOL – polygon backwards), significant differences in the anthropometric characteristics were found.

The results show that better performance has been demonstrated by the sample of Croatian boys than the sample of British boys. The authors believe that endogenous factors (genetic heritage, earlier beginning of puberty, etc.) as well as exogenous factors (geo-cultural conditions, climate, diet, way of living, etc.) are partly the causes of the difference in results. In order to establish the potential causes of the differences in performance, one would need to carry out additional studies. In these studies a greater number of measures of morphological characteristics and motor skills should be studied as well as the significance of the influence of certain exogenous and endogenous factors on the potential differences between boys who live in the Republic of Croatia and Great Britain.

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RELATIONS BETWEEN VARIABLES OF FATTY TISSUE AND MOTOR ABILITIES OF GIRLS OF THE 5TH CLASS OF ELEMENTARY SCHOOL

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Abstract

The sample of 203 girls of the fifth class of elementary school (11 years old ± 6 months) was applied to the system of 15 variables of which 3 were morphological variables of fatty tissue and 12 variables of motor abilities. The aim of this research was to define their relations and the data were processed by application of canonic correlation analysis. From the cross-correlation martix it is seen that between variables of fatty tissue and variables of motor abilities negative correlation prevails. By Bartlett's Hi-square test (χ^2) two pairs of statistically significant canonic factors were obtained. The first morphological canonic factor was interpreted as fatty tissue while the other one was not possible to be interpreted for poor informative values. In the area of motor abilities the first canonic factor was interpreted as motor agility concerning the fact that its structure consists of body coordination variables, frequency of foot tapping against the wall, explosive strength of arms and legs and repetitive strength of body, and the second as whole body coordination and frequency of arm and leg motion. Concerning the first pair of canonic factors results showed that there is negative correlation between fatty tissue and agility that is the fatty tissue of girls of this age deranges motor motion structures.

Key words: *girls, age of 11, fatty tissue, motor abilities, relations*

Introduction

Definition of relations between motor abilities and morphological characteristics represents the basic and still current both practical and theoretic issue which is of great importance for the possibility to form rational procedures for optimal orientation and selection of children and young sportsmen, planning, control and programming of education and training as well as efficient monitoring of relevant anthropological characteristics development (Findak, 1999).

Concerning this it is well-known that while one type of constitution in one motor activity directly deranges realization of kinetic program the same constitution in another motor activity, of different sex or age, can be very favourable which can be seen in some research (Kurelić, Momirović, Stojanović, Šturm, Radojević & Viskić-Štalec, 1975; Pejčić & Malacko, 2005).

In recent years by appearance and application of multivariate mathematical and statistical methods of data processing the problem of relations between some segments of anthropological status began being solved by canonic and regressive procedure. Although the research of relations were done between almost all analyzed segments of anthropological status in most cases of kinesiological anthropology the research of motor abilities with other segments were done. Research concerning relations between motor abilities and morphological characteristics showed that for both sexes subdermal fatty tissue has great negative effect on indicators of energy output especially on the parts of the body that have more accumulated fatty tissues (Kurelić, Momirović, Mraković & Šturm, 1979).

So the issue that arises concerning this consists of descovering statistically significant relations between particular latent dimensions of corresponding morphological characteristics and some parts of motor abilities which are relevant for particular activities. This way it would be possible on one hand to check and maintain desired anthropological harmony of children of this age and on the other hand implement desired educative and/or training technology and implementation of programs (Malacko, 2005).

The aim of this research was to define statistically significant relations between the system of morphological variables of fatty tissue and motor ability variables of girls of the fifth class of elementary school in order to check, on one hand, possible deranging factors of fatty tissue concerning manifestation of motor abilities and on the other hand, to define the compatibility of their development so that on the basis of this the correct and appropriate projections of their further development could be determined.

Methods

The sample of 203 girls of the fifth class of elementary school (11 years old ± 6 months) was applied to the system of 15 variables of which 3 were morphological variables of fatty tissue and 12 variables of motor abilities.

To assess fatty tissue the following manifesting variables (anthropometric measures) were applied: upper-arm skin fold (UAS), subscapular skin fold (SUS), abdominal skin fold (ABS).

To assess motor abilities the following system of latent and manifesting variables was applied: *body coordination* – 1. passing through and jumping over (PTJ), 2. agility in the air (AGA) and 3. obstaclecourse backwards (OCB); *the speed of motion frequency* – 4. hand tapping (HTA), 5. foot tapping (FTA) and 6. foot tapping against the wall (FTW); *explosive strength* – 7. standing long jump (SLJ), 8. medicineball throw from supine lying (MTL) and 9. 20m run from the standing start (20R); *repetitive strength* – 10. declined sit-ups on the bench (ASB), 11. hyperextension from prone lying (AHB) and 12. undergrip chin-ups on the bar (UCB).

In order to define relations between two different multidimensional anthropological syatems of manifesting variables the method of canonic correlation analysis was applied. The aim of this statistical method is to form linear combination within the system of independent variables so that between these two linear combinations maximum correlation exists.

Results

The table 1 shows the results of central and dispersional statistical parametres of morphological variables of fatty tissue and variables of motor abilities as well as their discrimination. Analysing skewness (Sk), star (*) marks variables that have normal (simetric) distribution which means that the result ranges from 0 – 1.00, while variables with abnormal (asimetric) distribution are interpreted as positive or negative asimetry according to their signs + or - .

By analysis of central and dispersional parametres of fatty tissue variables as well as their discrimination by skewness it is clearly noticed tht all applied variables have abnormal (asimetric) distributions because they exceed values of 1.00, which means that most girls of this age had increased volume of fatty tissue on all measured body segments.

Table 1. Basic statistic parametres and of testing the normallity of the distribution of variables

Variables	M	min	max	S	Sk	Ku
	Skin fold					
UAS	8.01	3.00	23.00	3.28	**1.21**	2.38
SUS	6.29	2.00	27.00	3.17	**2.46**	11.08
ABS	7.61	2.00	33.00	4.61	**1.57**	4.16
	Motor abilities					
PTJ	1837.79	1122.00	2960.00	410.55	**.81***	.25
AGA	705.39	.00	1920.00	237.79	**.17***	6.97
OCB	2184.27	1167.00	3972.00	520.96	**.61***	.43
HTA	23.34	15.00	33.00	2.92	**.41***	.87
FTA	18.33	14.00	24.00	1.63	**.23***	.69
FTW	17.01	4.00	23.00	2.33	**-.70***	4.24
SLJ	136.37	93.00	196.00	17.06	**.29***	.29
MTL	408.86	210.00	680.00	83.68	**.34***	.36
20R	405.48	332.00	469.00	26.35	**-.11***	.30
ASB	2.32	.00	12.00	1.91	1.10	2.68
AHB	10.84	.00	25.00	4.95	**.46***	-.22
UCB	.55	.00	2.00	.58	**.48***	-.68

Legend: **M** - mean, **min** - minimum value, **max** - maximum value, **S** - standard deviation, **Sk** - skewness, **Ku** - kurtosis Morphological variables: **UAS** - upper arm skin fold, **SUS** - subscapular skin fold, **ABS** - abdominal skin fold Motor variables: **PTJ** - passing through and jumping over, **AGA** - agility in the air, **OCB** - obstaclecourse backwards, **HTA** - hand tapping, **FTA** - foot tapping, **FTW** - foot tapping against the wall, **SLJ** - standing long jump, **MTL** - medicineball throw from supine lying, **20R** - 20m run from the standing start, **ASB** - declined sit-ups onthe bench, **AHB** - hyperextension from prone lying, **UCB** - undergrip chin-ups on the bar

Concerning motor ability variables all applied variables show satisfactory discrimination as regards the values of skewness do not exceed 1.00 except for declined sit-ups on the bench variable (ASB) which shows that they are adapted to the examinees and that they are appropriate for future statistical processing and mothodological interpretation and conclusions.

Table 2. Cross-corelation between of skin fold and motor abilities

Varijable	UAS	SUS	ABS
PTJ	**.36****	**.37****	**.39****
AGA	-.00	-.05	-.08
OCB	**.38****	**.34****	**.38****
HTA	-.02	-.04	.00
FTA	**-.21****	**-.21****	**-.16***
FTW	**-.16***	**-.14***	**-.14***
SLJ	**-.26****	**-.24****	**-.26****
MTL	**.21****	**.27****	**.24****
20R	**.34****	**.35****	**.34****
ASB	**-.31****	**-.35****	**-.37****
AHB	**-.30****	**-.36****	**-.32****
UCB	**-.36****	**-.37****	**-.41****
Rc	**Rc^2**	**χ^2**	**p**
.64	.42	142.58	**.00***
.36	.13	36.59	**.02***
.21	.04	9.52	.48

Legend:
Rc - canonic correlation, * $P_{.05}$ = .138
Rc^2 - canonic R - square ** $P_{.01}$ = .181
χ^2 - Bartlett's Hi-square test,
p - level of significance

In the table 2 that shows cross-correlation of variables between fatty tissue and motor abilities it is clearly noticed that girls have statistically significant negative correlations except for the variables of agility in the air (AGA) and hand tapping (HTA).

Determining statistically significant relations between fatty tissue variables and motor variables by Bartlett's Hi-square test (χ^2), it has been established that for girls there are statistically significant correlations (p=.00) concerning the first pair of canonic factor which is .64 (Rc=.64) while concerning the second pair canonic correlation was just .13 (Rc=.13) which is statistically important on the level of .02 (p=.02).

The first morphological factor (table 3) was interpreted as fatty tissue (UAS, SUS, ABS) while the second factor could not be interpreted for its poor informative values. In the area of motor abilities the first canonic factor was interpreted as motor agility concerning the fact that its structure consists of body coordination variables (PTJ, OCB), frequency of foot tapping against the wall (FTW), explosive strength of arms and legs (MTL, SLJ, 20R) and repetitive strength of body (ASB, AHB, UCB) and the second canonic factor was interpreted as whole body coordination (AGA) and frequency of arm and leg motion (HTA, FTA).

Table 3. Structure of canonic factors of skin fold and motor abilities (Fc)

Varijable	Fc - 1	Fc - 2
	Skin fold	
UAS	**.89***	.08
SUS	**.94***	.31
ABS	**.99***	-.12
	Motor abilities	
PTJ	**.61***	-.03
AGA	-.11	**.20***
OCB	**.59***	-.11
HTA	-.01	**-.34***
FTA	-.28	**-.39***
FTW	**-.23***	-.02
SLJ	**-.41***	.05
MTL	**.39***	.25
20R	**.55***	.14
ASB	**-.58***	-.00
AHB	**-.52***	-.34
UCB	**-.63***	.14

Legend:
Fc - 1 = first canonic factor
Fc - 2 = second canonic factor

The first morphological factor (table 3) was interpreted as fatty tissue (UAS, SUS, ABS) while the second factor could not be interpreted for its poor informative values. In the area of motor abilities the first canonic factor was interpreted as motor agility concerning the fact that its structure consists of body coordination variables (PTJ, OCB), frequency of foot tapping against the wall (FTW), explosive strength of arms and legs (MTL, SLJ, 20R) and repetitive strength of body (ASB, AHB, UCB) and the second canonic factor was interpreted as whole body coordination (AGA) and frequency of arm and leg motion (HTA, FTA).

Discussion and conclusions

In statistical methodology it is well-known that interpretation of canonic relations is done the usual way which means that linear value increase of result vector of canonic factor variables from the first anthropological area corresponds to the proportional linear increase of values of result vector of canonic factor variables from the second anthropological area and vice versa but under the condition that between the two examined systems of variables of different areas there is statistically important correlation.

On the basis of the first canonic factor analysis it is clearly shown that girls with increased quantity of fatty tissue (UAS, SUS, ABS) achieve worse results concerning motor agility that is in body coordination variables (PTJ, OCB), frequency of foot tapping against the wall (FTW), explosive strength of arms and legs (MTL, SLJ, 20R) and repetitive strength of the body (ASB, AHB, UCB) and vice versa with less fatty tissue they achieve better results in motor agility.

Although the structure of morphological canonic factor for the second pair of canonic factors could not be well interpreted for its poor informative variable value it can be assumed that reduced values concerning motor variables – agility in the air (AGA), hand tapping (HTA) and foot tapping (FTA) were caused by increased values of subscapular skin fold (SUS).

The results of the research justified the expectations. On the basis of the results got the hypothesis that girls from 11 to 12 years old show statistically significant negative relations between fatty tissue and motor abilities can be confirmed. It is quite possible that this very research is about motor variables which are genetically conditioned and do not represent the result of regular exercising that indicates that at this age and sex the desired harmony between fatty tissue and motor abilities is still not achieved.

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COMPARISON OF BODY WEIGHT SELF–ESTIMATION BETWEEN BOYS AND GIRLS – HIGH SCHOOL STUDENTS

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Abstract

Our investigation was aimed at estimates of appropriate body weight between boys and girls and we compared their real body weight (RBW) with appropriate (estimated) body weight (ABW) considering body height. For our investigation we used a questionnaire as a main research method. Data for 213 respondents (133 girls and 80 boys) aged 15 to 19 years old high – school students from different high – schools in Slovakia were analyzed. Statistical significance of relationship between boys and girls was tested using the Chi – square statistic. We found out that body weight self – estimation in girls is much lower than in boys ($p<0.01$). The level of knowledge in self – estimation (ABW) is better in boys than in girls ($p<0.05$). Furthermore we found out, that physically active boys can better self – estimate their ABW than girls who are physically active (no statistical significance). Better interventions are needed to promote healthy nutrition and physical activity to all adolescents.

Key words: *self – estimation, appropriate body weight, real body weight*

Introduction

Body – image as a part of physical self – estimation has a huge influence at the general self – assessment. Self – estimation of your own body is different from various points of view, for instance by ethnic group, gender, social context, status. Multivariate analysis revealed that sex, age, race, income, education and occupation influenced the misclassification of weight status (CHANG, CHRISTAKIS, 2001; NAWAZ et al., 2001). Satisfaction or dissatisfaction with your own body weight can be reflected in everyday human behaviour. Adolescent girls are more dissatisfied with their weight than boys (ter BOGT et al., 2006). In general, there is a significant tendency to underestimate body weight and over estimate body height (BASTERRA – GORTARI et al, 2007). Concretely, mostly boys with normal BMI want to be heavier, even overweight boys are satisfied with being overweight or want to be heavier comparing normal, overweight and obese girls, who are mostly selecting a smaller ideal body image (GILLIARD et al., 2007).

In our context we were interested how boys and girls estimate their real body weight (RBW) and we compared it with appropriate body weight (ABW) considering their body height. We also wanted to know if they can estimate their ABW correctly (BMI 18.6 – 24.9). As well we evaluated the results by participation in regular physical activity separately for both genders.

Methods

A questionnaire on real body shape (height and weight) as well as self – estimated body weight was contributed to high school students (n = 213) living in different parts of Slovakia. The questionnaire asked 133 girls (BMI average = 20.4) and 80 boys (BMI average = 21.5) to report their current body height as well as body weight and their appropriate body weight to make a self – estimated body weight. Height and weight were used to calculate their actual body mass index (BMI). Parameters for RBW as well as for ABW we had evaluated for each student individually. After that we compared data of real BMI with data of self – estimated body weight for each student individually and finding the correctness of self – estimation of their body weight. By chi – square statistical significance of the relationship in questionnaire was tested.

Results and discussions

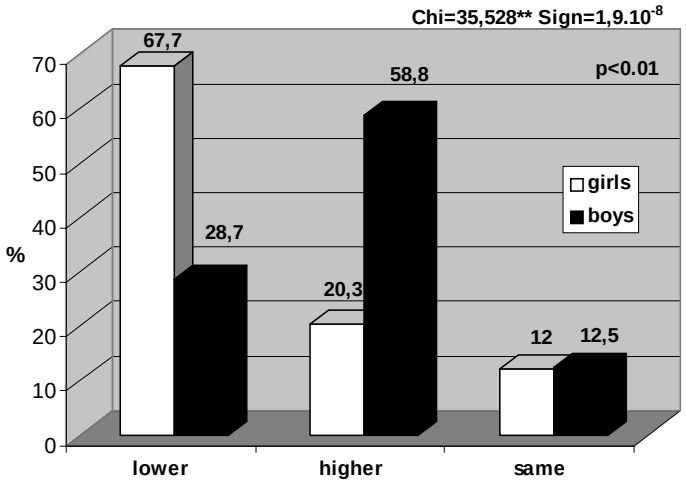


Figure 1. Self - estimation of ABW

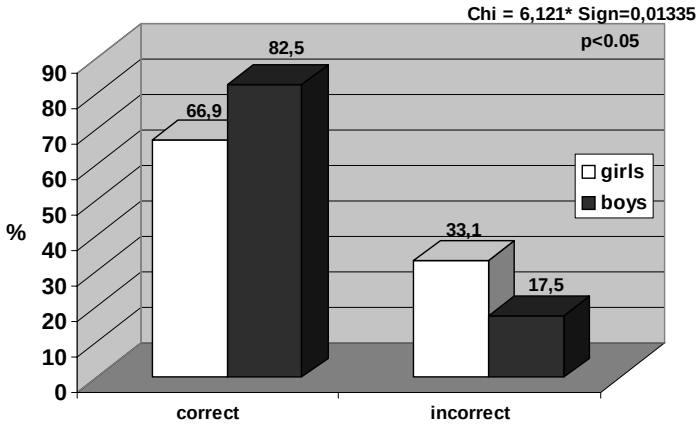
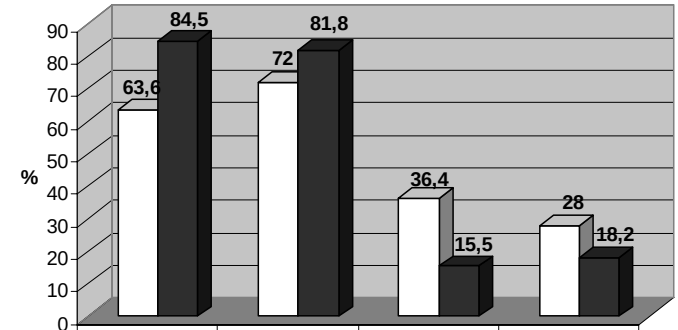


Figure 2. Knowledge in self - estimation of ABW



	correct		incorrect	
girls	63,6	72	36,4	28
boys	84,5	81,8	15,5	18,2

Figure 3. Body weight self - estimation by participation in sport activities

Differences between boys and girls' self - estimation of ABW were highly significant ($p<0.01$). We found out, that girls estimated their ABW lower more often (67,7%) than boys (28,7%) what means that girls want to be thinner than they really are, even their RBW is appropriate considering their body height (figure 1). 38% from those girls who underestimated their ABW (67,7%) considered their ABW under 18.6 of BMI value, what is classified as under nourishment. On the other side boys' self – estimation of ABW was higher (58,8%) than body weight self – estimation in girls (20,3%), what means that boys wish to be heavier than they really are. Those boys, who whished to be lightweight (28,7%), were mostly overweight or obese. Only 12,5% of boys and 12% of girls were totally satisfied with their RBW and they don't want to change it.

Our results further point out significant differences in knowledge of self – estimation of ABW between boys and girls ($p<0.05$). Body weight self – estimation in young boys is better than in girls (figure 2), when boys could better estimate their ABW (82,5%) than girls (66,9%). As I already mentioned above, girls, who showed unsatisfying self – estimation of their body weight (33,1%) mostly assessed their ABW much lower (under 18.6 of BMI) than their actual body weight. This is often bordering with under nourishment. The reason why those young girls represented in many cases too below – average values of their ABW is, that they are under the influence of a social aesthetic, would be a fashion paragon of physical image. In similar case it is also with boys, who want to look like strong, muscular heroes from action movies, that's why they over estimate (17,5%) their body weight (BMI value over 25).

Furthermore in this article we investigated differences in body weight self – estimation considering the participation in sport activity (active and inactive). Relationships between self – estimation of ABW and participation in physical activity were not statistically significant (figure 3). Results show that active boys (84,5%) are better in self – estimation of ABW than active girls (63,6%), who show mostly incorrect assessment of ABW (36,4%). We think, that those girls who are doing regularly physical activity are never satisfied with their body weight and mostly see them selves overweight (36,4%), even their RBW is appropriate according to their age and body height. In other hand boys who are not participating in physical activity showed worse self – estimation of their ABW. Many of them were overestimated their body weight. We think, that they want to see them selves more as (adult) man than a boy, that's why they add some more kilograms to their RBW, even they are overweight or obese.

Conclusions

Results of this study point out quite good self – estimation of body weight in high school students, when 74,7% of respondents could estimate correctly their ABW according to their body height and age ($p<0.05$). High significant differences we found out in comparison of self – estimation of ABW between boys and girls ($p<0.01$), when girls underestimated their ABW and boys overestimated their ABW. In this effort an important part has to be first of all better interventions to promote healthy nutrition, proper liquids and participation in everyday physical activity as a part of long – term active life style and well – being. This should be intermediated to all adolescents by P.E. teachers, parents and trainers.

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RELATIONS BETWEEN MORPHOLOGICAL AND MOTOR-FUNCTIONAL VARIABLES AND THEIR EFFECTS ON AEROBIC CAPACITY OF BOYS AND GIRLS IN THE FIRST CLASS OF ELEMENTARY SCHOOL

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Abstract

The sample of 1028 schoolchildren (509 boys and 519 girls) of the first class of elementary school (7 years old ± 6 months) was applied to the standard battery of measure instruments of 11 variables which is nowadays used in schools in Croatia. Of these 11 variables 4 were morphological and 7 motor-functional. Relations between two different systems of manifesting variables were established by canonic correlation analysis while the effects of the system of morphological and motor variables (as the system of predictory variables) were established on the criterion of aerobic capacity variable – running for 3 minutes (F3) and was calculated by regressive analysis. On the basis of canonic analysis for boys two canonic factors were determined while for girls there were three, on the level of p=.00. By regressive analysis both for boys and girls it was determined that the system of applied morphological and motor variables has a significant statistic effect on aerobic capacity (running 3 minutes - F3) on the level of .00 (p=.00). The results showed that boys and girls of the first class of elementary school have the same level of aerobic capacity of the total anthropological characteristics.

Key words: *relations, effect, aerobic capacity, morphology, motor ability*

Introduction

Determination of relations between morphological characteristics and motor abilities as well as their mutual effect on some relevant motor abilities represent actual kinesiology problems especially with aerobic capacity of boys and girls of the first class of elementary school. This is true not just because there were not enough research done so far but because it is believed that this ability is not enough developed at this age (Malacko & Popović, 2005).

There is almost no human motion structure that consists of cyclic motions that is not under great effect of complex mechanisms of regulation of excitation duration which is responsible for motion structures of moderate intensity in longer period of time where there are mechanisms of energy regulation and creation (Malacko, 2002).

In scientific literature the capacity is most often defined as ability to do certain motion longer with no decrease of efficiency that is longer activity with the same intensity. As the coefficient of innate characteristics is pretty high when capacity is concerned (H^2 =.70-80) there is the possibility of development of this ability but not to a great extent so it is suggested to develop it together with other motor-functional abilities at the earliest possible age of children (Findak, 1999).

While in one motor activity one type of conformation directly obstructs realization of kinetic program the same conformation in another motor activity can be extremely convenient. Concerning capacity research (aerobic capacity) in almost all sport activities depending on the age and/or gender running disciplines are mostly used because they are marked as typical training or competitive activities (Pejčić, 2007; Pejčić & Malacko, 2005).

The intention of this research was firstly to define relations between two different anthropological statuses (morphological and motor-functional) then to define their mutual effect on criterion variable of aerobic capacity (F3) in order to form as rational procedures as possible when planning and programming of teaching and training as well as optimal development of those relevant morphological characteristics and motor-functional abilities which directly or indirectly most contribute development of aerobic capacity of 7 year old children.

Methods

The sample of 1028 schoolchildren (509 boys and 519 girls) of the first class of elementary school (7 years old ± 6 months) was applied to the standard battery of measure instruments of 11 variables which is nowadays used in schools in Croatia. Of these 11 variables 4 were morphological, 6 motor capacity and 1 aerobic capacity.

To assess *aerobic capacity* (as criterion variable) variable of 3 minutes running (F3) was applied.

In morphological area the following latent that is manifesting variables (anthropometric measures) were applied: *longitudinal skeleton dimension* - body height (ATV), *the weight of the body* - body weight (ATT), *body volume* - circumference of forearm (AOP) and *subdermal fatty tissue* - upper-arm skin fold (ANN).

In the area of motor abilities the following latent that is manifesting variabes were applied: *the speed of frequency* – hand tapping (MTR), *explosive strenght* – standing long jump (MSD), *body coordination* – polygon backwards (MPN), *repetitive strength* – sit-ups (MPT), *flexibility* – pull-up hang (MPR) and *static strength* – straddle forward bend (MIV).

In order to define relations between two different multidimensional anthropological systems of manifesting variabes the method of canonic correlation analysis was applied. The effect of the system of morphological and motor variables (as a part of the system of predictory variables) on the criterion variable of aerobic capacity - 3 minutes running (F3) was calculated by regressive analysis.

Results

From the table 1 that shows cross-correlation between variables of morphological characteristics and motor abilities it is clearly seen that boys and girls have statistically negative correlations between morphological variables and variables and explosive strength of legs, static strength of arms and shoulders and aerobic capacity while body height and repetitive strength show positive correlation. In contrast to boys girls have negative correlations between morphological variables and coordination abilities.

Determining relations between morphological and motor variables by calculation of characteristic equations by Bartlett's Hi-square test (χ^2) it was determined that boys have statistically significant correlations (p=.00) with the first pair of canonic factor that is .33 (Rc=.33) while with the second pair the canonic correlation was just .23 (Rc=.23) which is also statistically important on the level of .00 (p=.00). For girls it was determined that there were statistically significant correlations on the level of .00 (p=.00) with the three pairs of canonic factors (Rc=.37, Rc=.27, Rc=.19).

Table 1. Cross-correlation between variables of morphological characteristics and motor abilities

Variables	boys				girls			
	ABH	**ABW**	**ACF**	**AUS**	**ABH**	**ABW**	**ACF**	**AUS**
MHT	**.11***	**.09***	.03	-.06	.07	.04	-.02	-.06
MLJ	-.01	**-.16****	**-.18***	**-.22***	-.01	**-.14****	**-.09***	**-.14****
MPB	.01	.08	.06	.05	**.15****	**.23****	**.16****	**.20****
MSU	.06	-.02	.02	-.08	.05	-.06	.01	**-.11***
MPH	**.09***	-.04	-.08	-.07	**.17****	.06	.04	.00
MFB	**-.10***	**-.20****	**-.15****	**-.12****	**-.09***	**-.29****	**-.27****	**-.26****
F3	**-.09***	**-.19****	**-.17****	**-.12****	**-.14****	**-.17****	-.07	-.04
	Rc	**Rc^2**	**χ^2**	**p**	**Rc**	**Rc^2**	**χ^2**	**p**
1	.33	.11	102.99	**.00***	.37	.14	145.24	**.00***
2	.23	.05	42.56	**.00***	.27	.07	66.23	**.00***
3	.14	.02	14.84	.13	.19	.03	26.63	**.00***
4	.09	.00	4.68	.32	.11	.01	7.16	.12

Legend:

Morphological variables: Motor variables: **Nb** = 509; **ABH** - body height **MHT** - hand tapping **Ng** = 519; **ABW** - body weight **MLJ** - standing long jump * **- $P_{.05}$** = .088; **ACF** - circumference of forearm **MPB** - polygon backwards ** **- $P_{.01}$** = .115; **AUS** - upper-arm skin fold **MSU** - sit-ups in 60 sec **Rc** - canonic correlation; **MPH** - pull-up hang **Rc^2** - canonic R - square; **MFB** - straddle forward bend **χ^2** - Bartlett's Hi-square test; **F3** - running for 3 min **p** - level of significance

On the basis of calculated matrices of canonic factors' strucure in the area of morphological variables (Table 2) it is clearly seen that both with boys nad girls the structure of the first canonic factor consists of variables of body weight (ABW), circumference of forearm (ACF) and upper-arm skin fold (AUS) so it has been interpreted as a canonic factor of body weight and fatty tissue. As the structure of the second morphological canonic factor both with boys and girls is just one variable – body height (ABH) it has conditionally been interpreted as longitudinal dimension of skeleton.

In the area of motor abilities the first canonic factor both with boys and girls has been interpreted as explosive and static strength, body coordination and aerobic capacity because it is defined by variables – standing long jump (MLJ), straddle forward bend (MFB), polygon backwards (MPB) and 3 minute running (F3). The second canonic factor for boys was interpreted as the speed of frequency, repetitive strength and flexibility concerning the fact that its structure consists of variables - hand tapping (MHT), sit-ups (MSU) and pull-up hang (MPH). For girls the second canonic factor

was interpreted as canonic factor of the speed of frequency and flexibility concerning the fact that its structure consists of variables – hand tapping (MHT) and pull-up hang (MPH). Since the third factor for girls is defined just by the variable sit-ups (MSU) it is conditionally defined as repetitive strenght.

Table 2. Structure of canonic factors (Fc) of morphological characteristics and motor abilities

Variables	boys		girls		
	Morphological variables				
	Fc-1	**Fc-2**	**Fc-1**	**Fc-2**	**Fc-3**
ABH	-.40	**-.75***	.60	**.74***	-.12
ABW	**-.93***	-.30	**.98***	.08	-.01
ACF	**-.86***	-.03	**.75***	-.08	-.61
AUS	**-.65***	.53	**.71***	-.46	-.17
	Motor variables				
	Fc-1	**Fc-2**	**Fc-1**	**Fc-2**	**Fc-3**
MHT	-.13	**-.67***	.07	**.40***	.40
MLJ	**.64***	-.54	**-.40***	.33	-.26
MPB	**-.27***	.04	**.65***	-.03	.11
MSU	.12	**-.40***	-.22	.48	**-.70***
MPH	.25	**-.50***	.16	**.57***	-.19
MFB	**.59***	.15	**-.80***	.41	.29
F3	**.59***	.06	**-.42***	-.31	-.40

Legend:
Fc - 1 = first canonic factor; **Fc - 2** = second canonic factor; **Fc - 3** = third canonic factor

By analysis of table 3 it can clearly be seen that predictor system of morphological and motor variables on criterion variable 3 minute running (F3) has multivariate and statistically important effect on the level of .00 (p=.00).

By univariate analysis of predictor system of morphological variables it can be seen that for boys no variable has statistically significant effect on criterion variable 3 minute running (F3) while for girls the negative effect has just body weight (ABW). Among motor variables for boys statistically significant effect on the level of .00 (p=.00) on criterion variable have the following variables – standing long jump (MLJ), sit-ups (MSU) and straddle forward bend (MFB) and for girls - standing long jump (MLJ) and polygon backwards (MPB) on the level of .05 (p=.00) that is .00 (p=.00).

*Table 3. Effects of predictor system of morphological and motor variables on criterion variable running for 3 min (**F3**)*

Variables	boys			girls		
	Morphological variables					
	β	**t**	**p**	**β**	**t**	**p**
ABH	.02	.43	.66	-.03	-.59	.55
ABW	-.15	-1.86	.06	-.27	-3.34	**.00***
ACF	-.05	-.87	.37	.12	1.74	.08
AUS	-.02	-.49	.62	.05	1.00	.31
	Ro = .20 **Ro²** = .04 **F** = 5.30 **p = .00***			**Ro** = .20 **Ro²** = .04 **F** = 5.48 **p = .00***		
	Motor variables					
	β	**t**	**p**	**β**	**t**	**p**
MHT	.02	.65	.51	-.02	-.47	.63
MLJ	.12	2.80	**.00***	.09	1.90	**.05***
MPB	-.02	-.63	.52	-.14	-3.04	**.00***
MSU	.19	1.32	**.00***	.08	1.82	.06
MPH	.05	1.38	.16	.06	1.41	.15
MFB	.14	3.31	**.00***	.06	1.47	.14
	Ro = .33 **Ro²** =.11 **F** = 10.88 **p = .00**			**Ro** = .27 **Ro²** = 07 **F** = 7.03 **p = .00**		

Legend:
Ro - multiple correlation; **Ro²** - multiple Ro - square; **F** - F - test; **p** - level of significance

Discussion and conclusions

On the basis of the first pair of canonic factors boys and girls achieve better results in explosive and static strength, body coordination and aerobic capacity if they have reduced values in variables concerning body weight and fatty tissue and vice versa they achieve worse results in the mentioned motor variables if they have higher values of body weight and fatty tissue.

In the second canonic factor boys achieve reduced values concerning the speed of frequency of arm, repetitive strenght of sit-ups and flexibility if they are shorter and vice versa in the mentioned motor variables they achieve increased values if they are higher. Girls achieve increased values in the speed of frequency of arm and flexibility if they are higher and vice versa they achieve reduced values in mentioned motor variables if they are shorter. Since in the third canonic factor the repetitive strength is independent it is impossible to analyze its relations with morphological variables because the isolated motor factor for its poor informative value could not be defined.

The results of regressive analysis of 7 year old boys and girls show that the whole system of applied morphological and motor variables has statistically significant effect on aerobic capacity (running for 3 minutes – F3) on the level of .00 (p=.00) both for boys and girls. It concretely means that when aerobic capacity of children in the first class of elementary school is concerned morphological characteristics and motor abilities participate equally. This shows that boys and girls of this age demonstrate their aerobic capacities on integral basis with visible difference among sexes. Concerning aerobic capacity boys achieve better results on the basis of statistically significant effect of variables of topological strength - explosive strength of legs, repetitive strength of stomach muscules and static strength of arms and shoulders. Concerning girls and aerobic capacity they on one hand achieve better results on the basis of statistically significant positive effect of variables of explosive strength and body coordination while on the other hand there is a negative effect of body weight as it could be assumed.

On the basis of the results of this research it can be concluded that boys and girls in the first class of elementary school do not have enough and equally developed aerobic capacity and this capacity is just a part of complex anthropological characteristics. This shows that when working with boys and girls of this age a higher attention has to be paid to application of special programs that are more oriented on development of motor abilities that contribute to achievement of better values concerning development of aerobic capacity.

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PHYSICAL EDUCATION IN A HIGHER EDUACTION SYSTEM OF THE REPUBLIC OF CROATIA: AN EXAMPLE OF PROFESSIONAL STUDIES

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Abstract

Higher education Law act (NN 54/96.) sets the foundation of dual system of higher education according to whom the higher education degree in the Republic of Croatia is achieved at a university and professional studies level. This sets a new dimension for a development and affect of Physical education (PE) that, according to a number of newly founded institutions, is not to be ignored. The aim of this paper is to show a position and role of PE in a higher education system of the Republic of Croatia at an example of professional studies and it covers a research of PE course presence and a status of professional teacher at Croatia's polytechnic studies, public schools of professional higher education and private schools of professional higher education. The insight into curriculum of the institutions brings out differences in presence and status of the course, as well as professional teachers of PE.

Key words: *PE course, professional teachers, public and private professional higher education*

Introduction

Higher education Law act (NN 54/96.) sets the foundation of dual system of higher education according to whom the higher education degree in the Republic of Croatia is achieved at a university and professional studies level. Higher education institutions are universities, polytechnics and schools of professional higher education together with all its constituents. Polytechnic and school of professional higher education are institutions that organise and implement professional studies. Polytechnic is a kind of school of professional higher education that implements at least three different studies in at least three fields. There are currently 12 public polytechnics, 2 public schools of professional higher education, 1 private polytechnic and 17 private schools of professional higher education in the Republic of Croatia. In accordance to Ministry of science education and sports data from 2005. 37% of students are studying at a professional, and 63% at university studies. In the 2005/06. academic year total amount of students at croatian higher education institutions equals up to 150.000 – 160.000 students; 130.000 at a university, and 12.000 at a professional level (7500 at public schools of professional higher education and 5000 at private schools of professional higher education). The projections of the Ministry department expect an increased entry to professional studies up to proportion of 60%:40%, and regarding the pre-existing conditions reflecting an increase of professional studies institution as well as an increase in the number of students, we hold it as a matter of priority to explore a position and role, same as a status of professional teachers of PE at croatia's polytechnic and professional higher education institutions, especially regarding a position and role in an education of a great number of professional studies students. Notably in accordance to the fact that a science stand manifests by a presence of the course in an educational system (Šporer, 2006).

Methods

A research was conducted during the February 2008. and it included all 32 substantive institutions executing professional studies in the Republic of Croatia, 14 of them being public and 18 private character. The methods used were content analysis - by analising curriculums of all institutional studies in a 2007/08. academic year and a telephone questionnaire. The relevant data was gathered on the internet resuorces of the institutions and through the personal oral contact with administrative services of the institutions.

Zero hypothesis (set in regard to researches age-long expirience through the work at polytechnic studies) are: the apearance percentage of PE course is higher at public than privat institutions; there is a correlation between the appearance, ECTS scoring, hourly vages of coure and a status of professional teacher at institutions; higher percentage of full-time employed professional teachers at public institutions; there is a great possibility for professional teachers full-time employment in a system.

Regarding the structure and organization of the institutions throuhg departments and studies is unequal and therefore improper for correlation: the main comparable variable was a number of professional studies. Comparative quantitative analysis is done on the ground of appearance of the PE course at a particular professional studies, and the other analysed variables are: the notion of the course, the number of ECTS points, the number of semesters, hourly wages of the course, an employment status of a professional teacher and total amount of students participating in a PE course.

Results

From the total sum of 32 institutions the PE course is present at 14 institutions or 43,75%. Regarding the fact that the structure and organization of those institutions throuhg departments and studies is unequal and therefore improper for correlation: the main comparable variable was a number of professional studies. Overall number of professional studies amounts up to 102. The PE course is present at 66 professional studies or 64,70%. Considering the total amount of professional studies 44 (43,13%) belong to an area of social, 39 (38,23%) of technical, 12 (11,76%) of biotechnical, and 7 (6,86%) of biomedical and health sciences. It is notable to point out how according to the Bylaw of scientific and arts area, fields and branches of National council of science kinesiology belongs to social science's area, field 5.07. Educational sciences, branch 5.07.04. and yet it's presence in the field of social sciences professional studies number far below the average – only 44,18%. In comparison to the record of 64,10% presence at technical professional studies it's a great surprise, and non-existence of PE course at biomedical and health sciences studies is almost unlikely. Biotechnical professional studies have the highest presence 90,90% of PE course.

The research reveals anomalies in ECTS scoring of PE course. The great amount of institutions does not appoint ECTS scores to the PE course 78,57%. The exceptions are Polytechnic of Karlovac appointing 1 ECTS, College of agriculture at Križevci appointing 2 ECTS and Higher school for business and governance with public privilege "Baltazar Adam Krčelić" at Zaprešić appoints 3 ECTS by a semester.

Hourly-wages on weakly bases is principally 0 lecture + 2 practise hours (at 92,85% of institutions) with exception of Polytechnic at Zagreb: 4 professional studies of II. Semester (Building construction, Civil engineering, Construction enterprises and Environment in construction) courses weekly based hour-wages are 1 lecture + 2 practise.

The length of PE course performance is fluctuating. The majority of 9 (64,28%) institutions has presence of the course at 4 semester (freshmen and second year of studies) 3 (21,42%) institutions with 2 semester and 2 (14,28%) institutions with 6 semesters performance.

A new segment in our analysis is a status of professional studies PE course teacher and a perspective for their employment in a system. In the present academic year 2007/08. the total amount of students in the professional studies system of the Republic of Croatia present at a PE course is 6369. At present time there are only 4 lecturers, 1 senior lecturer and 5,5 assistant lecturers with full - time employment status and 19 professional teachers in a status of associates. In accordance to regulations concerning Collective agreement for science and high school education (NN101/02, 81/03, 203/03, 28/06) labour standardization is set in a practical classes of PE up to 40 students in a group (paragraph 25.). This regulation is applicable to internal and external teachers and lecturers engaged in the educational process (paragraph 24.). In accordance to the facts mentioned above the system can instantly accept a full-time employment of 58 B.A.'s of kinesiology as an assistant lecturer, or 37 professional teachers fulfilling minimal conditions as a lecturer vocations.

Ownership analyses - private apropos public institutions has shown a rate of 14 (43,75%) public institutions : 18 (56,25%) private institutions. The presence analysis of PE course by public/private sector institutions sums 10 (71,42%) : 3 (16,66%). Public professional studies amount 72 (70,58%), and private 30 (29,42%). The presence analysis of PE course in connection to ownership analysis makes an odd figure: 57 (79,16%) presence on public professional studies and 6 (20,00 %) presence on private professional studies. The fact is that in the structure of private studies there are no studies of biotechnology or biomedical and health scientific field. There are 8 (26,66 %) studies in the field of technical and 22 (73,33 %) in the field of social sciences. At private technical sciences sector PE course is present at 1 (12,50 %), and private social sector 5 (22,72 %) of professional studies.

Geographic analysis has shown an appearance of professional studies institutions across the Republic of Croatia, but the highest concentration of the studies and institutions in the capital Zagreb. There are 16 (50,00 %) of total institutions in Zagreb, thereof 2 (12,50%) of them with the appearance of PE course, one of them in public, and the other one in private sector. The total sum of professional studies in the capital is 41 (40,19%) of total professional studies in the Republic of Croatia and 17 (41,46%) of them carry out PE course.

Discussion and conclusions

A matter of status and perspective of PE course and professional teachers is in a direct regard to a context of a modern society with an overall of positive and negative implications. The undoubtedly troublesome research results inquiring the youth abilities are the fact; their skills are in disproportion to a physical growth. A root to this unfavourable trend is hypokinezy as an attribute of a modern lifestyle and its exact outcome becomes physical and psychic dissipation in

proportion to a quantity of motion need (Findak, 1999.). The role of PE is grounded on biological, economic, pedagogic and cultural values of its area, and its aim is to settle bio psychosocial motives for motion as an expression of fulfilment of human needs increasing adaptive and creational abilities in a contemporary working and living conditions emphasizing a development of PE to prevent and improve its own, and the environment health (Findak, 1992.).

Our point of view stands on the following ground: is there a need for an additional argument to improve a status of PE course as well as professional teacher's percentage of full-time employment in the polytechnic studies, public schools of professional higher education and private schools of professional higher education institutions of the Republic of Croatia.

Just as Laporte notes that European Union needs to find a common framework which can be developed in a common European vision in a field of PE teacher system (Laporte, 1998.) we apply the same principle to our issue of professional studies and a role of PE in this field. Croatia in its precession processes needs to get informed and adjusted to European Unions standards in this field as well. There is a great deal of business ahead of us, but the German PE in the 1980s for example was in a transition of the PE curriculum and concepts of teaching PE. "Budget cuts, higher unemployment rates of PE teachers, and reductions of curriculum time allocation were three major phenomena to occur in other European countries as well. A clear process of European exchange of all previous concepts and currently renewed major vectors of development is visible. This process sits alongside an intention to balance the educational purpose of former core concepts of PE and this has led to new minor vectors of curriculum development ("in-between approaches") in some other countries. If this process of diffusion is termed as a total "harmonisation" of PE concepts in Europe, it may be the case that if this process is called "diversification" of former national PE concepts, it represents a European spectrum of vectors of PE development in this new millennium." (Naul, 2002.)

This trend to harmonisation was clearly articulated in the 1999. Bologna Agreement to create a common model for Higher Education in Europe with member states subsequently encouraged to elaborate a framework of comparable and compatible qualifications for their higher education systems, which should seek to describe qualifications in terms of workload, level, learning outcomes, competencies, and profiles. Hence, the European Commission funded thematic three-year project Aligning European Higher Education Structure in Sport Science (AEHESIS), which amongst others items will collate intelligence on the extent of implementation of the Bologna Process through identification of common elements (congruence), as well as any areas of specificity and diversity amongst higher education institutions across Europe. From the findings of the project's first two years, it is possible to draw inferences regarding the extent of harmonisation in European institutions and countries. Whilst it is obvious that ECTS interpretations are neither European-wide nor are credit 2 numbers and study load weightings required for a qualification consistent across institutions. The harmonisation process is well underway with broad agreement on concept and aims, which transcend cross-national divides and with relevant policies and structures already in position. On the other hand harmonisation is congruently represented in programme names and academic/vocational orientations, programme entry requirements, teaching methods, assessment and evaluation procedures, quality assurance measures, generic and physical-education-specific competences and not unsurprisingly first job destinations. In an effort to come closer to an ideal it is necessary not only to direct, but to educate young people in the spirit of PE through all stages of their education.

At the very end of this paper we are setting a number of questions indicating a future research of this problem we just slightly opened here (and hopefully provoked a fruitful polemics in professional and scientific circles). Would it be too pretentious to demand implementation of PE course to every social professional study? Is there a justifiable reason for non-existence of PE course at biomedical and health professional studies? Is there a need for a kinesiology profession to insist on implementation of the obligatory rule for the presence of the PE course in the statutes of the professional studies institutions (exemplar to The Statute of Zagreb University (paragraph 69., alinea 12.)) and appointment of appropriate figure of ECTS points?

Our hope is that systematic research of the Croatian, but at the same time future European problem at professional, but university level as well, just as its consideration from older, eminent colleagues can bring out a solution that will make us kinesiologists in this part of educational system proud.

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THE CHANGES OF THE MANIFEST MOTOR ABILITIES IN SCHOOL CHILDREN UNDER THE INFLUENCE OF THE EXPERIMENTAL PROGRAM OF SPORTS WALKING

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Abstract

The aim of the research is the analysis of the influence of the experimental program of sports walking in the teaching of physical education (EPSH) on the increase of the motor abilities of elementary school children. 13 tests of the motor abilities have been applied. The influence of EPSH on the increase of the motor abilities has been tested on the sample of 197 pupils of the fifth grade, aged 11±6 months. The given experimental program of sports walking has influenced positively the improvement the motor abilities.

Key words: *motor abilities, sports walking, boys*

Introduction

Sports walking in the Olympic athletic program contains the 20 km and 50 km races in the men and 20 km in the women competition (Ruchlewitz et al., 2006). The training of walkers is directed to the increase of the cardiovascular capacity, the strength of the upper part of the body and the flexibility of the arms, torso, hips and legs. In addition, it is emphasized on the maintenance of the regular technique. (Raković & Aleksandrović, 2006). Of the motor abilities, the long year training work of sports walking influences: the aerob endurance, the explosive strength, the basic body strength, the speed of alternative movement and the coordination (Milanović et al., 1991). Because of such positive influences on the general motor strength, it is useful for the adapted program of sports walking to be a part of the teaching process in physical education.

The aim of the teaching of physical education is the positive transformation of the motor abilities. Each program which satisfies this aim is considered to be successful. That is why each innovation, each new teaching content which satisfies this condition is welcomed.

The aim of the research is the establishment of the influence of the experimental program of sports walking in the teaching of physical education on the improvement of the motor abilities of elementary school pupils.

Method

The Experimental Program

The specially designed Experimental program of sports walking (EPSH) in the teaching of physical education is acceptable for the organization because it does not require the use of special objects, devices and equipments. The basic activity of the tested in the realization of the program is walking and running. In the preparatory phases each hour the complex of the exercises of forming is used. The interval method is used with the different combination of running and active phases (easy running and walking). In the beginning of training process shorter parts of walking and longer parts of running are applied in order to reach the inverse relation gradually to the end of the program by different combinations.

EPSH is realized three times a week (Monday, Wednesday, Friday) lasting 45 minutes each. In each class the introductory and preparatory part lasts 15 minutes, equal for all the tested who make 6 groups of 50 tested each. The basic part of the class is conducted in the 6 groups of 5 to 10 of the tested. The final part of the class consists of easy running with the gradual transfer to walking up to 500 m.

The population out of which the sample of the tested has been taken is defined as the population of the fifth grade pupils of elementary school. The total sample was represented by 197 boys, aged 11 ± 6 months, from four towns in south Serbia, included in EPSH.

The system for the estimate of the motor abilities is represented by the following tests (Kurelić & al., 1975): standing long jump (MSDM), standing triple jump (MTRS), the rising of the body on the Swedish desk (MDTK), pushups (MSKL),

deep forward bend on the small desk (MDPK), head-on splits (MČSP), side splits (MBSP), leg tapping (MTAN), running at 40 m from the high start (MT40), running at 60 m from the high start (MT60), transversal standing on the small desk for balance (MRUS), standing along the small desk for balance (MRUS), standing along the small desk for balance with eyes closed (MRZO).

Aiming to test the differences between the final and the initial measuring on the univariant level, the univariant analysis of the varians ANOVA has been applied, with the help of which the differences of the arithmetic means have been tested with the help of F test. The significances of the differences are establish on the level p=.05.

Results and interpretation

In the table 1. the results of the differences in the motor abilities between initial and final measuring on the univariant level are presented. By its analysis it can be stated that there is the difference between two measuring in almost all questioned variables. Statistically significant difference for the benefit of the final testing has been spotted in 11 out of 12 variables of the explosive and repetitive strength (MSDM, MTRS, MDZTK, MSKL), flexibility (MDPK; MČSP; MBSP), speed (MTAN, MT40, MT60) and balance (MRPS, MRZO). On the border of significance is the variable of balance - MRUS, standing along the small desk for balance.

Table 1. The significance of the differences in the motor abilities between two measuring

Variables	Measuring	Mean	Sd	F	p
MSDM	Final	161,28	17,741	14,314	**0,0002**
	Initial	154,57	17,704		
MTRS	Final	498,93	51,303	4,254	**0,0398**
	Initial	487,86	55,987		
MDTK	Final	21,29	6,921	12,237	**0,0005**
	Initial	18,84	7,113		
MSKL	Final	9,72	4,395	16,981	**0,0000**
	Initial	8,02	3,836		
MDPK	Final	33,75	8,404	41,026	**0,0000**
	Initial	28,52	7,919		
MČSP	Final	155,49	15,449	39,657	**0,0000**
	Initial	145,57	16,051		
MBSP	Final	154,41	15,998	31,439	**0,0000**
	Initial	145,41	16,087		
MTAN	Final	24,99	3,532	22,960	**0,0000**
	Initial	23,39	3,135		
MT40	Final	7,13	0,631	4,622	**0,0322**
	Initial	7,27	0,642		
MT60	Final	10,45	0,761	5,446	**0,0201**
	Initial	10,62	0,753		
MRPS	Final	4,99	0,650	5,600	**0,0184**
	Initial	4,84	0,626		
MRUS	Final	6,98	0,958	2,965	0,0858
	Initial	6,82	0,941		
MRZO	Final	4,55	0,594	6,414	**0,0117**
	Initial	4,41	0,537		

Discussion and conclusions

On the basis of the results of this research and the set aims the following conclusion can be drawn:

1. EPSH has positively influenced the increase of the tested motor abilities of the pupils – of the explosive and repetitive strength, speed, flexibility and balance. By that the basis aim of the teaching of physical education has been reached.
2. The content of EPSH may serve as a model for the realization of the training teaching work with the tested of this age.

3. This research gives a greater scientific contribution to the sports practice, that is, the increase of the interest for sports walking. The positive influence EPSH influences positively the motivation for the sport doing (in this case sports walking), because in a short time interval the basic technique of a new sport can be adopted.
4. The carrying out of EPSH is cheap, because not a lot of teaching aids in work are needed. That would be a contribution to the rationalization of the teaching process.

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PHYSICAL FITNESS OF STUDENTS IN THE EMERGENCY MEDICAL CARE STUDY PROGRAMME

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Abstract

The bachelor study program "Emergency Medical Care" focuses on training professional rescue workers who are qualified and competent to provide urgent premedical care and life-saving procedures. In a matter of fact in Slovakia hardly any investigation has been done on professional emergency care. On that account it is necessary to determine and specify requirements of motor performance that could allow with as high probability as possible to predict criteria included medical, technical as well as supporting motor profile within the whole complex of the profession's profile.

Key words: *condition, coordination abilities, emergency medical care*

Introduction

All professions have their specific motor tasks and they are more or less physically demanding. Partial scientific studies determining the kinetic particularities of individual professions make possible to particularize and improve profession's profile and professional preparation.

The bachelor study program "*Emergency Medical Care*" focuses on training professional rescuers who are qualified and competent to provide urgent paramedical care and life-saving procedures. Graduates can work in the component parts of the integrated rescue system, in the sphere of premedical urgent health care, clinical health care in hospitals in casualty and emergency departments, intensive care units, critical care units, management of rescue health care, in the sphere of research, in education institutions, military health care units, fire squads and others units delivering life and health saving services.

It is unquestionable that there are high physical demands of the career of emergency care. Many contemporary professions need to the great extent movement intelligence and dynamic variety of coordination abilities. Naturally, differentiation is necessary because the physical demands differ according to the job-specific task that rescue workers have to execute. Increased physical demands of this profession must be taken into account regarding the number of female candidates of this profession as well as the number of women having already executed this job. It is obvious, regarding the safety of the professional rescuers that they need to be in an excellent physical condition to be able to do such demanding job for a long time. It can be supposed that rescue tasks such as hoisting tasks, saving victims are related to factors such as stature, body mass, push-up scores, sit-up scores, endurance. A high level of muscle strength and muscle endurance, mostly of the trunk and lower limbs is necessary to execute the professional tasks easily and prevent injuries of the lower back (*Lemon & Hermiston, 1977 in Claessens, A.L. et al., 2003*).

The police, the military, the rescue mountain system or the fire brigade have already defined the criteria for required level of physical fitness and general motor performance as well as for exercise programmes to enhance and maintain optimal level of motor preparadness in these professions. However, up to this day there have still not been defined key points for consolidation essential requirements that concern optimal level of motor performance in candidates of professional rescue. There is being an absence of the conceptual framework for exercise programmes to enhance physical fitness of students in the mentioned study programme.

More detailed insight to the motor characteristics of examined professional rescuers provides a specific orientation on the problem of motor abilities diagnostics. It indicates what items the test battery should include so that its information value approximated to the structure of motor abilities in examined age group as much as possible. Research in condition abilities was preferred to the coordination ones and as a result the knowledge on the coordination sphere of motorics was stratified as well as their relations to the physical factors. Probably conditionality of coordination abilities by sensorial and psychical dispositions causes questionable selection of means in diagnostics. It is to be stressed that condition and coordination abilities form mutual motor fundamental and their isolated examination looses a part of its justification (*Měkota, 2000*).

In a matter of fact in Slovakia hardly any investigation has been done on professional emergency care. On that account it is necessary to determine and specify requirements of motor performance that could allow with as high probability

as possible to predict criteria included medical, technical as well as supporting motor profile within the whole complex of the profession's profile. The purpose of this study is a determination and a partial analyse of the motor performance of students of a bachelor study program "*Emergency Medical Care*" within their undergraduate preparation. We expect some differences in the level of condition abilities between the group of men and women. Coordination abilities are not signicantly influenced by sex factor in this examined age group.

Methods

The sample consisted of 36 students in the bachelor study program "Emergency Medical Care" at Faculty of Health, University in Prešov, Slovakia. Two groups were formed - 18 men, 17 women. The mean age of the male group was 21.7 years and the female group was 19.3 years. The subjects were informed of the purpose of this study and the test procedures during special information sessions. All tests were performed at the beginning of the term in the first study year. Physical condition was determined using the EUROFIT test battery. This battery consists of 9 tests which measure the basic motor capacity of the subjects (Council of Europe, 1993): 1. flamingo balance - static balance (with some difference in the execution), 2. plate tapping - frequency speed of an arm, 3. sit and reach - joint flexibility of a trunk, 4. standing broad jump - explosive strength of lower limbs, 5. hand grip - static strength of a dominant hand, 6. sit-ups - dynamic and endurance strength of abdominal, coxal and thigh muscle, 7. bent arm hang - static and endurance strength of upper limbs, 8. shuttle run 10x5 m - speed with change of way, 9. endurance shuttle run - run endurance. The stature and body mass were measured by using the physical tests - 10. weight, 11. height and 12. sum of skinfold, included in Eurofit.

Six additional motor tests (Hirtz, 1985; Měkota - Blahuš, 1983, Belej - Junger et al. 2006) were used to determine the space of coordination motor abilities in more detail: 13. jump on a mark - kinaesthetic differentiation, 14. run towards balls - orientation ability, 15. random drumming (n) – rhythmical ability, 16. Stick catching – reaction ability, 17. complex motor test – ability of joining the acyclic movements, 18. cock-shot – ability of adaptation and transfer of movements.

After the test session descriptive statistics (Mean, SD) were calculated for the group of men and women. Possible differences between the groups were explored using t-tests for independent samples. The significance level was set on p = 0.05 and 0.01. The relation between the individual indicators was explored by correlation analyses (r).

Results

The descriptive statistics (Mean, SD and t-values) of the groups of men and women are presented in Table 1. The analyses of variance demonstrate that there are significant differences between the group of men and women in all examined anthropometric characteristics and in the level of six in seven condition abilities. The results of t-tests demonstrate that there are significant differences between the groups of men and women at only three coordination dimensions in eight having been examined. At the same time, significantly higher level of body fat was noticed in the group of women.

The significant correlations between all examined motor and anthropometric characteristics in the groups of men and women as well are presented in Table 2. It was decided to present only significant correlation coefficients to be more transparent. The results indicate that in the group of men static balance, explosive, static, endurance strength, muscle endurance and rhythmical ability are found in significant correlations with more than three other abilities. The partial relations among the examined motor components and anthropometric indicators in the group of women differ from men. Ability of joining the acyclic movements is found in significant relations with the highest number of abilities. This is an indication that there are some differences between the groups of men and women in the partial structure of motor and anthropometric characteristics.

Table 1. Descriptive statistics of the anthropometric and motor characteristics in the groups of men and women, t-values between men (n = 18) and women (n = 17)

	Men		Women		
Dimension	*Mean*	*SD*	*Mean*	*SD*	*t value*
1. Flamingo balance (sec)	16.9	14.9	26.0	17.5	-1.6
2. Plate tapping (sec)	10.3	1.6	12.0	1.0	-3.6**
3. Sit-and-reach (cm)	27.3	9.2	24.8	9.7	0.7
4. Standing broad jump (cm)	226.5	22.5	177.9	14.4	7.5**
5. Handgrip (kg)	56.1	6.9	35.7	7.9	7.9**
6. Sit-ups (n)	28.5	4.3	24.7	3.8	2.6*
7. Bent-arm hang (sec)	51.3	17.1	39.0	15.5	2.1*
8. Shuttle run 50 (sec)	18.9	0.9	22.4	2.0	-6.3**
9. Endurance shuttle run (n)	67.5	14.2	38.2	8.1	7.4**
10. Weight (kg)	76.8	9.5	57.5	7.6	6.6**
11. Height (cm)	182.0	7.1	166.4	7.5	6.2**
12. Sum skinfolds (mm)	56.6	16.9	70	15.5	-2.4*
13. Jump on the mark (cm)	2.9	1.5	5.3	3.7	-2.4*
14. Run towards the balls (sec)	9.2	1.1	9.9	1.5	-1.7
15. Random drumming (n)	11.4	2.4	13.0	3.2	-1.6
16. Stick catching (cm)	15.8	3.7	15.9	5.6	-0.03
17. Complex motor test (sec)	16.7	1.6	18.3	1.8	-2.6*
18. Cock-shot (n)	1.8	0.9	2.1	0.9	-0.5

* $p < 0.05$; ** $p < 0.01$

Discussion and conclusions

The results of the anthropometric variables, motor components and t-values (Table 1) indicates the significantly higher level of condition motor components of the group of men, which is probably connected with their anthropometric parameters.

Table 2. Correlation coefficients between individual indicators of motor abilities in the groups of men and women

Dimension		1	2	3	4	5	6	7	8	9	10	15
1. Flamingo balance	M											
	W											
2. Plate tapping	M											
	W											
3. Sit-and-reach	M											
	W											
4. Standing broad jump	M	.67**										
	W											
5. Handgrip	M				.53*							
	W											
6. Sit-ups	M											
	W				.68**	.50*						
7. Bent-arm hang	M	.63**			.60*							
	W		-.53*									
8. Shuttle run 50	M											
	W											
9. Endurance shuttle run	M	.75**			.71**			.67**				
	W											
10. Weight	M							-.51*				
	W				.49*	.61**						
11. Height	M										.51*	
	W									.64**		
12. Sum skinfolds	M	-.58*						-.61**		-.65**		
	W											
13. Jump on the mark	M											
	W											
14. Run towards the balls	M								.49*			
	W							.55*				
15. Random drumming	M			.57*	.50*			.57*		.50*		
	W											
16. Stick catching	M						-.52*					
	W	-.58										
17. Complex motor test	M											
	W	-.50					-.57*		.54*			-.68**
18. Cock-shot	M											
	W			.52*								

Legenda: M -men, W - women
* p < 0.05
** p < 0.01

The space of coordination abilities is not defined by the significantly higher level in the group of men with the exception of frequency speed of an arm, kineasthetic differentiation and the ability of joining the acyclic movements. It can be supposed that the coordination motor components are not defined by so large distinctions between the group of men and women as condition abilities. These results are most closely linked to the results of (*Belej et al., 2006*).

The lower level of physical fitness in the group of women may be related to the significantly higher level of the body fat. The observed negative correlations for sum skinfolds in the group of men indicate negative influence of the sum of body fat on physical fitness (Table 2). Paradoxically, such relations were not observed in the group of women. It is observed

that rhythmical ability is in close relations to the flexibility and muscle endurance, which is difficult to explain. In the group of women the ability of joining acyclic movements is in very similar position within the partial structure of motor performance. It can be conluded that equally in both examined groups the coordination abilities are in close relations to the condition ones but on the other hand there were not observed significant correlations between the very coordination abilities. It indicates their probable stronger criterion value. Following the results of correlation analyses the smaller number of significant correlations between condition abilities in the group of women indicates their independence in the space of motor abilities. Comparable results are reported by *Ružbarská & Turek (2007).*

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INFLUENCE OF ADDITIONAL BASKETBALL PROGRAM ON CHANGES IN MOTOR SKILLS OF FIFTH GRADE STUDENTS

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Abstract

The objective of this research was to analyze the value of an additional weekly session based on the elements and games of basketball on the motor status of 11-year old students. The sample of 80 boys was examined by 12 motor tests over the 9-month period. Statistical evaluation generally showed that both kinesiological treatments with the interaction of growth and development factors provoked significant quantitative changes in motor characteristics of examinees, however, experimental basketball program caused significantly higher positive results which is primarily obvious through the measures of explosive and repetitive power, coordination and hand frequency motion.

Key words: *basketball program, motor skills*

Introduction

The central aim of physical education is to transform the dimensions of student's anthropological status while the special focus is directed towards transformation of morphologic, motor and functional subsystem (Breslauer, 2003). Because of quantitative class limitations, the primary concern of physical education methods' is to create a higher quality program structure in order to accomplish all aims and tasks. Physical education is greatly influenced by the constant innovations, additions and corrections of the existing PE programs along with a steady development of kinesiology, as a core science.

Additional physical education classes such as extracurricular and outside school activities, elective physical courses, school sport clubs, etc. are shown by many experiments to be very valuable in the area of elementary and secondary physical education. The main objective of this research was to evaluate an additional physical education class based on the experimental basketball program as opposed to just regular PE classes considering the effects of motor development of fifth grade students.

Methods

The research was conducted on a sample of 80 male students, age eleven ($\pm$ 6 months). The sample can be defined as random, taken partially from the selected population, those who were not active in any physical activity besides involvement in regular physical education classes.

The sample was divided into control and experimental group. The control group consisted of 42 examinees (N=42) who exclusively attended physical education classes strictly under the regular plan and program for fifth grade elementary school. The experimental group, made of 38 examinees (N=38), engaged in an additional weekly session based on the games and elements of basketball.

Motor skills assessment included a sample of 12 motor tests: Standing long jump (MSDM), 20m Sprint - standing start (M20V), Medicine ball throw – lying position (MBML), Abdominal crunches in 60 s (MDTR), Bent arm hang (MIVZ), 20 Yards (M20J), Polygon backwards (MPOL), Low beam stand (MSNG), Hand taping (MTAP), Forward bend (MPRK), Wide leg – forward bend (MPRR), Arms rotation (MISK).

Initial and final parameters of descriptive statistics were measured in both groups of entities. Groups' comparison in each testing occasion and analysis of transformation values was determined by Canonical Discriminat Analysis. Global motor changes were calculated by the Algorithm and program for quantitative analysis of changes under the model of differences (STA_DIFF) (Dizdar, Viskić-Štalec, 2002.), which includes evaluation of each variable by Univariate Analysis of Variance (ANOVA).

The experimental program was consisted of one class session (45 min.) per week throughout the school year (9 months). A carefully planned systematic program included the following teaching methods: oral presentation, demonstration, and setting and solving methodic tasks. Basketball elements were practiced mainly by the principle of 'Standard repeating' and 'Switching method' while in certain situations 'Half-situational' exercise method was integrated. Plain Situational method was not applied. The learning method was dominantly based on combined method of synthetic and analytic learning.

Table 1. Curriculum content of experimental basketball program

No.	CURRICULAR SECTION	CURRICULAR THEME	No.of freq.
1.	Running	Running with switching pace and movement angle	8
2.		Moving in defensive position (lateral; backwards)	4
3.	Jumping	Proper jumps	2
4.		Catching and throwing in the air	5
5.	Balancing state	Offensive stand “triple threat”	2
6.		Pivot	1
7.	Throwing	Chest passing (both hands; left hand; right hand)	4
8.		Making the basket with one hand from standing and moving position	8
9.		Passing in movement	10
10.	Technical drills	Dribble in movement (left hand; right hand); Dribble around obstacles	14
11.		Picking the ball from the ground (one hand; both hands)	6
12.		Dribble and stop (in “triple threat” position)	4
13.	Tactic drills	“Give and go”	2
14.	Games	Relay drills	11
15.		3 on 3 (Streetbasket)	7
16.		“Kids basketball”	5

Next to the specific types of drills within Main “A” phase of the class hour there was also a set of general conditioning drills within the Intro-preparation phase which are mainly designed towards development of explosive and repetitive power, endurance and speed. Regarding the basketball factorial structure, mentioned motor skills are most dominant (Milanović, 1993.) and often essential pre-requisites for mastering various specific elements.

Results and discussion

Descriptive statistical parameters for the control group (Table 2.) and experimental group (Table 3.) show the increase of arithmetic mean between initial and final stage practically in all motor variables. In fact, the improvement was not only noticed in control group variables: Medicine ball throw – lying position, 20 Yards, and Forward bend. Thus there is reasonable doubt that a regular physical education program is not sufficient for progress in explosive power – throwing type, agility and hip flexibility.

Table 2. Descriptive parameters – control group

CONT.G.	N	AS	Min	Max	St.D.	Skew	Kurt
MSDM_I	42	162,8	116,5	201,5	22,3	-0,3	-0,9
MSDM_F	42	173,1	134,0	204,0	19,3	-0,4	-0,8
M20V_I	42	4,3	3,3	5,7	0,4	0,8	2,1
M20V_F	42	4,0	3,4	5,0	0,4	0,6	-0,1
MBML_I	42	6,1	3,6	8,8	1,0	0,2	0,2
MBML_F	42	5,9	4,1	7,8	0,9	0,2	-0,7
MDTR_I	42	32,2	15,0	49,0	8,3	-0,1	-0,5
MDTR_F	42	34,8	19,0	46,0	6,4	-0,6	0,0
MIVZ_I	42	28,1	0,0	62,2	21,1	**1,8**	**3,0**
MIVZ_F	42	30,4	5,0	53,0	13,6	**0,4**	**-0,8**
M20J_I	42	6,0	5,0	6,9	0,4	0,2	-0,2
M20J_F	42	6,2	5,1	7,2	0,6	0,0	-0,1
MPOL_I	42	20,0	14,7	31,0	4,2	**1,4**	**1,3**
MPOL_F	42	18,2	14,1	26,0	3,0	**0,9**	**0,1**
MSNG_I	42	15,0	1,2	57,0	10,1	**2,0**	**6,1**
MSNG_F	42	18,0	2,2	74,7	16,8	**1,9**	**3,4**
MPRK_I	42	-2,4	-17,0	15,0	6,7	-0,2	0,4
MPRK_F	42	-2,6	-18,0	12,5	7,1	-0,1	-0,4
MPRR_I	42	45,1	24,0	62,0	9,2	-0,6	-0,1
MPRR_F	42	46,8	25,0	67,0	9,9	-0,1	-0,5
MISK_I	42	73,0	47,0	110,0	14,5	0,5	-0,1
MISK_F	42	69,2	46,0	92,0	13,2	-0,1	-1,5
MTAP_I	42	24,1	19,0	30,0	2,8	0,2	-1,0
MTAP_F	42	26,3	20,0	34,0	3,5	0,3	-0,3

Table 3. Descriptive parameters – Experimental group

EXP. G.	N	AS	Min.	Max.	St.D.	Skew	Kurt
MSDM_I	38	162,8	123,0	190,0	15,9	-0,3	-0,4
MSDM_F	38	173,8	143,5	210,5	17,5	0,0	-0,4
M20V_I	38	4,2	3,5	5,0	0,4	0,1	-0,8
M20V_F	38	3,8	3,1	4,3	0,3	-0,6	-0,1
MBML_I	38	5,8	4,8	7,5	0,8	0,4	-0,8
MBML_F	38	6,8	5,4	9,3	0,9	0,8	0,0
MDTR_I	38	31,6	19,0	47,0	6,0	0,3	0,1
MDTR_F	38	35,0	24,0	56,0	6,2	**1,0**	**2,1**
MIVZ_I	38	32,6	7,9	86,3	16,9	**1,2**	**1,7**
MIVZ_F	38	35,3	12,0	84,0	15,3	**1,1**	**1,4**
M20J_I	38	6,0	5,3	8,3	0,6	**2,1**	**6,4**
M20J_F	38	5,7	4,6	7,9	0,8	0,8	0,8
MPOL_I	38	19,9	13,8	30,5	4,0	1,0	0,7
MPOL_F	38	17,8	11,7	27,0	3,4	0,6	0,3
MSNG_I	38	13,3	2,2	47,7	9,3	**1,7**	**4,0**
MSNG_F	38	18,6	4,2	68,1	14,8	**-2,0**	**3,7**
MPRK_I	38	-2,5	-16,0	7,0	6,5	-0,6	-0,6
MPRK_F	38	-1,4	-18,0	8,0	7,5	-1,0	-0,1
MPRR_I	38	45,4	27,0	65,0	8,9	0,0	-0,3
MPRR_F	38	46,3	24,0	68,0	10,7	-0,2	-0,3
MISK_I	38	73,1	42,0	113,0	15,6	0,1	-0,2
MISK_F	38	72,9	25,0	99,0	16,3	-0,8	0,6
MTAP_I	38	24,2	17,0	31,0	3,1	0,5	0,5
MTAP_F	38	26,5	22,0	31,0	2,4	-0,3	-0,7

Legend: (**N** – No. of entities; **AS** – arithmetic mean; **Min**.– low result; **Max**.– high result; **St.D**.– standard deviation; **Skew** – Skewness; **Kurt** – Kurtosis)

The results of the Discriminant Analysis at initial testing (*Wλ=0,77; Eigen val. 0,02; p=1,00*) showed no differences between the control and experimental groups at the beginning of the entire experiment.

Changes in motor skills over the 9-month period confirmed significant improvements in both groups of entities. (Table 4.).

Table 4. Global motor changes between initial and final measurement

		Maha.dis				
		d2	df1	df2	F	p
Control group	**DF**	5,88	12,00	30,00	15,07	0,00
Exper. group	**DF**	8,14	12,00	26,00	18,12	0,00

Table 5. Results of changes in each variable

	Control group		Exper. group	
	F	p	F	p
MSDM	**28,61**	**0,00**	**47,01**	**0,00**
M20V	4,22	0,06	**88,26**	**0,00**
MBML	0,09	0,71	**80,05**	**0,00**
MDTR	**6,76**	**0,01**	**9,33**	**0,00**
MIVZ	0,53	0,47	1,66	0,21
M20J	2,72	0,11	**6,59**	**0,01**
MPOL	**6,59**	**0,01**	**26,21**	**0,00**
MSNG	2,07	0,16	**4,79**	**0,03**
MPRK	0,04	0,84	3,79	0,06
MPRR	2,31	0,14	0,32	0,58
MISK	3,52	0,07	0,01	0,91
MTAP	**53,08**	**0,00**	**31,57**	**0,00**

Variables that considerably contributed general positive change on motor space of control group are: Standing long jump, Abdominal crunches in 60 s, Polygon backwards, and Hand taping. Therefore, it can be concluded that the regular physical education plan and program for the 5th grade has positive effect on explosive power – jumping type, repetitive abdominal power, hand frequency movement and partial coordination (overcoming the obstacles backwards).

The combination of the regular PE classes and the additional basketball program produced positive changes in complete motor dimensions of explosive and repetitive abdominal power, coordination and hand movement frequency. In accordance with the contents of the regular and experimental program, mentioned changes were a consequence of high frequencies of running, jumping and technical elements within Main "A" and Intro-preparation phase of the sessions. In the future, when

constructing the basketball program, more attention should be pointed towards elements that develop better static power and flexibility.

Analysis of motor variables during final measurement show statistically significant difference between control and experimental group of examinees (Table 6).

Table 6. Differences between control and experimental group during final measurement

	Eigen-value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
1	0,45	0,56	0,69	26,51	12	0,01

Table 7. Group centroids on diskriminant function

	Root 1
G_1: Cf	0,63
G_2: Ef	- 0,69

Table 8. Correlation of motor variables with diskriminant function

	Root 1
MSDM_F	-0,031
M20V_F	**0,486**
MBML_F	**-0,465**
MDTR_F	-0,023
MIVZ_F	-0,009
M20J_F	0,194
MPOL_F	0,099
MSNG_F	-0,032
MPRK_F	0,117
MPRR_F	0,037
MISK_F	-0,187
MTAP_F	0,035

The position of group centroids, shown in Table 7. (*C:cont=-0,63; C: exp.=0,69*) verify considerable differences. The largest correlations with a discriminant function (Table 7.) attain variables 20m Sprint - standing start (0,486) and Medicine ball throw – lying position (0,465). Those variables mostly contributed towards group differences so the experimental group can be defined as a group with better explosive power – sprinting and throwing type.

On the basis of the overall statistical analysis presented, a general conclusion can be drawn that the experimental basketball program, applied by an extra weekly session over the 9-month period, is undoubtedly sufficient to create a significant improvement in the dimensions of explosive and repetitive power, coordination and hand frequency movement. According to the movement structure of the basketball game and the contents of additional applied program, the given results ought to be the consequence of specific high frequency movements.

Conclusion

The essence of planned and systematically applied workload comes down to a careful selection of adequate stimulants with precisely defined partial effects that seek a long-term global integration and raise of skills quality to the expected levels. Then a strong foundation is built for a gradual progress, creation of specific working models and relative individualization where the methodic tasks truly advance and the whole process is based on continuity where the final outcome becomes a consequence of cohesive achievement (Katić, 1995.).

It is very important to incorporate basic motor structure movements in young age. Basketball offers a wide range of exactly those kinds of movements and additionally they ensure more interesting, more social and motivational forms of activity. According to the complexities of each task and final outcomes of the given experimental program, there are open possibilities of correction or enrichment of current curricular tasks. This study definitely offers further deliberation on optimization and rationalization of physical education and extracurricular physical activities. Considering the fact that present lifestyle continuously diminishes the necessity of physical activity, studies like this are required more than ever before.

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LATERAL CHOICES OF HAND, EYE AND FOOT IN CHILDREN OF A PRIMARY SCHOOL OF BOLOGNA, ITALY

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Abstract

This study examined lateral choices in use of hands, feet and eyes in a group of 209 schoolchildren living in Bologna, Italy. Nine tasks were used: six for the hands, two for the feet and one for the eyes. The purpose was to identify similarities and differences, among different tasks, through performance tests.

Frequency and percentage of the answers for each task are reported, and the left-choice percentage obtained from the hierarchical cluster analysis for binomial data. Results show different left-handed percentage among the tasks regarding stepping foot and eye tasks compared to the manual items All the differences between right- and left-handed choices are statistically significant (binomial test $p<0.001$). The left-handers differences between the genders and the two ages result not significant with chi-squared test ($p>0.05$). Finally the calculation of a synthetic index of laterality is proposed.

Key words: *Laterality, handedness, mime, laterality index*

Introduction

The issue of laterality has interested the researchers in different fields, such as motor sciences and behavioural sciences. The facts that humans prefer to use a limb rather than the other, and that the preferred limb is not always the same for different tasks, have raised several questions. Furthermore, people show a variable functional asymmetry: somebody is markedly right- or left-hander when performing different (not only manual) tasks, while others show various degrees of mixed laterality (Greenwood et al., 2007). Another remarkable point is that the distribution between right and left-handers is unbalanced and varies depending on geographical areas (Leask, 2007). Undoubtedly, laterality is due to a genetic component (Bryden et al., 1997), but the socio-cultural influences may also be important (Porac, 1993; Fagard et al., 2004). Environmental influences has the peculiarity of changing over time. Therefore, some temporal changes may result from varied social pressures, so that some actions strictly forbidden in the past may be subsequently accepted. An example comes from Northern Ireland: as reported from Greenwood et al. (2007) for twenty centuries the left-handers have been discriminated and opposed, while today is the norm rather than the exception that Northern Ireland primary schools are provided with left-handed scissors. The most used method to define the laterality of a subject is to consider the writing hand (Porac and Coren, 1981), but this criterion requires caution due to the aforementioned concerns. The question arises early considering that the percentage of left-hand writers among children is already from the first years of life. The purpose of this work is to identify similarities and differences between different tasks involving the use of a single hand, foot or eye in first level scholastic population.

Methods

209 children (110 males, 99 females) attending the first (52 M, 48 F, aged 6.5) and fifth years (58 M and 51 F, aged 10.5) at a primary school in the city of Bologna (Italy) participated in the study, carried out with the cooperation of teachers during the school time in the motor education hours. An informed consent was given by the parents of all the children. To know the manual laterality and to record the hand writing five items of a mime test (Carbonaro et al., 1988, Greenwood et al., 2007) were selected. The test consisted in miming some actions of everyday life. Children were asked to sit before of a table and were invited to mime some suggested by the researcher. The actions required for the manual laterality were: 1) “drive in a nail” ; 2) “comb your hairs”; 3) “Make a ball of paper with one hand”; 4)”drink from a glass” and 5) “mix sugar”. The actions for podalic laterality, standing performed, were 1) “kick a ball” and 2) “skip on one foot”. The action for assessing ocular laterality was: “look through the tube.” A score of 1 for answering with the right and 2 for answering with the left has been assigned to each test. A laterality index was then established for each subject by adding the values reported for each test.

Statistical analysis: in addition to descriptive statistics (percentage of left and right answers) the differences between the percentage of subjects with dominant right and left hand in any items was analysed with non-parametric binomial tests. Chi-square tests were used to analyse the difference in the number of right-handers and left-handers in the two

genders and for the two considered age classes. A hierarchical cluster analysis for nominal data was used to highlight similarities and differences among any task.

Results

Table 1 shows the absolute and percentage number of right and left responses in the different examined tasks. Concerning the manual laterality, the right hand answers are higher than 80% in all the considered items. The left hand used for writing shows the lowest percentage among the different tasks (11,0%) and very similar is the percentage for the hand used for combing (11,5%). These percentages are different from others in melting (17,7%), making a ball of paper (15,3%), driving a nail (14,8%). In those tasks involving the use of the feet, the higher differences were shown in the foot chosen for hopping (36.4%). Indeed, the foot chosen for kicking has a percentage of left-handers comparable to that of the hand used to grab the glass (12.9), and intermediate between the minimum and maximum observed for the hand. The ocular laterality test showed a higher percentage of left-handers compared to manual laterality (23.9), but also lower than in the hopping task-foot. All the differences between right and left-handers for all the items were significant (non parametric binomial test $p < 0.001$).

Table 1.

	FREQUENCY		PERCENT	
TASK	RIGHT	LEFT	RIGHT	LEFT
Hand1: Drive in a nail	178	31	85,2	14,8
Hand2: Comb your hair	185	24	88,5	11,5
Hand3: Make a ball of paper	177	32	84,7	15,3
Hand4: Drink from a glass	182	27	87,1	12,9
Hand5: Mix sugar	172	37	82,3	17,7
Writing hand	186	23	89	11
Foot1: Skip on one foot	133	76	63,6	36,4
Foot2: Kick a ball	182	27	87,1	12,9
Eye: Look through the tube	158	50	75,6	23,9

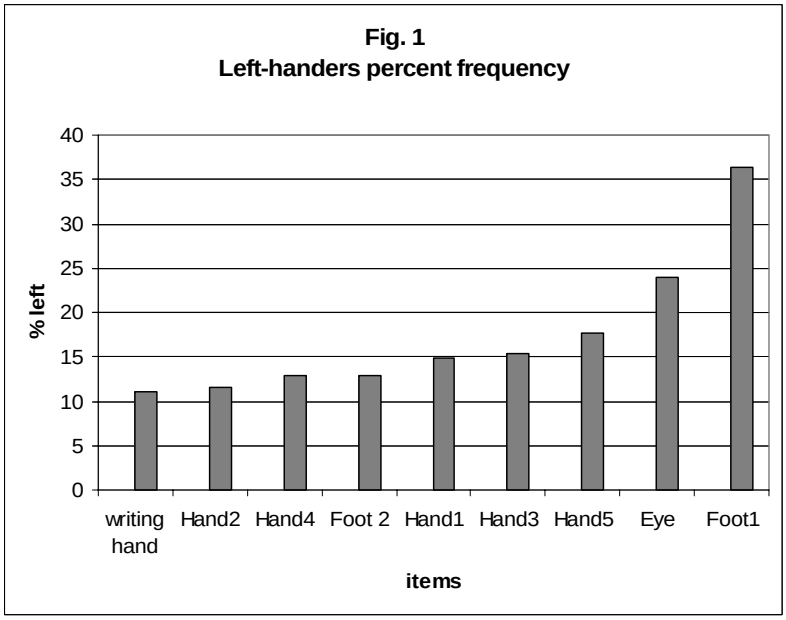

Figure 1. Examinated tasks, ordered according to the percentage of subjects choosing a left side to perform them.

For a better evaluation of the differences and similarities between the used tasks the data were processed through a hierarchical cluster analysis for binomial data (Table 2). In this way we can discriminate variables reporting similar responses. The writing hand and the hand used to take the glass are similar as choices. Secondly are connected to the first the two hands used for combing and hammering. Gradually farthest appears the hand that crunch the paper and before a link to the previous hand we can see the task of kicking the ball. The answers to the tasks relating to the eye and the hopping foot are the most different.

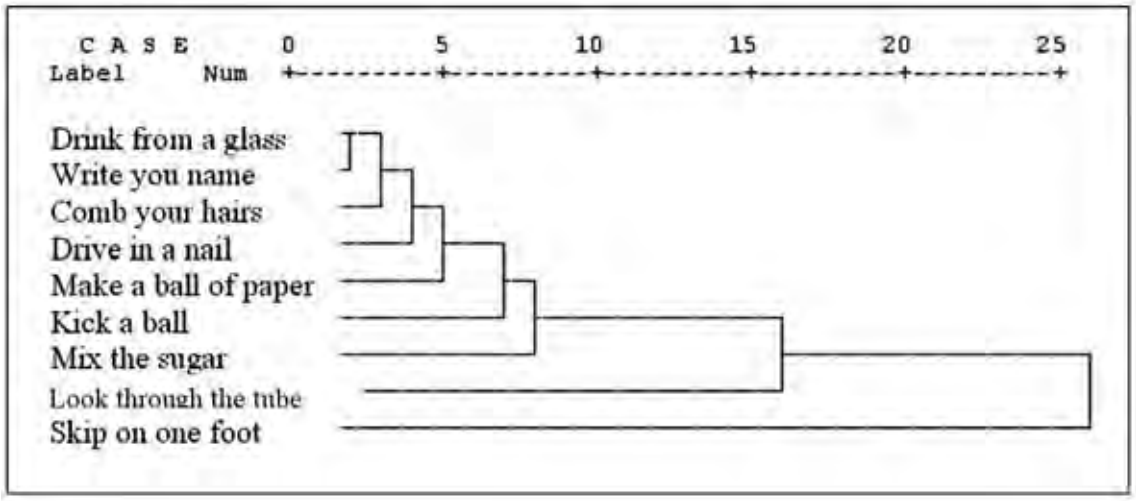

Figure 2.

In table 2 are reported left-handers' percentage of the two age classes divided for gender. Hand values range from 6,3% (females in the first class, writing hand) to 23% (hammering hand, males in the first class). With regard to the foot, the percentages range from a minimum of 9.6% in the kicking foot (males of the first class) to a maximum of 44.2% in the foot used to hopping in the same group of subjects. The left eye is used in similar percentages in the various classes (min. 23.5 - max. 25).

*Table 2. Left-handers percentage for age and gender groups * p<0,05*

%	Writing	Hand 2	Hand 4	Foot 2	Hand 1	Hand 3	Hand 5	Eye	Foot 1
M 1	9.6	17.3	11.5	9.6	23.1*	21.2	21.2	25	44.2
M 5	19	6.9	17.2	20.7	15.5	17.2	20.7	22.4	29.3
F 1	6.3	10.4	8.3	10.4	8.3*	10.4	14.6	25.0	35.4
F 5	7.8	11.8	13.7	9.8	11.8	11.8	13.7	23.5	37.3

Through the chi-square tests were not found significant differences between groups of the same gender in the two age, or gender differences for groups of the same age (chi-squared test p>0.05). Only the differences between males and females aged 6 for the hammering hand are significant (p<0,05).

To obtain a summary index of manual laterality the values of manual tasks (with the exception of that related to the writing hand) were summed. In this way scores that ranged from 5 (right answers only) to 10 (left answers only) were obtained. Figure 3 shows the percentage of subjects with response from 6 to 10. The percentage of the first class is pretty high, over 20%, so we can consider that the students who perform one left choice in the five tests has randomly choose, because no manual item presents percentages above 20%. Two or more left choices authorize us to suppose that the subject is left-handed oriented.

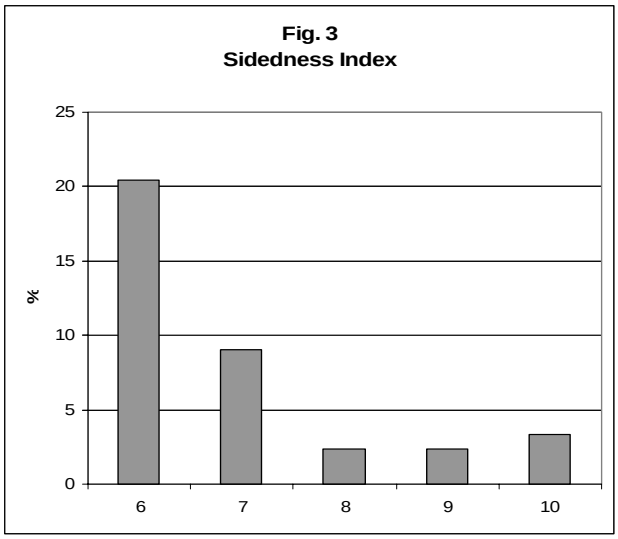

Figure 3.

The completely right choices were 61.9% of the total; with only one left answer were 20.48%; other choices show strongly lower percentage (<9%), however less than each single laterality task, including the hand of writing.

Discussion and conclusions

The different percentages found in the manual task can be explained on the basis of social conditions and other factors. The tasks with the lowest percentage of left-handers are probably influenced by the people surrounding the child, in a more or less conscious way. The writing and

combing hand require precision movements, too, that are not involved in making a ball of paper or grabbing a glass. The hammer task requires both precision and strength, therefore requires a discriminating factor different from other tasks, and this could explain the percentage of left-handers with intermediate values between the previous items and those requiring less accuracy. In any case, the glass reported a very low percentage of left-handers, similarly to hand-writing, while the hand used to mix the sugar the highest percentage. This suggests that this item is less influenced by the environmental conditions, but perhaps the hand that grabs the glass could affect the results in this task.

The footedness in kicking presents values substantially similar to those of writing, leading to think that this may be due to the necessity to maintain control of motor gesture (see Canan K. et al.,2008). Eyedness data are in line with the literature: right-eyed children are 76.1%. The data found in the literature (70% left-eyed) refer to adults (Bourassa et al. 1996). The cluster analysis confirms that the manual tasks are very similar to each other, as the kicking foot. The eye and jumping foot tasks are instead very distant from the others. By analyzing gender differences, some authors found differences between males and females in sidedness, taking in account the sum of the directions of six different tasks, although not significant for each individual task, deducing that males tend to be less right-biased than females in the analysed population (see Greenwood et al., 2007). In our sample the percentage of left-handed males is higher than females in almost all tasks, except for the hopping (males 35.4%, females 37.3%), looking through the tube and combing, but differences are statistically significant only in the case of the driving in a nail for males and females aged 6. No sex difference was found in left-eyedness between males and females, as reported in previous studies (Dellatolas et al., 1998; Gabbard, 2000).

The proposition of a criterion to point out children handedness is useful for teachers in order to indicate the best hand for writing and for other sport techniques requiring a lateral choice. We propose a measure of the overall laterality of each individual through a synthetic index: defining the right dominant hand is defined when scores are 5-6, the left dominant hand with scores 7-8-9-10.

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THE MOTOR-SPORT EVALUATION IN THE PRIMARY SCHOOL IN ITALY

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Abstract

The relationship between educational systems, formative outcomes and didactic constitutes the fundamental core of the efficacy of learning paths in every disciplinary field. In the primary school, also in consideration of its disciplinary, pluridisciplinary and interdisciplinary articulation, didactics is tied to the necessity of a constant control, which is able to orient the teaching process in every field of knowledge, comprised the motor one, and it demands specific methods and appreciation and judgment of the formative processes tools. The educational context needs methods and didactics which are able to answer to the formative needs of the scholastic institution, they are much more different than those which are used by the world of the sport. It needs also tools and patterns of evaluation which are coherent with objects and goals of the National Indications of the Italian Ministry of Education of 2007.

Key words: *body, learning, tests, school, teaching programmes*

The last Indications of the Italian Ministry of Education assert with clarity that, in order to have educational characteristics, the sport experience must aim to build a relationship between body, movement, growth regulative structures, functions and laws aiming to the awareness of the functions and the dynamical needs of the individual. For the first time in the history of the programs of motor activities for the primary school, it has been delineated a picture of the motor and sport activities which is not only capable of training or building specific capacities, but also aimed to favour the consciousness of the child in evolutionary age both of his kinaesthetic needs and of feeding rules, while it makes the antagonism between sport and dependency clear. According to ministerial indications in the first five years of the Italian primary school motor activities and sport are finalized:

- To clear the relationship between body and cognition, in a bioeducational key of the didactics, within which the movement and the corporeitycontribute to the construction of the knowledge beyond facilitating the various dimensions of the group relation.
- To acquire through spatial, analogical, relational sport principles.
- To address the motor-sport activity to the development of an increasing consciousness of their own potentialities and of the capacity to develop them.
- To address the sport towards an emotional education, throwing again its multifactoriality and its educational-formative connotation.
- To promote a "diagnostic" function of the not verbal communication, which is a tool for the decoding of demands and needs of the pupils.
- To favour the development of the sport as a place where the right to the diversity, centred on the group core of cooperation, can emerge, as a subject which is capable to naturally and actively include cultures and traditions.
- To construct a regulative vision of the sport experience beyond an educational one, and a communitarian function of the motor activities, as a real social arena, an incubator of indispensable to the civilized living values.
- To reconsider in a pedagogical shape the recreational aspect of the motor-sport activities which are addressed to children and to assert the centrality of the right to the sport of the disabled, through the explicit judgement of the mechanisms of selection, which are often propaedeutic to prejudgments and emargination.

  The goals for the development of the competences from six to eleven years of age indicate the tracks to cover, which are strategic within the "curricolo" for motor-sport discipline, and they move on at least six axis which are related to the motor-postural control, to the expressivity, to the ability, to the styles of life, to the rules and to the use of the technique:
- The acquisition of the self-consciousness through the listening and the observation of one's own body, the mastery of the motor and postural schemes;

- The usage of a motor and bodily language in order to communicate one's own states of mind, through rhythmic-musical dramatization and experiences.
- The experimentation of the various sport disciplines through multiple experiences, also through technical gesture.
- The acquisition of tied to the well-being life-styles which preview the knowledge of the body and its relationship with feeding.
- The understanding of the rules of the game and of the sport and the value to respect them also in the play-activities.

The five object of learning which are present in the Ministerial Indications and related to the corporeal-kinaesthetic dimension, they are developed in two stages: the first must be catched up in the first three years and the second one is previewed for the fourth and fifth year. They need specific evaluation systems. In the context of the primary school the motor-sport evaluation must be not only parameterised and modelled to the structure of the discipline, to its particular characteristic, to its functions, to its connection with the curricular frame, but it demands also to the operators the capacity to observe the gestures and the motor actions. The observation of the motor performance of the subject in its individual and team shape characterizes a valuable and unavoidable tool of evaluation of the motor learning level, of the difficulties which are tied to the performance, of the diversified motor answers and of the number of attempt made by the subject and which, often unconsciously, determine an improvement in its capacity to answer to the external input (Schmidt& Wrisberg, 2000).

In the Italian scholastic context, the batteries of test for the cross-sectional evaluation of learning for the adaptability of the contents and the methods of participation which are easily dispensed and widespread among teachers, they are finalized to the evaluation of the capacity of listening, understanding and memorization. The study of the fine motricity, of the self-perceived orientation, of the static-dynamic equilibrium and of the whole of the practical activities as the orientation in the space and in the time, the skill, the precision, the rapidity, they need tests which allow to estimate the psycho-sensorial and psychomotor operation of the children starting from the first years of life. Moreover the tests must be capable to analyze the motor level and its connection with metacognitive capacities and the logical-mathematical abilities and to inquire the mnemonic performance and the meta-mnemonic abilities. The tests must diagnose the various modalities of learning and the multiple motivational components and only if they answer to specific methodological protocols, they can be able to estimate jointly practical and motor abilities (De Beni & Zamperlin, 2005 – Polàcek, 2005 – Cornoldi, 1994 – Pazzaglia, 1994).

To the use of the Scale of Psychomotor Development Of the First Infancy which supplies a general indication on the psychomotor development of the child through the analysis of postural and motor control, of the eye-hand coordination, of the language and of the social relations, it would be useful to place side by side, starting from the first years of the primary school, batteries of test for the evaluation of those object which are previewed in the National Indications. The first object is related to the body and to the sense-perceptive functions. It corresponds to the capacity to recognize and to graphically represent the body and its parts and it demands the capacity of using the visual, auditory, tactile, kinaesthetic information and the utilization of an evaluation method that answers to the theoretical model according to which the learning process has sense-motor bases and it needs tasks and procedures that connect the motor dimension with that cognitive one. The use of VMI Developmental Tests of Visual-Monitor Integration (Beery & Buktenica, 2000) which is constituted by tests that concur the evaluation of the capacities of the individuals to integrate visual and motor abilities, it consists in the copy of an evolutionary sequence of geometric shapes through the use of 27 items. The additional test of visual perception of the geometric shape values the capacity of the child to recognize in 3 minutes a maximum of 27 geometric shapes and the additional test of motor coordination previews the task to trace in a printed publication the shapes stimulus in the time of 5 minutes. An ulterior graphical test of productivity of outcomes which can be simply dispensed and is capable to study the visual and motor structure in the child, it is represented by the Bender Visual Motor Gestalt Test (Bender, 1979) that consists in copying a series of drawings, above all geometric ones. The graphical reproductions allow to make interpretations about the perceptive and motor development of the subjects. The second objective, related to the movement of the body and to its relation with the space and the time, it demands the coordination of various motor schemes, the static and dynamic equilibrium management and the capacity to organize the orientation in reference to spatial and temporal coordinates and recognizing and reproducing rhythmical sequences also with tools. For this objective it is advisable the use of a methodology of evaluation which must be suitable to the age and to the scholastic context as the Movement ABC (Henderson) that represents an effective tool in order to realize individual motor evaluations from 4 to 12 years through various typologies of tasks: manual skill, abilities with the ball, static and dynamic equilibrium. The battery of tests is made up of a test of performance which previews the individual execution of motor tasks as tests of manual abilities, games with the ball and equilibrium abilities and one checklist of observation which is constituted by 48 items which are related to the behaviour of the subject, taking into account the performance in more and more complex phases. The third objective, related to the body-language as a communicative-expressive pattern, it is acquirable through a personal use of the body to communicate state of mind, emotions, feelings, meanwhile controlling the different postures which are also usable in the dance and in the moments of dramatization. In this case the evaluation can follow a model like that one of the tests of the Battery Piaget-Head (Galifret-Granjon, 1980), that concurs

to study the right-left difference in the child in subjects from 6 to 14 years of age and it is made up of 2 series of tests: the first corresponds to the right-left test of Piaget; the second one corresponds to the hand-eye-ear test of Head. The fourth objective, related to the game, to the sport, to the rules and to the fair play, demands in the first phase the knowledge of the executive modalities which are connected to the various games of movement and pre-sport individual and team games, recognizing the value of the rules in a positive way. In the last biennium it is indispensable the simplified technical knowledge of multiple sport disciplines, the capacity to succeed in resolving motor problems, also taking into account technical suggestions, and to use popular games for the conquest of the rules. Moreover, it is asked the participation to the games and the sport contests, accepting one's own limits and the eventual defeats, recognizing the importance of the collaboration, the diversity and the sense of responsibility. For the characteristics of this specific objective it is advisable a system of evaluation which is connected to the method of the Scale of Motor Development of Oseretzky (Oseretzky, 1959); it comprises 6 tests which are grouped by the age and are related to static coordination, to the dynamic hand and general coordination, to the rapidity, to the contemporary movements of the limbs, to the execution precision. The fifth objective is related to emergency and prevention, health and well-being. In the first three years of age it is asked to know and to use spaces and tools, recognizing the various feelings of well-being connected to play-motor activity. In the last two years, instead, the acquisition of behaviours which are adapt for the prevention and the emergency in the different context of life, and the acknowledgment of the relationship between feeding, physical exercises and health constitutes the competences to acquire. The characteristics of this objective would demand an evaluation which is characterized by the use of interviews, of specific closed-answer questionnaires which involved also the family and which are finalized to inquire on the degree of knowledge not only of norms about the emergency and the health, but also of those about the life styles which can be adopted at school and in extra scholastic environment. In conclusion the evaluation of motor-sport activities in the scholastic environment in the primary school could not prescind from the full knowledge of the unity of the various dimensions of the person within the formative processes (affective, relational, social, kinaesthetic atmosphere) and it demands the use of protocols which are able to appreciate jointly the motor level, the different various capacities of the person and the possible connections between corporeity and learning in the children.

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DEVELOPMENTAL CHANGES OF RELATIONS BETWEEN MOTOR PERFORMANCE AND INTELLIGENCE OF EARLY ELEMENTARY AGE CHILDREN

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Summary

The aim of this study is to analyze developmental changes of relations between motor performance and intelligence of early elementary age children (7, 9 and 11 years; N= 159). A battery of 7 tests was used for estimating motor performance. Intelligence testing was implemented with the Ravens progressive color-matrices test. The relations between motor performance and intelligence were estimated with the multiple regression analysis. The results showed that statistically significant connection does exist between motor performance and intelligence at the age of 11 and that it increases with age. 20m dash (MT20) and backward polygon (MPOLIGO) found to have statistically significant connection with intelligence. It has been confirmed that the developmental changes have a significant influence on the relations between motor performance and intelligence.

Key words: *Early elementary age children, intelligence, developmental changes*

Introduction

Relations between motor performance and intelligence have been treated in numerous previous studies. Statistically significant canonical correlation between motor (speed of simple movement and coordination) and intellectual abilities were established in the studies of Mejovsek (1977,1979), with similar results presented by Kovac (1999). In addition, positive relations between intellectual abilities and functional mechanism for movement structuring, tonus and synergetic regulation were established (Momirovic & Horga, 1982).

Considering "integral development theory"(Ismail & Gruber, 1967), considerable number of studies were design to investigate relations between intelligence and motor abilities on the sample of preschool children. Obtained results implies to existence of medium to medium- high statistically significant connection between motor and intellectual abilities explained mostly thru connection of intelligence with either parameters of time-limited coordination motor tasks (Thomas, & Chisom, 1972; Eggert, & Schuck, 1978; Zimmer, 1981; Planinsec, 2001; 2002a), or motor tasks defined as "speed of simple and frequent movements" (Mohan, & Bhatia, 1989; Planinsec, 2002b; Stojanovic & Stojanovic, 2006). Furthermore, some studies indicate revealed connection between intelligence and explosive strength and balance on the sample of adults (Madic, 1986; according to: Planinsec, 2001; Planinsec 2002a) as well as static strength parameters. (Stojanovic,Rubin, Stojanovic i Fratric, 2006). In addition, on the sample of children most of studies implied that the connection between intellectual and motor abilities is stronger at a lower age and that it decreases with the progression of age.

Interestingly, there are very few similar studies on the sample of early elementary age children. One of them (Planinsec , 2002b), on the sample of 10,12 and 14 years old children, implies to the existence of difference in the obtained connection between preschool and early elementary school children, with the connection being highest at the sample of 12 years children.

The aim of the present study is to analyze the developmental changes of relations between motor performance and intelligence of elementary school children.

Methods

The research was performed on the sample of 159 boys 7, 9 i 11 years old (N = 47, 59 and 53, respectively). The sample was drown from the population of children in kindergartens in the city of Novi Sad. Data used in this study were obtained in the project "anthropological status and physical activity of the Province vojvodina inhabitants", which was partially financed by the Province secretary of science and technological improvement. All testing were done between 23.03 2006 and 15.06 2006. Measuring was organized thru working places, with maximum of 10 children at one working place at the time.

The battery of seven tests used in this research was selected on the basis of experiences with adults, and was modified to suit small children (Bala, 1999). These tests are used to asses the effectiveness of the following functional mechanisms: movement structuring, tonus and synergetic regulation, regulation of excitation intensity and regulation of excitation duration. (Gredelj, Metikos, Hosek & Momirovic, 1975).

The battery of motor test included:

1) 20m dash (MT20) – to estimate speed of movement,
2) Arm plate tapping (MTAPING)- , to estimate Frequency of simple movements
3) Standing broad jump (MSKOKDA) – to estimate explosive strength,
4) Obstacle course backwards (MPOLIGO)- to estimate Functional coordination of primary motor abilities,
5) Cross arm sit-ups (MPODIZA)- to estimate repetitive strength of the trunk,
6) bent-arm hang (MIZDRZAJ)- to estimate static strength of arms
7) Forward bend and touch on a bench (MPRETKL)- to estimate flexibility.

Intelligence testing was implemented with the Ravens progressive color-matrices test. The results obtained from the measuring and testing procedures were analyzed by the SPSS programme for regression analysis.

Results

The results of the regression analysis on the sample of 7 years old boys are presented in table 1 and 2. Based on the presented results, it could be concluded that there is no statistically significant correlation between the entire system of predictors on the criterion (p> ,05), with the multiple correlation coefficient (R) being ,362, which means that determination coefficient is ,131. Consequently, it could be concluded that 13% of the common variance between motor and cognitive variables is explained. Furthermore, none of the individual motor variables obtain statistically significant β coefficients with criterion variable (Table 3).

Table 1. Multiple correlations, coefficient of determination and significance level on the sample of 7 years old boys

R=,362	R^2=,131	F=,838	Sig,= ,563

Table 2. Correlations of predictors with criterion variable and significance level on the sample of 7 years old boys

Varijabla	Beta	t	Sig.
MT20	,350	-,128	,899
MPOLIGO	,017	1,832	,075
MTAPING	-,071	,088	,931
MPRETKL	,221	-,436	,665
MSKOKDA	,000	1,448	,156
MIZDRZAJ	,218	,000	1,000
MPODIZA	,054	1,155	,255

The results of the regression analysis on the sample of 7 years old boys are presented in table 3 and 4. Based on the presented results, it could be concluded that there is no statistically significant correlation between the entire system of predictors on the criterion (p>,05), with the multiple correlation coefficient (R) being ,372, which means that determination coefficient is ,139. Consequently, it could be concluded that 14% of the common variance between motor and cognitive variables is explained. Furthermore, none of the individual motor variables obtain statistically significant β coefficients with criterion variable (table 4).

Table 3. Multiple correlations, coefficient of determination and significance level on the sample of 9 years old boys

R=,372	R^2=,139	F=1,172	Sig,= ,335

Table 4. Correlations of predictors with criterion variable and significance level on the sample of 9 years old boys

Varijabla	Beta	t	Sig.
MT20	,085	,557	,580
MPOLIGO	-,074	,474	,638
MTAPING	,243	-,364	,717
MPRETKL	,061	1,665	,102
MSKOKDA	,084	,445	,658
MIZDRZAJ	,100	,362	,719
MPODIZA	,112	,653	,517

The results of the regression analysis on the sample of 11 years old boys are presented in table 5 and 6. We can see that there is a statistically significant correlation between the entire system of predictors on the criterion (p>,05), with the multiple correlation coefficient (R) being ,531, which means that determination coefficient is ,282. Consequently, it could be concluded that 28% of the common variance between motor and cognitive variables is explained. Furthermore, two of seven motor variables (20m dash (, 391) and Obstacle course backwards (, 156)) have statistically significant β coefficients with criterion variable (table 6).

Table 5. Multiple correlations, coefficient of determination and significance level on the sample of 11 years old boys

R=,531	R^2=,282	F=2,530	Sig,= **,028**

Table 6. Correlations of predictors with criterion variable and significance level on the sample of 11 years old boys

Varijabla	Beta	t	Sig.
MT20	-,391	3,005	**,004**
MPOLIGO	-,156	-2,023	**,049**
MTAPING	-,037	-,851	,399
MPRETKL	-,096	-,281	,780
MSKOKDA	,054	-,679	,501
MIZDRZAJ	-,157	,223	,824
MPODIZA	,191	-,906	,370

Discussion and conclusion

Presented results imply that there is interesting relation between motor performance and intellectual abilities among elementary school boys. There were no significant connection on the sample of 7 and 9 year old boys, but statistically significant relation was established on the sample of 11 years old boys (p=,029). Furthermore, it can be stated that connection is stronger at a higher age. Those results are not in line with previous studies done on the sample of preschool children. Statistically significant connections between motor performance and intellectual abilities on the sample of 6 and 8 years old children were reported by Eggert, & Schuk, (1978) with connection decreasing with age. Similar results were established by Dickes (1978) on the sample of children aged 5 to 9 and by Zimmer (1981) on the sample of children aged 5 to 6. In addition, Stojanovic & Stojanovic (2006) reported statistically significant association between motor and intellectual performance on the sample of preschool children (4-7 years) with the ability of coordination of movement having the strongest connection.

However, research done on the sample of schoolchildren aged 10, 12 and 14 years (Planinšec, 2002b) showed different trends in the motor performance and intellectual connection, which more in line with results is obtained in our study. Furthermore, coefficient of determination obtained on the sample of 12 and 11 years old boys in those studies are almost identical.

It could be hypothesized that different latent structure, which consequently influence motor- intelligence relation, between boys of different age could at least partially be responsible for the obtained results.

Several studies indicate the predominance of informational over energetic component on movement patterns at preschool children, with decreasing influence with age (Thomas, & Chisom, 1972; Madic, 1986; Planinšec, 2002a). In addition, growing influence of informational component at the age of 10 has been reported by Planinšec (2002b). So, it could be hypothesized that early elementary aged children have stable latent structure of motor abilities, considering informational component impact. This in turn decreases influence of intellectual abilities on the motor performance until boys reached prepubescent period.

As for individual predictors and intelligence, it could be concluded that variables MT20 (20m dash) and MPOLIGO (Obstacle course backwards) have statistically significant correlations, which in line with previous studies. The connection between the speed of movement and cognitive abilities was established for older adults and is explained with faster and more efficient central nervous system or nerve conduction velocity (Mejovšek, 1979). The speed of neural transmission is important for the speed of information processing, which in turn has a significant influence on the level of intelligence (Vernon, & Mori, 1992). The connection between coordination of movement and cognitive abilities has been reported for children by several researchers (Thomas, & Chisom, 1972; Dickes, 1978; Planinšec, 2001). Informational complex movement patterns, as Obstacle course backwards, presents task which in order to be solved have to include cognitive processing. Complex coordination movement patterns need cognitive processing mostly for modeling motor programs for movement execution, but also for permanent remodeling of movement during execution based on the feedback information's.

Based on the presented results of this study, as well as other similar studies, it could be concluded that developmental changes significantly influence the connections between motor performance and intelligence, with connection being unstable with age progression.

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THE PREFERENCES TOWARD SPORTS OF STUDENTS IN INSTITUTIONS OF HIGHER EDUCATION

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Abstract

This research was conducted to establish preferences toward sports of students in three Zagreb's institutions of higher education with majors in humanities and social sciences, and natural sciences and engineering. The sample of 1358 students, specifically 443 male and 915 female students, evaluated 59 sports based on the scale of behavioral aims with grades from one through five. Noticeable difference based on gender was established in preferences toward sports. Male students prefer football, table tennis and similar so-called "adrenalin" sports, while they tend to avoid so-called "feminine" sports with emphasis on an esthetic component of activity. Female students on the contrary, prefer aerobics, dance, ice-skating and roller-skating. Badminton and individual sports such as cycling and swimming is equally appealing to both female and male students. While there were no significant differences in preferences among female students from different higher education institutions, differentiation were more expressed among male students.

Key words: *preferences toward sports, students, gender difference, higher education institutions*

Introduction

The period of higher education and the beginning of the adulthood is characterized by the achievement and retainment of a certain level of development for a longer period of time. The main goal of physical education in the institutions of higher education is to preserve all of our anthropological features, prevent health problems, preserve and potentially improve health, as well as to help us acquire habits for lifelong beneficial participation in sports and recreational activities.

Initially students have various motoric skills, and motoric and functional capabilities. Their attitude towards physical activities, health, acquired habits and world in general represents a wide social spectrum.

It is established that habits acquired during childhood and adolescence influence behavior to a great extent and the quality of life in adulthood (Buckworth, 2001.; Kraut at al., 2003; Telama at al., 2005.). Also, it is of great significance to establish positive habit toward regular and lifelong physical exercise from the earliest age. Important factor for a regular physical activity lies in proper offer of different sport-recreational programs since motivation is a key factor for a long-term regular engagement to specific sport activities. Individuals who prefer sport competitions have shown an intrinsic motivation such as pleasure and challenge, in contrast to those who exercise without participating in competitions who have shown extrinsic motivation towards physical appearance, weight and stress control (Kilpatrick at al., 2005). The research on this subject so far has shown statistical differences to a great measure among genders (Dzewaltowski at al.,1997; Kilpatrick at al., 2005.), or education for different vocations (Prot at al., 2005) in preferences toward sport-recreational activities. Male students show tendency for team sports and competing generally, while female students prefer aerobic and dance.

In order to make physical education more interesting and successful, the opinions and attitudes of students are more than appreciated and it is they who can influence the introduction of all sorts of new programs such as aerobics, yoga, dances, badminton, rowing and etc.

Variety of sports and recreational activities makes possible for everyone to find adequate physical activity given their anthropological characteristics, motoric skills and motivation for participating.

Methods

Purpose of the research

The goal of this research was to determine preferences toward particular sport-recreational activities, and to determine whether there exists any statistically significant gender difference and differences among students of different institution of higher education.

An adequate offer of sports is an important factor that enables participation in physically beneficial activities. An appropriate guidance of interest towards a sport activity demonstrates that any individual can achieve personally significant results.

The sample of subjects

The research was conducted during Winter Semester 2007-08 on a sample of first year (freshmen) male and female students of three different institutions of higher education in Zagreb majoring in different areas; students from Faculty of Humanities and Social Sciences (FF) with major in humanities and social sciences, students from Faculty of Science (PMF) with major in science, and students from The Polytechnic of Zagreb (TVZ) with major in technical sciences or engineering - shown in details in Table 1.

Table 1. Number of female and male students participating in research differentiated by gender and institution of higher education

	FF	PMF	TVZ	TOTAL
	frequency	frequency	frequency	frequency
male students	220	73	150	443
female students	674	199	42	915
TOTAL	894	272	192	1358

The sample of variables

Students participated in this research on voluntary base. Data was obtained by filling out an anonymous questionnaire (Prot at al., 2001.) about preferences towards sport activities. The questioner shows preferences of students towards 59 sports through the scale of behavioral aims. Each student ranked a sport on the scale with five levels. Mark 5 represents a sport in which a student would definitely like to participate if there was a possibility. Mark 4 stands for a sport in which a student would gladly participate. Mark 3 corresponds to a sport in which a student would occasionally participate (or if circumstances were favorable). Mark 2 is a proxy for a sport in which students do not want to participate, or maybe would take part if there was nothing else available. Mark 1 indicates a sport in which a student would never and under no conditions participate.

Data processing methods

In processing of data we applied standard methods of descriptive and inferential statistics. All obtained data were processed with appropriate statistical software package (SPSS).

Results and discusions

Tables 2 through 5 show results of 10 most and least favorite sports from the viewpoint of students of three different higher education institutions. The results are ranked on the base of average mark.

Table 2. List of the first 10 sports from the viewpoint of female students

	HIGHER EDUCATION INSTITUTION - female students								
	FHSS			FS			TPZ		
	SPORT	Mean	N	SPORT	Mean	N	SPORT	Mean	N
1	dances	3,77	638	dances	3,86	199	badminton	3,79	42
2	badminton	3,32	651	weekend outfitting	3,71	199	aerobics	3,57	42
3	aerobics	3,32	650	badminton	3,53	199	dances	3,52	42
4	yoga	3,32	643	swimming	3,46	199	volleyball	3,48	42
5	swimming	3,23	641	aerobics	3,45	199	weekend outfitting	3,43	42
6	fitness	3,22	637	roller skating	3,42	199	figure skating	3,31	42
7	weekend outfitting	3,11	637	figure skating	3,30	199	roller skating	3,31	42
8	roller skating	2,98	634	cycling	3,28	199	fitness	3,24	42
9	cycling	2,93	641	fitness	3,21	199	swimming	3,12	42
10	volleyball	2,87	637	yoga	3,14	199	cycling	3,02	42

Table 2 shows the list of the first 10 sports from the viewpoint of female students (1 - 10) due to the value of arithmetic mean. It is noticeable that female students prefer sports that include music, rhythm and esthetic, like dances and aerobics, but sport-recreational activities such as weekend outfitting, badminton, swimming, volleyball and fitness are also ranked highly. Female students find badminton and volleyball appealing also because they are not interacting via direct physical contact with the opponent in contrast to all the other sport games that did not show up on a list of most desirable ones. Weekend outfitting, cycling and mountaineering are recreational activities they use in order to satisfy their needs for exercise in the nature on their own and with company. Generally they have shown tendency toward physical activities that can be preformed individually and do not have primarily competitive character. Aerobics, as a typical '' feminine '' activity, holds a high desirable place among all students because it enables most of them achieving personal success. Along with aerobics, yoga and badminton are sports with which many of them encounter for the first time at faculties because they were not a part of mandatory program in their education, and they are highly ranked on a list of desirable sport-recreational activities.

An adequate offer of sport contents during education surely enables participation in beneficial physical activities.

Table 3. List of the last 10 sports from the viewpoint of female students

	HIGHER EDUCATION INSTITUTION - female students								
	FHSS			FS			TPZ		
	SPORT	Mean	N	SPORT	Mean	N	SPORT	Mean	N
1	wrestling	1,42	640	wrestling	1,37	199	bowling	1,40	42
2	body building	1,42	634	weight lift	1,56	199	field hockey	1,50	42
3	weight lift	1,48	638	body building	1,60	199	kayaking/canoeing	1,64	42
4	field hockey	1,60	639	ice hockey	1,71	199	softball	1,64	42
5	rugby	1,62	631	sport fishing	1,76	199	wrestling	1,67	42
6	sport fishing	1,64	629	rugby	1,78	199	sport fishing	1,67	42
7	ice hockey	1,69	640	bowling	1,89	199	baseball	1,69	42
8	bowling	1,69	639	boxing	1,91	199	water-polo	1,69	42
9	triathlon	1,73	634	baseball	1,94	199	golf	1,71	42
10	water-polo	1,73	634	triathlon	1,97	199	triathlon	1,71	42

Table 3 shows the list of the least 10 sport-recreational activities from the viewpoint of female students. The direct contact in wrestling and boxing along with unesthetical component in weight lifting and body building is main reason female students refuse participating in that activities. Likewise they are not fond of typical ''male'' sports like ice hockey, field hockey, rugby and water polo.

There are no significant differences in the most and in the least desirable sport activities among female students of different higher education institution.

Table 4. List of the first 10 sports from the viewpoint of male students

	HIGHER EDUCATION INSTITUTION - male students								
	FHSS			FS			TPZ		
	SPORT	Mean	N	SPORT	Mean	N	SPORT	Mean	N
1	football	2,97	211	football	3,37	73	football	3,73	150
2	table tennis	2,84	208	table tennis	3,18	73	motto sport	3,49	150
3	basketball	2,77	210	cycling	3,00	73	table tennis	3,19	150
4	swimming	2,75	207	mountaineering	2,99	73	swimming	3,06	150
5	archery	2,71	210	swimming	2,96	73	rafting	3,04	150
6	shooting	2,71	209	basketball	2,85	73	snowboard	3,01	150
7	mountaineering	2,70	210	tennis	2,85	73	cycling	3,00	150
8	chess	2,68	211	parachuting	2,84	73	handball	2,97	150
9	cycling	2,65	210	badminton	2,79	73	basketball	2,93	150
10	weekend outfitting	2,63	210	chess	2,79	73	tennis	2,92	150

Table 5. List of the last 10 sports from the viewpoint of male students

	HIGHER EDUCATION INSTITUION - male students								
	FHSS			FS			TPZ		
	SPORT	Mean	N	SPORT	Mean	N	SPORT	Mean	N
1	callisthenics	1,32	211	acrobatics	1,42	73	callisthenics	1,54	150
2	aerobics	1,37	211	aerobics	1,52	73	acrobatics	1,58	150
3	tuned swimming	1,43	211	sport gymnastics	1,56	73	aerobics	1,63	150
4	sport gymnastics	1,48	209	callisthenics	1,56	73	tuned swimming	1,67	150
5	acrobatics	1,49	210	tuned swimming	1,58	73	roller skating	1,89	150
6	roller skating	1,66	211	roller skating	1,84	73	yoga	1,92	150
7	figure skating	1,72	210	softball	1,88	73	sport gymnastics	1,93	150
8	wrestling	1,76	209	wrestling	1,89	73	field hockey	1,94	150
9	equestrian sport	1,78	209	yoga	1,92	73	figure skating	1,94	150
10	field hockey	1,79	210	field hockey	1,99	73	softball	1,95	150

Table 4 shows the list of the first 10 sports from the viewpoint of male students (1 - 10) due to the value of arithmetic mean. Male students of three higher education institutions mostly prefer football. Popularity of this sport, especially the media one, is obvious in the world as in Croatia, and the desire for companion is present also. Sports such as table tennis, badminton, tennis, basketball and handball are ranked very high. It is interesting that fitness is not listed among top ten desirable activities, and that so called "adrenalin" sports like moto sport, rafting, snowboarding and parachuting are listed among the top ten popular sports especially among The Polytechnic of Zagreb's students. All these sports require high psycho-physiological abilities and exhausting training, and they present danger, raise adrenalin level and offer students the ability to prove themselves and to others. Financial conditions are the key boundary for engaging in this sort of sports and they are impossible for implementing in regular physical education. Swimming is highly ranked and is of interest for students mainly because of the simplicity of movement, health aspect and individual approach. The choice of top ten sport activities differs by students of different higher education institution. FF's students are into archery and shooting meanwhile these sports are of no interest to PMF's and TVZ's students. Likewise, TVZ's students do not list chess which is interesting to both FF's and PMF's students.

Male students of three different high education institutions share the same attitude towards the choice of the least ten desirable sport activities and do not want to engage in so called '' feminine '' sports which have a strong esthetic component.

Table 5 shows list of the last ten sports from the viewpoint of male students to the value of arithmetic mean. From all shown it can be inferred that there exist statistically significant differences among preferences toward certain sport-recreational activity due to gender differences.

Conclusions

This research was conducted in order to improve physical education by introducing various sport programs that would primarily fulfill and take into consideration needs, dispositions and interests of students of different institutions of higher education. Based on detailed analysis of obtained data, the physical education can be organized in a better way on what can be achieved not only based on material prerequisites but by homogenizing groups according to their interests and commitment to a sport. With this kind of approach it is possible to appropriately plan physical education and to influence improvement of anthropological features of student population.

Considering that interests and needs of different students for physical activity differ and depend on their abilities and conditions to engage in different activities, there is a need for continuance of this research and monitoring of present condition, to plan and program future activities. The possibility of an individual choice, from variety of sport programs at different faculties, would motivate students to think of physical activity and education as their daily need and satisfaction, and not as an obligation or a burden, which presents a challenge for the students as well as for the professors.

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RELATIONS BETWEEN SOME ANTHROPOLOGICAL CHARACTERISTICS AND SCHOOL SUCCESS IN PARTICULAR SCHOOL SUBJECTS OF THE 5TH ELEMENTARY SCHOOL GRADE PUPILS

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Abstract

The purpose of this research was to determine relations between anthropological characteristics and the school success of the 5th grade pupils of elementary school. Sample of examinees included 231 schoolboys and 214 schoolgirls. Anthropological characteristics in both samples have been estimated according to the set of 10 variables, tests, which are commonly used in the curriculum of the subject of physical education, and the school success was determined using the set of variables which consists of grades from 10 obligatory school subjects. The canonical correlational analysis was used to determine relations between selected sets of variables. It has determined statistically significant relations in three canonical pairs for schoolboys, and four pairs for schoolgirls. The obtained and interpreted canonical pairs in both samples point to the connection between the sets of the variables and the existence of the different results in mentioned pairs in the result structure , considering the gender of examinees. These results indicate the importance of the subject of physical education in elementary school.

Key words: *anthropological characteristics, grades, pupils, canonical pairs*

Introduction

Nowdays, as part of educational process in elementary school, it is very important to influence positively on the pupils bio-psyho-social characteristics with the purpose of their preparedness for a qualitative functioning, in current as well as future everyday life situations. According to optimal growth and development, a significant role has also been attributed to the positive transformation of anthropological status of pupils to which, undoubtedly and considerably, the school subject of physical education can contribute. It is important to point out that physical education as the only subject in which teaching contents considered in the curriculum for the particular grade depend on the specific level of the pupils' knowledge and abilities. In other subjects there is the usage of the universal program contents which are the same for all pupils. Also the success in other subjects, to a certain degree, includes only the acquirement of theoretical knowledge and the ability of its use, while in physical education the role of pupils' motor knowledge and achivements dominates, as well as getting a desirable level of their anthropological characteristics. It is well known that adequate and systematical physical exercise has positive effect not only on the development and maintaining morphological characteristics and motor and functional abilities, but also on the improvement of cognitive abilities (Findak & al., 2006). Grades in particular subjects depend mostly on development and acquirement of different aspects of cognitive abilities, which are largely conditioned by acquisition and the usage of theoretical knowledge in practice. Considering these facts, the importance of the physical education, as planned and purposeful organized process of physical exercise in educational system, is generally and unfoundedly degraded. So far the researches dealing with the connection of morphology and the motor space (Kondrič & al., 2002), as well as the connection of motor space and school knowledge (the Katić,1988.), have indicated the existence of significant relations in the school population.

The purpose of this study was to determine relations between some anthropological characteristics, and these are anthropometric characteristics, motor and functional abilities which are estimated with standardized tests used in physical education, and with grades expressing the 5th grade pupils' success of chosen elementary schools, in order to explore the influence of the mentioned anthropological characteristics and its effect on the school success.

Methods

The examinee sample in this research consisted of 231 schoolboys and 214 schoolgirls of the 5th grades from 14 elementary schools from the area of Varaždin county (Bednja, Cestica, Druškovec, Kamenica, Klenovnik, Maruševec, Petrijanec, Radovan, Vidovec, Vinica, Višnjica, Voća, Vrbno, Tužno). The measuring of the examinees was carried out in January, February and March 2007.

For the purpose of this research two sets of variables were used, one for the evaluation of anthropometric characteristics of motor and functional abilities, and the other for the evaluation of school success of pupils. The variable sample for the evaluation of mentioned anthropological characteristics includes 10 standardized tests which are commonly used in the physical education. The domain of anthropometric characteristics considers body height (ATV), body weight (ATT) and forearm circumference (AOP). For the evaluation of functional and motor abilities of examinees the following tests have been used: 6minute run (F6), hand tapping (MTR), polygon backwards (MPN), bent-arm hang (MIV), straddle sit-and-reach (MPR), standing broad jump (MSD) and sit-ups (MPT). The set of variables for evaluating the school success includes grades from 10 regular school subjects which examinees got in the first semester of 2006 / 2007: Croatian language (HRV), Art education (LIK), Musical education (GLA), Foreign language(JEZ), Mathematics (MAT), Science (PRI), History (POV), Geography (GEO), Technical education (TEH) and Physical education (TZK). The canonical correlational analysis was used for establishing the relations beetween selected variable samples, especially for both defined samples and the analysis computer program Statistica 6.0 was used for processing all data. The chosen and interpreted pairs of canonical factors in both examinee samples are based on the coefficients of canonical correlation of factor within particular canonical pair (Canonicl R) and square of canonical correlation (common variances of factors in pair (Canonical R – the QR) shown for boys in table 1., and for girls in table 3. in the next chapter. In order to establish the statistical significance of coefficients of canonical correlations the level of statistical significance was set on $p < 0,05$.

Results

In the schoolboys sample the canonical correlational analysis established statistically significant relations between the sample of variables for the evaluation of anthropological characteristics and the sample of variables for the evaluation of school success in three pairs of canonical factors (the table 1.). The obtained values show that the first pair has explained 21% of variances, the second pair 17%, and the third 14%. All three significant pairs of canonical factors draw 51% of total variances.

In the schoolgirls sample the canonical correlational analysis established statistically significant relations between the sample of variables for the evaluation of anthropological characteristics and the sample of variables for the evaluation of school success in four pairs of canonical factors (table 4.). The obtained values show that the first pair has explained 31% of variances, the second pair 26%, the third 20%, and the fourth 14%. All four significant pairs of canonical factors draw 51% of total variances.

Table 1. Basic parameters of the canonical correlational analysis in domain of the anthropological characteristics and the school success of the schoolboys sample

	Canonicl	Canonicl	Sign.
	R	R-sqr.	(p)
1	0,46	0,21	0
2	0,41	0,17	0
3	0,38	0,14	0,02

Table 2. Structure of canonical factors in the variable set for the evaluation of anthropolog. characteristic of the schoolboys sample

	CAN1	CAN2	CAN3
ATV	0,049	-0,608	0,032
ATT	0,132	-0,383	-0,022
AOP	0,086	-0,206	0,085
F6	-0,394	0,183	0,473
MTR	-0,503	0,212	-0,492
MSD	-0,474	0,507	0,143
MPN	-0,593	0,186	0,314
MPR	-0,744	-0,401	-0,196
MIV	-0,245	-0,014	0,080
MPT	0,049	-0,073	-0,430

Table 3. Structure of canonical factors in the variable set for the evaluation of school success (grades) of the schoolboys sample

	CAN1	CAN2	CAN3
HRV	-0,368	0,134	-0,347
LIK	-0,529	-0,285	0,134
GLA	-0,53	0,058	-0,162
JEZ	-0,468	-0,293	-0,454
MAT	-0,230	0,159	-0,361
PRI	-0,391	-0,118	-0,248
POV	-0,539	-0,095	-0,246
GEO	-0,481	-0,075	-0,603
TEH	-0,507	0,484	-0,360
TZK	-0,668	0,266	0,185

Table 4. Basic parameters of the canonical correlational analysis in domain of the anthropological characteristics and the school success of the schoolgirls sample

	Canonicl	Canonicl	Sign.
	R	R-sqr.	(p)
1	0,56	0,31	0
2	0,51	0,26	0
3	0,45	0,20	0
4	0,37	0,14	0,002

Table 5. Structure of canonical factors in the variable set for the evaluation of anthropolog. characteristic of the schoolgirls sample

	CAN1	CAN2	CAN3	CAN4
ATV	0,140	0,029	-0,132	0,394
ATT	-0,065	-0,184	-0,537	0,367
AOP	0,028	-0,279	-0,437	0,271
F6	0,186	0,402	0,411	-0,187
MTR	0,662	-0,084	-0,105	-0,164
MSD	0,753	0,381	0,348	0,285
MPN	0,575	-0,149	0,253	-0,436
MPR	0,184	0,581	-0,556	-0,245
MIV	0,037	0,282	0,678	-0,205
MPT	-0,009	0,519	0,184	0,017

Table 6. Structure of canonical factors in the variable set for the evaluation of school success (grades) of the schoolgirls sample

	CAN1	CAN2	CAN3	CAN4
HRV	0,432	0,191	-0,343	0,186
LIK	0,066	0,594	0,085	-0,164
GLA	0,310	0,453	-0,530	-0,028
JEZ	0,569	0,322	-0,304	-0,081
MAT	0,444	0,516	-0,173	0,465
PRI	0,288	0,551	-0,351	0,246
POV	0,421	0,212	-0,080	0,332
GEO	0,508	0,365	-0,267	0,417
TEH	0,584	-0,042	-0,468	0,177
TZK	0,839	0,270	0,293	-0,044

Discussion and conclusion

The canonical correlation analysis has determined existance of statistically significant relations in three pairs of canonical factors in the schoolboys sample (factor structures presented in table 2. and 3.) and four pairs in the schoolgirls sample (presented in tables 5. and 6.).

The first canonical factor for schoolboys, in the variable set for evaluation of the anthropological characteristics, is defined monopolarly and it is possible to define it as a factor of general mobility. It is mostly explained with variables that evaluate flexibility, coordination, speed of hand movement and explosive strength, while the repetitive strength and static strength contribute to the canonical correlation in smaller degree. In the evaluation of school success it can be defined as a factor of general success, with small contribution of mathematics grade, but with the largest contribution of physical education grade. The relation of the first pair of canonical dimensions could be explained as the overall school success conditioned by the pupils general mobility development. The second canonical factor has bipolar characteristics, and in the variable set for the anthropological characteristics evaluation it has been mostly defined by body height, explosive strength (on the positive pole), flexibility and bodyweight in smaller degree. In the other variable set it is mostly defined by the success in the subjects of technical and physical education on positive pole and the success in the subjects of foreign language and art education on negative pole. The obtained relation could be defined as successful practical usage of knowledge, in specific tasks, stimulated with manifestations of motor abilities which depend on body structure. The structure of the third canonical factor in the first variable set is mostly contributed by aerobic endurance and coordination on the positive pole, or speed of movement and repetitive strength on the negative pole. In the variables of the school success evaluation it is defined monopolarly and explained with certain success in almost all subjects, mostly in geography, and least in musical, art and physical education. One could say that in these canonical factors which are primarily defined by mentioned abilities, there is very little contribution to success in subjects of musical and technical education as well as in physical education.

In the schoolgirls sample the first canonical factor in domain of anthropological characteristics is dominantly explained by the explosive strength, speed of movement and the coordination and it is possible to define it as a factor of the inborn motor abilities. In the variable set of grades, is dominantly explained by the success in physical ed. , but also by the success in other subjects which contributes to its definition (with the exception of grade in art ed.). The relation of the first canonical pair could be explained as the success mostly in the physical education, but also in other subjects, conditioned mainly by the level of the girls' inborn motor abilities. The second canonical factor is in the domain of girls' characteristics mostly explained by the variables for evaluation of flexibility, repetitive strength, endurance and explosive strength in smaller degree. Within grades it is mostly defined by the success in art ed., science, mathematics and musical ed.. Therefore, in order to explain the obtained relation it is possible to say that it is based on previously mentioned girls' abilities whose level contributes to the success in mentioned subjects. According to this pair of canonical dimensions one could conclude that it is related to specific usage of acquired knowledge in teaching. This can be also illustrated by the lower figures in obtained correlation with the physical education grade, because one is likely to say that pupils in 5th grade have poor foundation of motor knowledge. The third canonical factor is mostly explained on the positive pole by static strength and aerobic endurance, and on the antipole by the variables for the total body mass and flexibility evaluation. In the domain of success it is mostly defined by grade in musical and technical ed., but it is also largely contributed by the grades in science, croatian and foreign language. The established relation indicates influence direction of those caracteristics on succes in specified subjects. The last significant isolated canonical factor is mostly defined by anthropometry variables on positive and coordination on negative pole. It could be defined as a factor of growth and development, followed by failure of coordination in task realisations. In the area of success it is determined by grades in mathematics, geography

and history. This relation could be described as a successful acquisition of curriculum contents from mentioned subjects, associated with characteristics of schoolgirls' growth and development.

The research results show almost regular distribution of all variables in three statistically significant canonical pairs in the schoolboys sample, which means that it is possible to claim, with great amount of certainty, which anthropological characteristics and in which degree participate in success in particular subjects. In the schoolgirls sample, in four statistically significant canonical pairs, there is an overlap between the influences of anthropological characteristics and the grades in some subjects, so one could say that there are some variations when explaining the girls' school success. The obtained relations of canonical dimensions in this research, based on the results gained from 231 schoolboys and 214 schoolgirls from 14 elementary schools, point to the existence of great influence of the estimated examinees' anthropological characteristics on their success in elementary school. As the physical education is the only subject in educational system to have the aim for developing and transforming the anthropological characteristics which, as it is well known, have important roles in integrated development of pupils, the future researches certainly need to pay more attention to mentioned anthropological characteristics in school success in order to define their connections better and more precisely.

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EFFECTS OF SPORTS-ACTIVITY PROGRAMS IN REDUCING SUBCUTANEOUS FAT IN FOUR-YEAR-OLDS

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Abstract

Today, children are spending increasingly less time meeting their natural need for physical activity, while the benefits of physical exercise are vital to the proper growth, development and health of every child.

This paper explores the effects of a nine-month sports-activity program (four 50-60 minute sessions per week) on changes to the morphological features of city children of preschool age. The sample consisted of four-year-olds of both sexes: the experimental group included 57 children from two sports-oriented nursery schools: Rijeka ("Zamet") and Zagreb ("Vjeverica"); the control group, 39 children attending nursery schools: Rijeka ("Oblačić") and Zagreb ("Različak") that offer conventional nursery-school programs. Results show that the kinesiological program did not generate any statistically significant differences in body mass, skeletal dimensions or circumferences, whereas a statistically significant difference occurred in skinfold measurements in favour of the experimental group in terms of subcutaneous fat reduction that can be attributed to the effect of the kinesiological program. Properly designed sports-activity programs for nursery school children contribute significantly to regulating optimum body structure, preventing obesity and, in turn, to ensuring the health of children.

Key words: *sports-activity programs, preschool children, body structure*

Introduction and subject of the paper

It is in a child's nature to exercise, jump about, climb things, run around…, but what happens to the children who spend too much time indoors, do not get enough play, aren't very active and sit around too much? And if, in addition, these children have no peers with whom they can spontaneously engage in play, but instead regard their television set as a friend (Welsman, Dietz, Gortmaker, 1985), the question emerges as to whether such children will be able to meet their innate need for exercising or will they begin to acquire sedentary habits from a very early age?

Today's way of life for most young families implies that their child attends all-day nursery school. For this reason, it is vital that nursery schools possess internal (good programs), as well as external quality (well equipped).

Kinesiological programs targeting preschool children should provide for the proper growth, development and health of every child. Namely, well-organised sports-activity programs can yield multiple benefits to children of preschool age. The development of motor skills and abilities will unquestionably contribute to the cognitive, social and emotional development of preschool children.

Seeing how, today, full attention is focused on the issue of insufficient physical activity from earliest childhood, kinesiological programs – designed for preschool children and organised in a way that ensures the participation of all children regardless of their social status – are a strategy for child health care and combating obesity, which has, in the past decade or so, also been on the rise in preschool children (Ogden, Flegal, Carroll, Johson, 2000).

Objective of the paper

The objective of this paper is to determine whether a nine-month, programmed kinesiological program designed for preschool children can impact on certain changes in morphological features, especially in reducing subcutaneous fat in children attending sports-activity programs.

Methods

a) Study sample

The study sample consisted of children of the age of four:

The experimental group comprised 57 four-year-olds of both sexes from two sports-oriented nursery schools, one in Rijeka ("Zamet") and one in Zagreb ("Vjerevica"), who participated in a nine-month, sports-activity program that was designed for preschool children and carried out four times weekly in 50 – 60 minute sessions (Hraski, Živčić, 1996).

The control group consisted of 39 four-year-olds of both sexes who attended a conventional, regular nursery school program at two nursery schools, one in Rijeka ("Oblačić") and the other in Zagreb ("Različak").

The girls and boys of the experimental and control groups were compared together. The chi-square test was applied to establish that no differences exist in distribution per sex between the groups. Another reason why boys and girls were not compared separately and a comparison of sexes was not made is that the size of the sample was not large enough and any possible differences that might be obtained could be attributed to chance and not to the actual situation.

Table 1. Distribution per sex within experimental and control groups

GROUP	GIRLS, N (%)	BOYS, N (%)	CHI-SQUARE TEST	*P*
Experimental	25 (43.9)	32 (56.1)	0.0182	0.89
Control	17 (42.6)	22 (57.4)		

b) Measuring instruments

An assessment of morphological attributes was conducted with 12 anthropometrical measurements measured using a standard procedure according to the International Biological Program (Weiner and Lourie, 1969) and using measures that are commonly applied in kinanthropometrics procedures (Mišigoj-Duraković *et al.*, 1995).

Morphological measurements used in defining body volumen and mass are: body mass (BM), upper-arm circumference (UARMC), upper-leg circumference (ULEGC); in defining skeletal dimensions: height (H), leg length (LEGL), arm length (ARML), elbow breadth (ELBB), fist breadth (FISTB), knee breadth (KNEEB); and in determining subcutaneous fat: upper-arm skinfold (UARMSF), back skinfold (BACKSF), and lower-leg skinfold (LLEGSF).

c) Description of the experiment procedure

The experiment was conducted in nursery schools in Rijeka ("Zamet" and "Oblačić") and in Zagreb ("Vjeverica" and "Različak"). The above mentioned anthropological measurements were taken of both groups – the experimental groups at "Zamet" and "Vjerevica", and the controls groups at "Oblačić" and "Različak" – at the beginning and at the end of the experimental program.

The experimental group was subjected to a nine-month, programmed sports-activity program designed for preschool children and carried out four times weekly in 50 – 60 minute sessions (Hraski, Živčić, 1996). The primary features of the program are: integration with basic nursery school programs; the development of motor-skills potential in children; appropriate equipment and facilities for the age group in question; two coaches cooperating with nursery school teachers; the testing of motor skills, proper diet. The contents of the program on which the delivery of the project is based include: basic forms of physical activity, techniques of sports disciplines, and playing. During the same time, the experimental group attended a regular nursery-school program.

d) Data processing methods

Basic statistical data (descriptive statistics: arithmetic mean, standard deviation) were calculated for all particulars of the tests.

The independent samples t-test (Student's t-test) was used to compare the results of initial measurements between the experimental and control group, and the paired (dependent samples) t-test was used to compare the progress of the individual variables over a nine-month period. The chi-square test was used to compare distribution per sex between the groups.

The independent samples t-test (Student's t-test) was used to compare the progress of the experimental group and the progress of the control group in morphological variables, calculated at the individual level for each study subject for each particular test by subtracting the results of final measurements from the results of initial measurements. A multi-variant analysis of progress between the groups was carried out by forward stepwise discriminant analysis.

Results and discussions

Table 2 presents the results of comparing the initial measurements of the experimental and the control group.

Table 2. Comparison of initial measurements of morphological anthropometrical features of four-year-olds of the experimental (N=57) and control groups (N=39), and the statistical significance of differences

Variables	E1	SDE1	C1	SDC1	t	p
WEIGHT kg	17.8	2.50	19.5	2.37	-1.08	**0.28**
HEIGHT cm	105.36	5.32	105.75	4.36	-0.42	**0.67**
LEGL cm	55.53	3.51	56.07	3.17	-0.85	**0.40**
ARML cm	43.67	2.75	43.53	2.22	0.29	**0.77**
ELBB cm	4.79	0.42	4.97	0.36	-2.55	**0.01**
FISTB cm	5.57	0.32	5.58	0.27	-0.04	**0.97**
KNEEB cm	6.88	0.46	6.99	0.46	-1.30	**0.20**
UARMC cm	16.87	1.33	16.83	1.14	0.19	**0.85**
ULEGC cm	32.46	2.82	32.63	3.29	-0.30	**0.77**
UARMSF mm	8.49	2.87	7.77	1.99	1.51	**0.13**
BACKSF mm	4.91	1.53	4.71	1.34	0.70	**0.48**
LLEGSF mm	8.95	3.12	7.96	2.06	1.94	**0.06**

Results presented in Table 2 refer to: the arithmetic mean of initial measurements of the experimental group (E1) and the control group (C1), standard deviations (SDE1 and SDC1) of the experimental and control groups, independent samples t-test (t) and statistical significances (p).

The results obtained from initial measuring indicate that, unlike in the other variables measured (P>0,05), a statistically significant difference exists (P=0,01) in the elbow-breadth variable between the experimental and control group. This shows that the experimental and control groups are well paired and can be used to compare the prospective follow-up of the effects of the conducted program on the variable measured. Considering that no difference appeared in any one measurement other than elbow breadth, this difference can be ascribed to chance.

Table 3 presents the results of morphological measuring between the experimental and control group after nine months. They are defined as progress calculated at the individual level for each study subject and for each individual test by subtracting the results of initial measurements from those of final measurements.

Data show an increase in the morphological measurements of height, leg length, arm length, elbow breadth, fist breadth and upper-arm circumference (P<0,001 for all) in control-group children over a nine-month period, while no statistically significant changes have occurred in the variables of body mass, knee breadth, upper-leg circumference, upper-arm skinfold, and lower-leg skinfold (P>0,05 for all). In the back skinfold variable, a considerable increase in the amount of fat is observed (P=0,001). Unlike in the control-group children, in the children of the experimental group significant changes are observed in all measured morphological variables of the skeleton (P<0,01 for all) and circumferences (P<0,001 for all), as well as in variables measuring subcutaneous fat (P<0,02 for all), in which a significant reduction in all variables is observed.

Table 3. Comparison of changes to certain anthropometrical measures (final – initial measurements) between the experimental (XE) and control groups (XC), and the statistical significance of their differences

Variables	XE	XC	SDXE	SDXC	t	p
WEIGHT	1.39	1.50	0.73	1.01	-0.609	0.543
HEIGHT	4.51	4.82	1.18	3.35	-0.638	0.524
LEGL	2.00	2.03	1.22	2.28	-0.067	0.964
ARML	2.27	2.11	0.88	1.41	0.676	0.500
ELBB	0.20	0.11	0.29	0.18	1.827	0.070
FISTB	0.24	0.19	0.29	0.23	0.835	0.405
KNEEB	0.45	-0.26	1.33	2.08	-0.26	0.795
UARMC	1.36	1.58	1.91	2.32	-0.53	0.592
ULEGC	1.43	0.69	2.01	4.35	1.14	0.256
UARMSF	-0.64	0.04	1.27	1.13	-2.87	**0.004**
BACKSF	-0.21	0.43	0.67	0.86	-4.26	**0.000**
LLEGSF	-1.31	-0.26	1.44	1.57	-3.50	**0.000**

Results presented in Table 3 refer to: average progress between initial and final testing in the experimental and control groups (XE and XC), standard deviations of the experimental and control groups (SD1 and SD2), Student's t-test (t) and statistical significances (p)

The results obtained indicate that, in body mass progress, there is no statistically significant difference between the groups (experimental and control; P>0,05 for all variables) with regard to skeletal dimensions and circumferences, whereas there is a statistically significant difference between the experimental and control group with regard to skinfolds (P<0,005 for all) in favour of the experimental group, implying that the experimental group, unlike the control group, succeeded in reducing subcutaneous fat which can be ascribed to the influence of the kinesiological program. Using multivariate discriminant analysis, three variables were isolated, the progress of which significantly distinguishes the experimental group from the control group (BACKSF, P<0,001; ELBB, P=0,002; UARMSF, P=0,004; F=13,35, P<0,001 for the model). Progress of the ELBB variable is lesser in the experimental group, which is consistent with other observations and the body build of children of this age.

Concerning the impact of physical exercise on obesity, some authors have concluded that physical activity at this age does not have any statistically significant effect on the reduction of body weight but rather has a greater impact on improving motor skills. The same authors speak in favour of encouraging physical activity from this age on and of focusing attention of proper nutrition (Reilly, Kelly, Montgomery, Fisher, 2006).

A shortcoming of our study lies in the fact that, due to the size of the sample, we were unable to analysis data per sex. Another shortcoming is that the study involves only children from urban communities, and we cannot project results to children living in suburban or rural communities where results might be different.

Clearly, a strategy for child health care and obesity prevention starting at preschool age should involve an increase of physical activity and proper nutrition for children. Properly designed sports-activity programs in nursery school children contribute significantly to regulating optimum body structure, preventing obesity and ensuring child health.

Conclusion

Kinesiological programs targeting preschool children can bring about significant change to body structure by reducing subcutaneous fat. This is especially important for city children, who do not spend a lot of time in playgrounds. Kinesiological programs for preschool children help to combat obesity, making even greater the need for regular physical exercises in preschool institutions to be carefully designed and organised.

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DEPENDENCY OF MOTOR EFFICIENCY UPON THE MORPHOLOGICAL CHARACTERISTICS OF FOUR-YEAR-OLD CHILDREN

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Abstract

This paper examines the problems of establishing relationships between motor abilities, using nine variables, and morphological characteristics, using twelve variables, in four-year-old children. On a sample of 108 children of the age of four (both sexes), stepwise regression analysis was used to establish the dependency of individual motor tests upon the morphological characteristics and the sex of the children. Results obtained indicate that morphological characteristics exert an influence on the performance of most motor tests, and they show which morphological characteristics prevail in performing individual motor tests.

Key words: *anthropometric measures, motor abilities, preschool children, relations*

Introduction and paper subject

The efficiency of motor manifestations is directly dependent upon an entity's anthropometrical dimensions. In this field, the focus of analysis has mostly been on the morphological characteristics of athletes from a sample of athletes of top-level performance in their disciplines, as well as on the effect of morphological characteristics on performance in particular sports disciplines (Blašković, 1979).

The relationship of morphological and motor characteristics in school children (Kondrić, Mišigoj, Metikoš; Pejčić) and in children athletes (Malina, Bouchard, Bar-Or, 2004) has also been a subject of research, in which the authors have concluded that it is important for motor space and morphological space to be researched jointly.

As preschool children are increasingly becoming the focus of research in kinesiology, the question arises as to the reasons for monitoring this age group, in terms of kinanthropology.

Assuredly, the reasons are many and involve needing to:

- Know how our children are growing and whether they are developing properly, and, to call attention to any irregularities, early on, that may occur in the relationships of kinanthropological characteristics in the growth and development process;
- Detect the first signs of obesity;
- Analyse the state of functional and motor abilities;
- Learn about the habits of children of preschool age (do they spend too much time in front of the television, sitting down, indoors…);
- Identify the extent to which the lifestyle of parents impacts on the lifestyle of a preschool child and how this reflects upon the later life of the child;
- Associate morphological characteristics with motor efficiency, for example, to which extent does corpulence impact on strength;
- Understand the impact of regular exercising (participating at least three times weekly in 45 minutes sessions in a kinesiology program geared to preschool children) on improving motor and functional abilities, on morphological characteristics (reduction of subcutaneous fat) and on the proper growth and development of a child.

If irregularities in the growth and development of a child, which could result in increasingly greater problems at an older age, are brought to the attention of the child and his/her parents at an early stage, the chances of combating these unrelenting elements (over-weight, elevated blood pressure, poor functional and motor abilities) are much greater if the fight begins early on in a preventative, rather than therapeutic form.

Objective of the paper

The objective of the paper is to determine whether the results obtained in individual motor tests of four-year-olds are dependent upon the morphological characteristics and the sex of the child and to establish the extent of this association.

Methods

a) Study sample

The study sample consisted of 108 four-year-old children of both sexes (the same number of boys and girls) attending nursery schools in Zagreb ("Vjeverica" and "Različak") and in Rijeka ("Zamet" and "Oblačić).

b) Sample of variables

An evaluation of morphological attributes was conducted with 12 anthropometrical measurements measured using a standard procedure according to the International Biological Program (Weiner and Lourie, 1969) and using measures that are commonly applied in kinanthropometrics procedures (Mišigoj-Duraković, 2008).

Morphological measurements used in defining body volume and mass were: body mass, upper-arm circumference, upper-leg circumference; in defining skeletal dimensions: height, leg length, arm length, elbow breadth, fist breadth, knee breadth; and in determining subcutaneous fat: upper-arm skinfold, back skinfold and lower-leg skinfold.

The evaluation of motor efficiency in four-year-olds was carried out using nine motor tests. Three tests (carry-the-blocks, sit-ups and toe-touches in a sitting position with feet spread) were taken from the Mediterranean American International School (1988), and three tests (standing long jump, chin-ups and the front split), from the proposed Model of Hierarchical Structure of Motor Abilities (Gredelj, Metikoš, Hošek, Momirović, 1975). Three tests (walking backwards, lifting arms in a face-down position and ring-hopping) were designed by the author, Trajkovski Višić (2004).

The tests covered the fields of coordination, strength and flexibility (three tests for each ability). The tests also covered all four motor factors that have been isolated as fundamental motor dimensions:

1. tests that cover the area in which prevails the ability of structuring movement (carry-the-blocks – agility; ring-hopping – coordination in rhythm; walking backwards – reorganising the stereotype of motion),
2. tests, the results of which are largely affected by the mechanism of functional synergy and muscle tone regulations (front split, toe-touch in a sitting position with feet spread, lifting arms in a face-down position - flexibility),
3. a test in which the prevailing factor is the regulation of movement intensity (standing long jump – explosive strength of the legs),
4. tests in which the prevailing factor is the regulation of the duration of excitation (sit-ups – repetitive strength of the torso, chin-ups – static strength of the arms and shoulder area).

c) Data processing methods

Data was processed and analysed using STATISTICA version 6.0 (StatSoft, Tulsa, USA). $P<0.05$ was considered as statistically significant. After all variables were tested for normality of distribution using Kolmogorov-Smirnov test stepwise regression analysis was performed for each of the dependent variables representing motor efficiency. Stepwise regression was used as the most conservative method because of the relatively small sample and a dozen of used independent variables.

Results and discussion

Stepwise regression analysis is an indication of the association of dependent variable with independent variables. This means that it identifies the independent variables that are likely to have the greatest impact on the outcome of dependant variables.

On a sample of 103 to 108 children of the age of four, by associating the dependency of the individual motor tests (carry-the-blocks, ring-hopping, walking backwards, sit-ups, chin-ups, standing long jump, split, toe-touch in sitting position, and lifting arms in a face-down position) to the morphological characteristics of the children (height, weight, leg length, arm length, elbow breadth, fist breadth, knee breadth, upper-arm circumference, upper-leg circumference, upper-arm skinfold, back skinfold and lower-leg skinfold) and to the sex of the children, the following results have been obtained:

Table 1. Stepwise regression analysis of the dependent variable of carry-the-blocks.

Number of subjects	Dependent variable	Independent variable	Beta	Standard error	t	P-level
103	Carry-the-blocks	Length of leg	-0.436	0.089	-4.87	0.000004

On a sample of 103 four-year-old children, by associating the dependency of the motor test of carry-the-blocks (agility) to the morphological characteristics and sex of the children, the stepwise regression analysis showed that leg length is the most prevailing morphological characteristic in this test (β=-0.4363; 95% CI, –0.26 to –0.61), indicating that children with longer legs achieved better results in this motor test that explains agility as a motor ability.

Table 2. Stepwise regression analysis of the dependent variable of ring-hopping.

Number of subjects	Dependent variable	Independent variable	Beta	Standard error	t	P-level
103	ring-hopping	Length of leg	-0.233	0.096	-2.428	0.016

By associating the motor test of ring-hopping (coordination) with the morphological characteristics and sex of the children, the stepwise regression analysis shows that the length of leg, as a morphological characteristic, has the highest level of dependency in this test (β=-0.233; 95% CI, -0.22 to –0.44). The result obtained show that the child with longer legs will achieve the best results in the ring-hopping test.

Table 3. Stepwise regression analysis of the dependent variable of walking backwards

Number of subjects	Dependent variable	Independent variable	Beta	Standard error	t	P-level
106	Walking backwards	Length of leg	-0.347	0.09	-3.848	0.0002
106	Walking backwards	Sex	-0.238	0.09	-2.642	0.009

By associating the motor test of walking backwards (coordination) with the morphological characteristics and the sex of four-year-olds, the stepwise regression analysis shows that this test was most closely associated to the length of leg and the sex of the child, indicating that children with longer legs achieved better results in this test (β=-0.347; 95% CI, -0.17 to –0.52) and that the results achieved by girls were superior to those of boys (β=-0.238; 95% CI, –0.06 to –0.30).

Table 4. Stepwise regression analysis of the dependent variable of sit-ups

Number of subjects	Dependent variable	Independent variable	beta	Standard error	t	P-level
106	Sit-ups	Weight	-0.546	0.180	-3.032	0.003
106	Sit-ups	Height	0.546	0.134	4.296	0.00004

The motor test of sit-ups (repetitive strength of the torso) is most closely associated to the variable of a child's weight and height, meaning that the child who weights more has poorer results (β=-0.546; 95% CI, -0.19 to –0.74). Also, the taller the child, the better the result achieved (β=0.546; 95% CI, 0.31 to 0.89). The results obtained indicate that a child who weighs more is also fatter, hence, achieving poorer results in the test, whereas a taller child is more developed and stronger, and consequently, performs better in this test.

Table 5. Stepwise regression analysis of the dependent variable chin-ups

Number of subjects	Dependent variable	Independent variable	beta	Standard error	t	P-level
108	Chin-ups	Elbow breadth	-0.216	0.0946	-2.29	0.0239
108	Chin-ups	sex	-0.179	0.0946	-1.898	0.060

By associating the motor test of chin-ups (static strength of arms and shoulder area) with the morphological characteristics and sex of four-year-olds, the stepwise regression analysis shows that this test is most closely associated to elbow breadth, indicating that the larger the elbow breadth, the poorer the results; hence, fatter children perform more poorly in this test (β=-0.216; 95% CI, -0.03 to –0.25). The independent variable of sex suggests a slight advantage in favour of boys and explains the superiority of boys over girls in performing this test (β=-0.179; 95% CI, 0.01 to 0.18).

Table 6. Stepwise regression analysis of the dependent variable of standing long jump

Number of subjects	Dependent variable	Independent variable	beta	Standard error	t	P-level
104	Standing long jump	Height	0.479	0.30255	5.509	0.0000

When the standing long jump test (explosive strength of the legs) was associated to the morphological variables and the sex of four-year-olds using stepwise regression analysis, the results showed that the variable of height has the greatest influence of the performance of the motor test of standing long jump. This means that children who are taller can jump further (β= 0.479; 95% CI, 0.31 to 0.79).

Table 7. Stepwise regression analysis of the dependent variable front split

Number of subjects	Dependent variable	Independent variable	beta	Standard error	t	P-level
108	Split	Lower-leg skinfold	0.538	0.114	4.684	0.000009
108	Split	Elbow breadth	-0.51	0.09	-5.614	0.000000
108	Split	Height	0.38	0.094	4.033	0.000106

The stepwise regression analysis of the dependent variable front split (flexibility) showed that the morphological variables most closely associated to the front split test are the lower-leg skinfold, elbow breadth and height. The results obtained indicate that: the front split test is associated to the lower-leg skinfold, explaining that the greater the skinfold of a child, the better the child's results (β=0.538; 95% CI, 0.32 to 0.85); the front split test is also associated to elbow breadth, explaining that the larger the elbow breadth of a child, the poorer the child's results in this test (β=-0.51; 95% CI, –0.33 to –0.84); the third variable to which the front split test is associated is height, explaining that the taller the child, the better the child's performance in this test (β=0.38; 95% CI, 0.20 to 0.58).

Table 8. Stepwise regression analysis of the dependent variable of toe-touch in sitting position with feet spread

Number of subjects	Dependent variable	Independent variable	beta	Standard error	t	P-level
108	Toe-touch, seated with feet spread	Upper-arm skinfold	0.253	0.093	2.694	0.008

The stepwise regression analysis showed that, for the performance of the motor test toe-touch in sitting position with feet spread (flexibility), the upper-arm skinfold is the morphological variable that has the greatest influence on test results, explaining that the greater the skinfold, the fatter the child, resulting in better performance in this test (β=0.253; 95% CI, 0.07 to 0.25). This confirms that fatter children naturally have better flexibility, a fact that some other authors have also confirmed.

Table 9. Stepwise regression analysis of the dependent variable of lifting arms in a face-down position

Number of subjects	Dependent variable	Independent variable	beta	Standard error	t	P-level
107	Lifting arms in a face-down position	Length of leg	0,424	0,09	4,06	0,000093

The results obtained indicate that children with longer legs, that is, taller children with longer extremities, performed better in this test. This means that children who have longer extremities – in this test, longer arms, as it is assumed that longer legs also suggest longer arms – will achieve better results in the test of lifting arms in a face-down position (flexibility) (β=0.368; 95% CI, 0.19 to 0.56).

Conclusion

Based on the results obtained, the interdependency of motor abilities and morphological characteristics with regard to sex has been established. This association speaks in favour of the fact that motor space should not be researched separately from morphological space, because of the significant influence that morphological characteristics exert on the structure and level of motor abilities.

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DRUG-CONSUMING AMONG 14-YEAR-OLD PUPILS WHO ARE INVOLVED IN SKIING ACTIVITIES

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Abstract

The aim of this research was to establish whether there is a correlation between sport activity and drug-taking among 14-year-old pupils who are involved in skiing activities. This research is based on a questionnaire of 30 variables and the probability relations among the variables have been tested by the Hi-square. On average, they practice sport 2 to 3 times a week. The majority of male pupils practice sport competitively (43%), while female pupils primarily practice unorganized recreational winter sports (54%). 8% male and 12% female pupils smoke; the majority of male and female pupils had the first cigarette at the age of 13. 90% male and 94% female pupils tried an alcohol beverage, the majority between ages 10 and 13. 18% male and 26% female pupils tried drugs. The prevailing types of drug-taking are vapour inhaling, pills and marijuana. The majority of pupils said they tried to smoke, drink alcohol and take illicit drugs out of curiosity. Parents mainly encourage their children to practice sport. The majority of pupils think that sport and smoking do not go together; they are of the opinion that sport activities are those activities that could discourage drug-taking. We have ascertained that there is no statistically significant correlation between sport activities and taking licit and illicit drugs. Differences would be probably more evident in a later period of time – the transition from primary to secondary school. To discourage young people from licit and illicit drug-taking, they should be offered more activities so that they can spend their free time in a reasonable and qualitative way.

Key words: *sport activity, drug-taking, pupils, skiing activities*

Introduction

The majority of people who take drugs start taking them in the most vulnerable period of growing up – adolescence. This is the period when the majority of young people goes to school and do many things not being certain if they will ever do them again later. The period from starting school to adolescence is getting shorter and shorter (Turk, 2002). Perhaps it is this rapid growing-up, which often passes them by, the reason why young people cannot plan their spare time and are often bored, are displeased with themselves and do not respect themselves – all of which can perhaps lead to a desire to have fun in a different, more dangerous way. Adolescence is also considering the meaning of life and searching one's own self (Zaletel-Kragelj, 2004). The age of 13 to 14 is the period when adolescents usually start experimenting with drugs. The coeval or group pressure is high – those who take drugs prone to encourage members of the group to do the same. The influence of parents is getting weaker. Adolescents disagree with them in many things; they are reluctant to parents' authority and keep secrets. It is also the period of numerous changes in physical appearance; adolescents are highly occupied with themselves and are worried about their appearance. The expectations form their parents and the community are growing; therefore, adolescents often lack confidence and self-confidence (Tomori, 2003).

Skiing nowadays is unquestionably one of the more important sport and recreation activities in winter time. Skiing as all other sport activities influence a child's development – it affects all aspects of the development, from motor, cognitive, emotional to social development. Alpine skiing is a physically demanding activity requiring a lot of physical strength and endurance. If we want to get appropriately fit for the skiing season, special preparations are required. The preparations start already before winter time and an all-year sport activity plays an important role here too. A universal child's development is the best injury prevention method.

The most widespread drugs among adolescents are still alcohol and tobacco. The results of a research by the European bureau of WHO, which included 162.000 young people (aged between 11 and 15) from 35 countries have shown, that 23.2% girls and 22.5% boys aged 15 have declared themselves as regular smokers. These results rank Slovenia fourth (Drole, 2004). Between 1995-2003, the percentage of young people who start smoking at the age of 11 or earlier markedly increased. Almost one third of those who in 2003 stated they have smoked, smoked their first cigarette when they were 11 or younger. Boys start smoking earlier than girls. Most critical years for girls to start smoking are the ages between 13 and 15 (Stergar, 2004).

Researches show that young people very well know how smoking affects health; however, the latent period (mostly ages between 25 and 30) when serious health problems may occur is too far away for them (Lampret, 2004). Despite that, health problems may occur already in young people. The CDC (Centres of Disease Control and Prevention) data indicates that lung capacity of young people who smoke is lower than of those who do not smoke. Smoking namely interrupts the lungs growth. Early signs of cardiovascular diseases appear quite fast in young people. Smoking weakens a person's physical shape so the endurance and motor abilities of young people are lower. The resting heartbeat rate of young smokers compared to non-smokers is faster by 2 to 3 beats per minute. Young smokers suffer from short breath three times more often. They are eight times more likely to smoke marijuana, twenty-two times more likely to take cocaine and three times more likely to drink alcohol (Stergar, 2000).

Alcohol is a drug causing 57.000 adolescents in Europe to die in car accidents every year. In Slovenia, driving under the influence of alcohol causes every third car accident with a death toll. To decrease these numbers, all of us must strive to decrease the consumption alcohol among primarily adolescents. We should be aware that the consumption of alcohol among adults influences the attitude of adolescents towards alcohol and other drugs (Rogl, 1995).

Drug addicts are rarely found among groups of people who reject drugs for their special interests and goals (Videmšek, Karpljuk, & Debeljak, 2000). Undoubtedly, sport activities represent an important factor in preventing drug-taking. Most people begin taking drugs in their youth and become addicted easily. Therefore, it is important to offer young people a number of various healthy activities, among which skiing and winter activities undoubtedly belong to as well.

The aim of this research was to analyze sport activities and drug-taking among 14-years-old pupils who are involved in skiing activities and establish their attitude towards drugs and ascertain whether there is a correlation between sport activity and drug-taking. We were interested if those young children who are more sports active less frequently take licit or illicit drugs.

Methods

Participants/ Instruments/ Procedures

The sample of subjects studied here includes 14-year-old 8th grade pupils - 124 male and 136 female pupils. The study includes pupils from 7 different primary schools in Slovenia.

This research is based on a questionnaire of 30 questions on sport and drugs, adapted for 14-year-old pupils.

Data has been processed by the SPSS software (Statistical Package for the Social Sciences). Frequency and Contingency tables have been generated with the help of FREQUENCY and CROSSTABS sub-programs. The probability relations among the variables have been tested by the Hi-square.

Results

The results have shown that all of participants are practicing skiing in their spare time. The majority practice sport 2 to 3 times a week in winter (47% male and 63% female pupils). The majority of male pupils practice sport competitively (43%); the next sport activity is unorganized recreational sport. Almost one half of female pupils practice unorganized recreational sports (Figure 1).

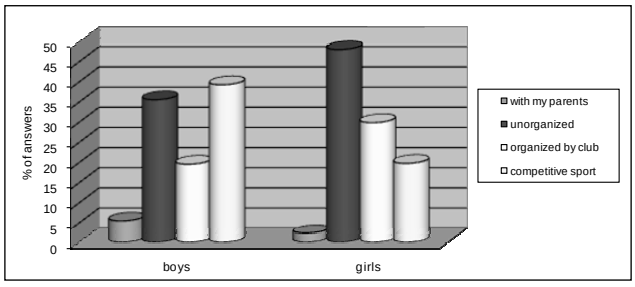

Figure 1. What kind of sport do you do?

There are about one third of parents, where both parents are sport active. This research does *not* show that pupils whose parents are *not* active would statistically significant be less sport active. Despite the fact that so many parents are not sport active, it is encouraging that the majority of parents encourage their children to do sport.

This research indicates that most pupils spend their spare time practicing skiing for meeting friends. Adolescence is the time when children push their parents away while their friends are becoming more and more important. Despite that, it is encouraging that so many young people devote their spare time to sport.

Even though the results of the WHO show that in Slovenia 23% boys and girls at the age of 15 smoke (Drole, 2005), this research indicates that in primary schools, the percentage is much lower – 8% male and 12% female students smoke. We must emphasize though that the selected sample of subjects studied here is *not* a representative one for Slovenia and

that children are one year younger. A similar research studying children of the same age (Videmšek, Karpljuk, Štihec, & Debeljak, 2003) has though shown that 11.5% students smoke. These results are quite similar to those nearly 20 years ago, where Debeljak and Kalan (1987) established that 9% boys and 14% girls aged 14 smokes.

A little over one half of the pupils questioned never tried smoking. The majority of male and female pupils had their first cigarette at the age of 13. The results have shown that there is no statistically significant difference between the frequency of sport activity and smoking. We cannot state that those who smoke are not that often sport active. The majority of those who smoke, smoke on special occasions only and the time they smoke ranges from 1 to 6 months to two and more years. The primary reason why children start smoking is curiosity. Children want to know how a person feels when smoking. At the same time, they want to be liked, or do not want to be an exception among others. The coeval pressure is high in this period and it can influence the "smoking" habits of adolescents. With over one half of male and female pupils, none of their friends they spend time with smoke. With a little less than one half, some of their friends smoke.

There is a little over one half of the questioned children's parents who do not smoke and 15% where both parents smoke. Whether parents smoke or not, does not however influence the frequency of male and female pupils sport activity. The majority is of the opinion that sport and smoking do not go together.

According to the ESPAD survey, which collects data on alcohol and other drugs among 15 to 16 year-old students in 35 European high schools, the number one drug is still alcohol. Over 90% of 15 to 16 year-old students have tried alcohol (Lorenčič, 2004). The results of this research show that 95% male and 90% female 14-year-old pupils tried alcohol. They mostly drink alcohol once a month or less frequently and first tried it between the age of 10 and 13. The main reason they have first tried alcohol is curiosity and it is the children's parents who offered alcohol to majority of pupil's questioned.75% male and 80% female parents drink alcohol. The majority of questioned pupils state they can have fun without alcohol.

The ESPAD survey shows that as much as 29% students tried illicit drugs and 7% students are regular users (Lorenčič, 2004). The results of this research show that 20% male and 23% female pupils tried drugs. The prevailing types of drug-taking are vapour inhaling, pills (e.g. sedatives) and cannabis (marijuana, hashish). The majority of pupils tried drugs at the age of 13 (8% male and 16% female pupils). Those who have tried drugs, say they first tried it for the same reason as cigarettes and alcohol – curiosity. The majority of pupils say they are familiar how drugs are harmful.

The answer to the question "What is in your opinion the most important reason young people start taking drugs?" almost one half answered it was the curiosity. The second most frequent answer was a desire to be accepted or approved by the coevals. The other answers were curiosity and attempt to overcome emotional depression anxiety and distress.

Half of the pupils questioned are of the opinion that sport activities are those that would turn young people away from taking drugs, next would be the promotion of parties with no drugs and alcohol (Figure 2).

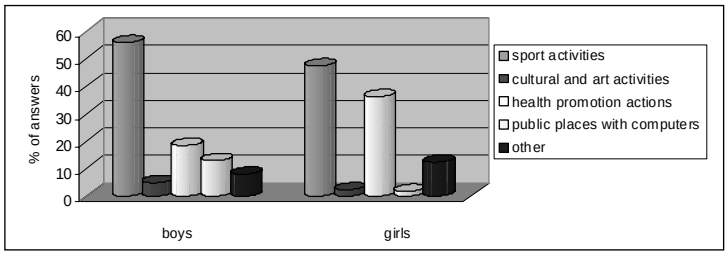

Figure 2. Which activities you think would turn young people away from taking drugs?

80% male and 85 female pupils think that there are not enough places for young people to have fun. In the future, we should make some changes to have such places for children and adolescents where they could gather and spend their spare time in a reasonable way.

We have ascertained that is no statistically significant correlation between sport activities and taking licit and illicit drugs. However, a statistically significant correlation has been ascertained between sport activities and attempts to drink beer, wine and inhaling vapours with male and female pupils. All the questions were related to attempts and not regular usage of licit and illicit drugs.

Discussion

The fact is that the problem of drug-taking cannot be entirely solved, but it could be reduced. The questionnaire was focused on 14-year-old pupils who still visit the primary school. According to their age, quite a large number of primary school pupils smoke, drink alcohol or takes drugs. The number will probably increase when these children get to a secondary school. In order to move into a positive direction, we need to be more active within the families, schools and local communities.

If parents are sport active and have their children involved in sports as well, children will accept sport as part of their everyday life and spare time. Parents are also responsible to openly talk to and inform children about the drug-taking problem (Videmšek, Karpljuk, Štihec, & Debeljak, 2003). Permissive attitude towards smoking and alcohol in a family, where in addition some of the parents smoke and drink too much alcohol, more likely causes children to start smoking or take any other drugs. Experts recommend (Stergar, 2004) parents to start talking about smoking, drinking alcohol and

taking drugs to their children when they are 5 or 6 years old, since many children have their first cigarette and an alcohol drink very early. By then, they should be appropriately familiarized with drugs being unacceptable and harmful.

Also school plays an important part; after all, children spend a lot of their time there. It is important that the school is outward oriented, accepting encouragements form the environment and tries to respond to changes life brings inside and outside of the institution. With the support from the local community, schools should offer a lot of activities for children to expand their knowledge, abilities and skills and thus enable children to spend their spare time in a qualitative way, also during school holidays vacation (summer, winter breaks). It is important that we become aware that the problem of drug-taking is increasing, along with which the age of drug-takers is decreasing. We need to act precautionary – have activities and promotions to inform children about the positive effects of sport activities on one hand, and danger and consequences of drug-taking on the other hand.

"Sport without drugs" should become a rule and a part of the moral of all who practice sport. A lot of attention is devoted to achieving a better physical shape, with which the problem of drug-taking is also related. Besides, young people can massively be motivated and convinced to join sport. Most convincing are also medical reasons and particularly the reasons pertaining to one's general appearance (Lampret, 2004).

Fight against drugs continues and is seeking new methods that would enable a more healthy way of life among young people. Schools are nowadays participating in various projects with which young people are being motivated to promote sport and not drugs. Joining in this fight are also medical and other institutions pertaining to preventive and curative treatments (Kopriva, 2002). PE teachers should get involved more as well. In cooperation with parents, they could well use sport to restrain drug-taking and build upon a relationship towards sport activities. Deprecation, prevention, and prohibition of drug-taking among young people are undoubtedly means that can help reduce these bad habits. Despite that we are of the opinion that young people will be turned away from drug-taking by means of planning a qualitative way of life. People who are adequately occupied most likely fulfil their needs by taking part in appropriate activities and these ways do not feel the need for any kind of substitutes (Sullivan, 2004).

Conclusion

One of the most important factors influencing the decrease of drug-taking habits is providing appropriate and adequate activities for young people in their spare time. It is the spare time that should be properly conducted and planned. Spare time should be fulfilled with activities that would fully engage each young individual. And sport activities, among which at first place winter activities, certainly find place among them.

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INFLUENCE OF SCHOOL ABSENTEEISM ON SOME ANTHROPOLOGICAL CHARACTERISTICS OF PULA GRAMMAR SCHOOL GIRLS

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Abstract

The aim is to determine if there is any relation between some anthropological characteristics and school absenteeism. A set of 6 variables (predictors) was applied to estimate features of 79 grammar senior class schoolgirls and 3 absenteeism variables (criteria - a total number of skipped classes and the excused and unexcused number of skipped classes). Regression analysis showed a statistically significant relation between the anthropological characteristics and every single school absenteeism variable The results showed primary biotic needs of young population have been threatened by their school absenteeism (among them PE classes, too). Teachers are trying to restore the balance by requesting parents' collaboration in solving this serious issue of enhancing avoidance of school obligations.

Key words: *anthropological characteristics, fitness, excused classes, unexcused classes, total number of skipped classes, senior class*

Introduction

Sedentary lifestyle is nowadays a basic feature of life of every age category. School population is specially exposed and vulnerable because when they begin to attend school, their way of living is changed considerably and their total physical activity is reduced dramatically. Physical education (PE) is neither sufficient or has not been adequately included in the curriculum, in spite of the fact that its importance for growth and development, health in general, prevention of developing various factors dangerous in adult life has been multiply evidenced.

Habit of lifelong chronic physical activity (PA) acquired in adolescence remains throughout the life. Changes of anthropological characteristics are health indicators and, therefore, they should be followed-up all the time, especially those that are changeable during life. In school PE a standard battery of measuring instruments has been using for several decades to follow-up crucial anthropological characteristics, including chosen anthropometric, motor and functional measures. Continuous follow-up of fitness and trends enable introduction of intervention measures to change possible physical fitness state in the interest of health protection and improvement.

The objective of this paper was to analyse the differences in the standard test battery scores assessing some anthropometric, motor and functional characteristics achieved by schoolgirls attending the Pula Grammar School senior classes. The hypothetical aim was also to point out how absenteeism in general and from PE classes included affected the observed variables.

It is a rather modern behaviour trend of the secondary school students to avoid attending school teaching (Reid, 2005, 2004). An increasing number of students is absent for unexcused reasons, and also the number of excused hours of absence has increased, but the analysis of causes surpasses the limits of this paper. We should just say that the current phenomenon is: parents are willing to justify even unexcused absence of their. Their tolerant attitude towards students' avoidance of school obligations gives a serious cause for concern and cries for deeper analysis.

Methods

The sample of subjects included 79 respondents, the senior class grammar schoolgirls from Pula who were obliged to attend regularly two PE classes per week as stipulated by their secondary school curriculum and syllabi.

The predictor set of variables consisted of measuring instruments assessing their anthropological characteristics (the standard official battery of instruments used in Croatian schools to assess students' fitness): anthropometric characteristics - *body weight* (ATT) and u*pper arm skin folds* (ANN); motor abilities - *dynamic muscle strength endurance* (MPT – number of sit-ups in 60s), *flexibility* (MPR - straddle seat forward bend), *static strength* (MIV – bent-arm hang); and aerobic endurance (functional abilities) – *6 minutes run* (F6).

The set of criterion variables consisted of 3 variables: the total number of skipped classes, the number of the by parents excused and the number of the unexcused absences from the classes.

Basic statistical parameters were calculated: arithmetic mean (MEAN), standard deviation (SD), minimum (MIN) and maximum (MAX). Regression analysis was used to determine the relations between the predictor and criterion sets of variables.

We also compared the obtained results with those published as the development norms at the Republic of Croatia level (Findak et al., 1996). Unfortunately, the author did not have any scores of female peers who exercise every day at her disposal or who are engaged in sports to compare the in the study obtained results with them, which would surely make the whole picture even clearer.

Results

Comparison between the norms and the obtained scores of Pula's girls.

Table 1. Actual anthropological characteristics of the Grammar School schoolgirls compared with the average results at the Republic of Croatia level

Variables	Excellent values at the Republic of Croatia's level	the obtained scores - MEAN	SD	MIN	MAX
ATT – kg	less than 59	61	8.13	49	80
ANN – mm	11 – 12	14	3.76	8	22
MPT - numbers	49 and more	34	5.76	21	48
MPR – cm	86 and more	67	8.79	51	84
MIV – s	54 and more	13	10.87	0	68
F6 – metres	1300 and more	930	131.95	99	1150

The significant statistical differences are obvious in almost all the variables – all in favour of the norms. We are glad that body weight and skinfolds did not appear as statistically significant, but maximum values are causing some concern. Do not forget that these features are susceptible to exercise, active lifestyle and proper nutrition habits.

Motor abilities, whose innate coefficients are considerably lower, as repetitive and static strength, and flexibility are under considerable influence of the process of exercises, and, therefore, it is possible to expect their further development. However, they are stagnating or even declining. Table 1 shows that average value of static strength of arms and shoulder girdle (MIV) is only 13 seconds and it corresponds to the below-average values of the elementary school first class pupils.

And aerobic endurance, being also under considerable influence of exercise, cannot be called even poor; they are disastrous when compared with the average values expected at that age. As functional abilities belong to those characteristics on which significant influence is possible during the whole life span, even in old age, the status of our girls cries for emergency intervention of all relevant factors, parents among the first.

Table 2. Senior class girls' (N=79) absences during the observed school year

Absence	*MEAN*	*MIN*	*MAX*	*SD*	*TOTAL No.*
EXCUSED HOURS	119.49	4	447	38.71	**9,440**
UNEXCUSED HOURS	4.68	6	40	2.86	**369**
TOTAL HOURS					**9,809**

Absenteeism and truancy is obviously a great pedagogical issue - during a school year lasting 32 weeks, the subjects were absent 9,809 hours in total, 9,440 hours were excused and 369 hours were truant (not excused). On average, each Pula Grammar senior class student was absent 120 excused and 5 unexcused hours. If one school working day comprises 7 class periods, it means that each student was absent 17 days or 2.5 weeks per year on average.

Table 3. Correlations between the predictor and the criterion variables

	ATT	ANN	MPT	MPR	MIV	F6	EXCUSED	UNEXC.	TOTAL
ATT	**1**								
ANN	0.45	**1**							
MPT	-0.33	-0.51	**1**						
MPR	-0.46	-0.54	0.54	**1**					
MIV	-0.54	-0.46	0.55	0.59	**1**				
F6	0.02	0.04	0.03	-0.14	0.11	**1**			
EXCUS	-0.17	0.05	-0.05	-0.13	0.06	0.06	**1**		
UNEXC	0.11	0.11	0.04	-0.11	-0.09	0.01	0.21	**1**	
TOTAL	-0.24	0.03	-0.01	-0.16	0.10	0.06	0.82	0.31	**1**
P<0.05									

Table 4. Regression analysis results

	B	SE B	BETA	t	p
Variables	547.10	164.19		3.33	0.00
ATT	-3.94	1.50	0.13	-2.62	0.01
ANN	1.60	3.21	0.07	0.50	0.62
MPT	0.56	2.03	0.04	0.28	0.78
MPR	-3.12	1.20	-0.40	-2.61	0.01
MIV	0.75	0.73	0.16	1.01	0.31
F6	-0.00	0.06	-0.00	-0.04	0.98

Multiple R	.4054
R. Square	.1643
Adjusted R Square	.0947
Standard Error	.6929
F	2.359
P<. 0388	

A wide range of correlations among the predictors is obvious (Table 3); they vary from high negative, over zero, to high. The probable reason is that variables belong to different structure of human characteristics, and on the biotic basis they are sometimes indispensably negative, sometimes positive, or only in either moderate positive or negative correlation. It is natural that weight (ATT) is in the positive correlation with skin fold (ANN), and in the negative one with dynamic muscular strength endurance (MPT), flexibility (MPR), and strength of the arm and shoulder girdle muscles (MIV).

Criterion variables are positively connected as expected (0.82 and 0.31 for excused and unexcused skipped hours in relating to the total number of absence, respectively). Correlations between the predictor and criterion variables are zero, moderately positive and more frequently negative, and in fact, they are two almost independent sets of variables. At first sight, this is a paradox, because it means that the anthropometric, motor and functional features have no contribution to absences, i. e. that absenteeism and truancy are independent of those anthropological characteristics. In order to determine more exactly such results in this paper, the results were subjected to regression analysis, too (Table 4).

According to the regression analysis results it was possible to explain the criterion by certain parts of the predictor set, although the explained variance was small (16.43 %). Two significant individual predictors were singled out. The first one is weight (**ATT**) and its contribution is negative (-0.35). It is the same with flexibility (**MPR** –0.46). It is possible to come to a conclusion from the obtained results that the students of greater body mass, lower values of flexibility and aerobic endurance were more absent from school. The reasons should be searched, among other things, in two sources: in the developing stage and physical activity.

These results underline a necessity to pay high attention to quality of PE classes teaching, to all kinds of extracurricular activities and out-of-school training in order to increase good fitness and maybe help in that way reducing total absences from school.

The results obtained in this research are of primary importance for the kinesiologists working at schools and other teachers. But they also depend on many other intramural and environmental factors, not only physical education, such as population specific factors, development stage, physical activity, social milieu, as well as on the socio-economic family conditions and general culture of living.

All the above indicates the fact that primary biotic requirements – physical activity in all forms, of young population have been impaired and threatened, and we are trying to restore the balance by requesting the parents' support when justifying absences and tolerating students' excuses from the school obligations.

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CHANGES OF MOTOR ABILITIES IN THE PROCESS OF PHYISICAL EDUCATION

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Abstract

The initial locomotive parameters were taken on the sample of 192 subjects, sixth grade female pupils of elementarz schools, while the final testing was done six months later. Twelve tests were used to define the mechanisms of structuring motion, synergie regulation and tension regulation and tension regulation, the intensity of excitation and duration of excitation and duration of excitation. Applying the multivariant analysis of the variance, the obtained results indicate that the physical education classes resulted in statistically significant chages in the level of the researched parameters at the multivariant level. As for the univariant level, a statistical significance was determined for nine of the total of twelve test. The author believes that the results of this research can be very useful in high-quality planning, programming, realisation, and control of the pedagogic activities with the pupils of this age group.

Key words: *locomotive space, physical exercise devices*

Introduction

Physical education represents a pedagogical process that, by means of physical exercises methodically and sistematically, influences on reinforcing and strenghtening of health, development of physical abilities, acquisition of locomotive abilities and development and cultivation of moral and estethic qualities in order to form a versatile developped personality.

Success of pupils in the physical education classes is conditioned by the structure of many different abilities, knowledge and qualities that can be measured and analysed and thereafter, by means of appropriate instruments of physical exercises and working methods, get improved in the course of teaching process. According to the official Curriculum of physical education teaching, the pupils of the sixth grade of elemenetary school were enabled to adopt locomotive abilities in athletics, basketball and exercises on instruments and on floor. These sports within some pupils are highly demanding in the sense of partecipation of numerous anthropological qualities while the others, structurally simpler sportive disciplines are basically less demanding in the anthropological sense.

Establishing of abilities and qualities of pupils is one of the basic teacher's activities in the framework of increasing of anthroplogical qualities and locomotive abilities.Diagnostic procedures in the physical education are important in order to determine individaul qualities and abilities of pupils. The testing results make easier planning and work programming and represents the firs step in creating, supervision and control of teaching process. On the basis of established anthrolplogical qualities of pupils can be set the optimal aims and tasks of teaching process for certain teaching cycles.

Following the realisation of the curriculum, of the process of innovation of educational teaching work and evaluation of the results shouldn't be only the elements for the further improvment of the educational practise but as well as to encourage a teacher to keep constantly his attitude towards work as more responsable and creative.

Realisation of this longitudinal study was accomplished within one semestar following the effects of physical education in the sixth grade of elemenatry schools. The content of transformational process were exerices on instruments and on floor, athletics and basketball.

Subject and problems of the study

Subject of the study

Subject of the study are locomotive abilities of female puplis of elementry schools age 12 years comprehended with regular physical education curriculum.

Study issue

Results of the study and of following of development of locomotive abilities of children and young people should have an important role in adopting of Curriculum and as well as during the implementation of transformational processes according to the individual abilities and features.

The individual form of work and especially work with homogeneous groups is still not enough represented in physical education classes. This issue deserves a special attention as from the point of view of developing pupils' autonomy, their critical opinion and creativity as well as from the point of view of teaching democratisation, i.e. to enable every pupil to achieve its best results with his own abilities.

In this work, the subject of the study is how much does the physical education influence on changes of the level of locomotive abilities of elementary schools pupils.

Aim of study

According to the subject and issue of the study, the aim of the study is to establish the changes of locomitive abilities in the process of physical education.

Methods

For the needs of this study was chosen a sample from pupils of elementary schools, age 12 years +-6 months, comprehended with regular classes of physical education. The sample consisted of 86 pupils.

A sample of variance was composed in order to provide basic information regarding basic locomotive abilities of examinees. To measure locomotive abilities were used variances from Kurelic and collaborator's study from 1975.

To estimate mechanisms of structuring motion

1. Agility on floor MOTL
2. Foot tapping MTAN
3. Hand tapping MTAP

To estimate action of synergic regulation and tension regulation

4. Toe touching MDPK
5. Front split MSPA
6. Staying on one foot along balance bench MSUK

To estimate mechanisms of excitation regulation

7. Running 20 m startup M20L
8. Standing jump MTRS
9. Flying jump MSDM

To estimate mechanism of regulation of excitation duration

10. Capriole MVIS
11. Body lifting on swedish bench MDTK
12. Mixed knuckles MMZG

In this study were established the effects of physical education classes on changes of locomotive abilities of pupils by means of multivariant analisys of variance (MANOVA) and on the basis of data from the initial and final measuring of locomotive abilities.

Results

The results of tests of equality of dispersion (chart 1) on the initial and final measuring obtained by means of Box's M test transformed into F relation, indicate discarding of hypothesis of equality of dispersion, therefore the analysis of variance in multivariant space is justified.

Chart 1. Testing of equality of dispersion of initial and final measuring

Box's M	145.80
F test	2.03
Q	**.000**

At locomotive dimension of mechanism of motion structuring (variances 1, 2 and 3), shown in chart 2, was deduced a statistically important increase of final measuring level in relation to the initial level what is indicated by univariant F test and its statistically probability Q.It is important to underline that larger part of locomotive tasks at variances of mechanism for motion structuring consists of movements for which execution are very important previously formed locomotive programes gained at classes of physical education. The applied tests, although locomotive complicated, are not considerably connected with intelectual processes because there aren't any locomotive issues in informative sense. Mostly prevails energetic component, therefore for the speed of movement execution are essential subcortical (locomotive) regulative mechanisms, and cortical activity comes up to probable corrections according to the demands of concrete locomotive activity.

Chart 2. Relation between variances on univariant level

Variance	Inter group squares	Inner group squares	F test	Q
1. MOTL	292.30	30.08	8.36	**.002**
2. MTAN	203.05	12.32	14.43	**.000**
3. MTAP	456.28	39.60	10.52	**.002**
4. MDPK	386.38	123.38	3.10	.073
5. MSPA	4673.62	222.70	16.06	**.000**
6. MSUK	159.90	146.32	1.02	.210
7. M20L	1.38	.30	3.50	**.022**
8. MTRS	9874.01	2261.56	30.10	**.000**
9. MSDM	3400.22	618.20	4.62	**.020**
10. MVIS	195.01	896.01	7.33	.461
11. MDTK	296.20	34.82	7.33	**.006**
12. MMZG	176.22	27.42	5.46	**.011**

WILKS'S LAMBDA	.562
GENERAL CORELATION σ	.998
F TEST	78.22
Q	**.000**

Statistically significant increase of the level of synergic regulation and of tension regulation (variance 4, 5 and 6) at the end of testing period is present only at front split MSPA. At variance toe touching (MDPK) and staying along the balance bench (MSUK) is not established a statistical significance in final measuring in relation to initial one, because the applied exercises in physical education classes didn't affect the variance of structural features of muscles and ligaments and their elasticity although the level of this parameter depends on structure and shape of joint bodies where the movement occurs.

The instruments for exercises have influenced statistically significantly on the increase of level of mechanism of exitation intensity what was confirmed at the end of testing period (variance 7,8 e 9). This probably occured due to the fact that the tasks were good prevision for exterioration of high activity of nervous-muscular system, elasticity and ability of muscles relaxing. During the research of changes under influence of physical education, Bilić (2005) obtained statistically significant changes of variance (7,8 i 9) at sample of twelve-years old female pupils of elementary school. Besides, for this parameter are very important energetic supplies in the muscles as well as increased entry of energetic substances.

Statistically significantly increase of results at the mechanism of exitation duration (variance 10,11 and 12) is not present only at variance jumping (MVIS). At the other variances (lifting on the swedish bench (MDPK) and mixed knuckles (MMZG) the applied instruments for exercises for physical education caused statistically important increase of this dimension, probably due to higher frequency of activating of locomotive time units situated in the area of abdominal wall and shoulders. At these tests is dominantly present repetitive strenght that represents ability for long term work necessary to overcome the appropriate external charge up to 75% of maximum.

Chart 3. Differences in results of measurements influenced by experimental treatment

F TEST	78.22
Q	**.000**

WILKS LAMBDA λ test, that determines quality and quantity of differences coming from the influence of testing treatment of applied set of locomotive tests at the initial and final measuring, shows that with a notable certitude can be rejected the assumption of equality of centroids in two subsequent measuring.

Conclusion

In the process of physical education that lasted 6 months, were followed the effects of realisation of phyiscal education classes at female pupils of sixth grade of elementary schools. At the end of testing period, in the manifesting area, was ascertained that statistically important increase of level of nine variances of 12 in total that define dimensions of locomotive abilities. In the latent space was ascertained that a whole set of locomotive variances is statistically different at the final in relation to the initial measuring.It can be supposed that regular methodical formation of physical education classes (instruments, charge, methods for development of physical and functional abilities, forms of work etc.) affected positivelly on the increase of locomotive abilities level of pupils. The results of this study can be useful for a better planning, programming, execution and control of physical education classes with the pupils of this age.

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THE RELATIONSHIP BETWEEN SCHOOL CONDUCT AND SWIMMING PERFORMANCE OF HIGH SCHOOL STUDENTS

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Abstract

We have attempted to show the existence of a relationship between the swimming performance of students and their school conduct. Tests were conducted on a sample of 101 first year students from the Sisak Vocational School during a four year period. The 25 and 50-metres freestyle and the 25-metres backstroke techniques were used for the comparison, as well as exemplary, good and poor school conduct. A multivariate analysis of variance showed significant differences and students with exemplary conduct, had better results in all 3 motor tests. Therefore, we can conclude that school conduct has a statistically significant impact on swimming performance as the activity requires certain knowledge that depends on better conduct.

Key words: *high school students, impact, kinanthropological attributes, conduct*

Introduction

The subject of research of a large number of kinesiologists (Kurelić, Momirović, Stojanović, Šturm, Radojević, Viskić Štalec (1971, 1975) Gredelj, Metikoš, Hošek, Momirović (1975)) has been centred on the structural and functional approaches to examining the anthropological area of students of various ages. The largest number of professional and scientific works can be found at the Faculty of Kinesiology of the University of Zagreb, including those of Reljić, Juras, Findak and Neljak. In their scientific works, Neljak (1992), Findak and Cankar (1995) elaborated on the pedagogic impact on students, as well as conducting research on the relationship between kinanthropological characteristics and conduct of first year high school students (2008). However, as the results of the research did not yield a statistically significant difference, it remains a debated issue - one group of kinesiologists believe that a difference does exist and another group doubts there is any possibility or justification for such a possibilty. We have attempted to show that a difference does exist through 3 swimming performance tests that were executed on a sample of vocational (trade) school students.

Methods

The sample of students was drawn from Sisak Vocational School. The students were all aged 15 and were first year students enrolled in one of the following vocational diploma courses - construction site equipment operation, crane operation, ceramics and plating, truck operation, painting and decorating, brick masonry and carpentry. The careful selection of courses was due to the fact that the said three year courses have minimum admission requirements. In other words, even students with a low grade point average in elementary school can enrol. Over the course of 4 years, a sample totalling 101 first year students was taken from the 2002/2003 to the 2006/2007 school year.

For one set of criteria, the conduct of each student was recorded as either exemplary, good or poor. Exemplary conduct assumed that the student attended class regularly, had a maximum of 5 unjustified absences, and was both a model to his peers and persevering in his studies. A teacher's proposal for exemplary conduct had to be approved by the school's Faculty Board. Good conduct assumed that the student had committed an infraction, had 11 to 22 unjustified absences and had neglected certain student duties. Lastly, poor conduct assumed that the student had received verbal or written warnings or was suspended and had over 23 unjustified absences. Warnings and infractions had to be approved by the Academic Board, whilst warnings, suspensions and terminations had to be approved by the Faculty Board. Furthermore, students with poor conduct had committed a breach of discipline, were likely to neglect student duties and were prone to destructive behaviour towards other students and the school.

The second set of criteria included 3 swimming performance tests. Students were tested in 3 swimming techniques – 25-meters freestyle, 50-meters freestyle and 25-meters backstroke. The results were recorded during physical education classes. It should be mentioned that due to poor economic and technical conditions, 60% of the total number of planned class hours at Sisak Vocational School are organised as swimming activities. Thus, students spend a large amount of time at the Sisak Sports Centre, which has an Olympic-size swimming pool.

Data processing was done by a Statistics Program (for Windows 6.0).

Results and discussion

The first 4 tables (Tables 1-4) concentrate on the descriptive features - number of students (N), mean (Mean), minimum (Min) and maximum (Max) results, range (Range), variant (S^2), standard deviation (S), squashed (A3) and curvature distribution (A4). When taking into consideration only the mean (Mean), there is evidence of a difference in swimming performance among all 3 groups. According to inverse metrics, poorer swimming performance is actually an indication of better student results. Therefore, by calculating the mean of the swimming performance tests the resulting value is lower. This indicates that students with poor conduct had the lowest results and were the slowest swimmers (Table 1). At the same time, students with good conduct (Table 2) achieved medium results, whilst those with exemplary conduct achieved the best results (Table 3). The biggest mean differences were visible between the 25-metres and 50-metres freestyle results. Consequently, it is possible to conclude that swimming performance results are related to student conduct. Further proof of this theory can be seen in Table 5.

When a system of kinanthropological characteristics and conduct assessment is applied, the resulting Wilks value ג (0.88) and overall difference coefficient Rao's R (2.18) are statistically significant as the discrepancy is less than 5% (p=0.047).

Table 1. Kinanthropological characteristics of students with poor conduct

k=1	N	Mean	Min	Max	S.D.	A3	A4
FRE_25	37	20.02	15.84	31.69	3.80	1.58	2.17
FRE_50	37	49.36	38.65	80.48	9.23	1.46	2.56
BAK_25	37	28.55	20.93	48.54	6.83	1.37	1.42

Table 2. Kinanthropological characteristics of students with good conduct

k=2	N	Mean	Min	Max	S.D.	A3	A4
FRE_25	29	19.63	14.94	25.78	2.68	0.68	0.01
FRE_50	29	47.38	34.26	64.03	6.48	0.29	0.25
BAK_25	29	27.38	20.51	62.12	8.14	2.99	11.64

Table 3. Kinanthropological characteristics of students with exemplary conduct

k=3	N	Mean	Min	Max	S.D.	A3	A4
FRE_25	35	18.36	14.13	21.05	1.63	-0.60	-0.14
FRE_50	35	43.54	35.88	55.62	5.03	0.29	-0.33
BAK_25	35	26.05	19.27	55.47	6.07	3.60	16.45

Table 4. Kinanthropological characteristics of total number of students

	N	Mean	Min	Max	S.D.	A3	A4
FRE_25	101	19.33	14.13	31.69	2.94	1.67	4.01
FRE_50	101	46.77	34.26	80.48	7.57	1.40	3.60
BAK_25	101	27.35	19.27	62.12	7.00	2.50	8.10

Table 5. Results of multivariate analysis of variance

	Wilks λ	Rao's R	df 1	df 2	p
1	0.88	2.18	6	192	0.047

The biggest differences in Table 6 can be seen between the 25-metres and 50-metres freestyle variables, whilst the 25-metres backstroke variable did not yield a statistically significant difference and cannot be related to any of the recorded models of conduct. As some practitioners have theorised, results indicate that differences in conduct can be distinguished through swimming activities.

Table 6. Impact of individual variable

	Mean Effect	Mean Error	df	p
FRE_25	26.61	8.28	3.21	0.04
FRE_50	312.54	52.09	6.00	0.00
BAK_25	56.47	48.90	1.15	0.32

Vocational schools have a relatively homogenous student body. The students are usually of a specific social and economic status, with certain conative characteristics, and the students' overall curricular achievement in elementary school has a direct impact on their further education, which usually implies enrolment in a vocational school. Conditions of enrolment include grades in specific subjects, a medical check-up and the selection of a trade (trade workshop). Furthermore, scholarships have been introduced to encourage students to enrol in vocational schools. These are all reasons behind the visibly more liberal conduct of vocational school students, which results in poor conduct assessment, as well as the fact that teachers have a more subtle approach to such students. The final conduct assessment is the result of all the pedagogic measures a student received during the school year. Positive pedagogic measures can result in praise or awards, whilst infractions are dealt out to students who have committed a breach of discipline or have not fulfilled their duties. Thus, students assessed as having good conduct have received infractions due to breaches of conduct, many hours of unjustified absence, or frequent interruptions in class. Students who are given a poor conduct assessment have usually committed a number of breaches of the student conduct code during and outside of class and are often involved in cases of violence and bullying. Such conduct can sometimes lead to crises as teenagers change on both a cognitive and biological sphere and have the need to prove their independence and develop their personal identity. In this case, certain motor skills can be evidence of the type of student one is dealing with. In the descriptive tables (Tables 1, 2, 3, 4), it is clearly visible that students with exemplary conduct are also, on average, the fastest swimmers in all three swimming disciplines – 25 and 50-metres freestyle and 25-metres backstroke. Taking into consideration that water is a specific medium, which requires certain rules of conduct and a high level of motor knowledge for executing the swimming activity, it is evident that students with exemplary conduct approached the PE activities and tasks with a higher degree of awareness. Both the 25 and 50-metre runs fall into the sprint category, therefore, regardless of a student's natural speed capacity, without acquiring the necessary swimming technique, especially breathing, it is impossible to achieve satisfactory results - recorded as motor skills achievement. Swimming demands continuous practice and resolve and does not fall under the category of leisure activities. Furthermore, there is little or no communication in this individual water sport. Therefore, taking into consideration these facts, it is not a surprise that students with poorer conduct were also poorer swimmers. In the 25-metres backstroke test, all the students had more or less equal results regardless of their conduct assessment (Table 4). The biggest difference in the results could be seen in the 50-metres freestyle test (Table 4). Backstroke is the least demanding technique as the breathing is not of such a vital importance. This is further proof of the dedication, resolve and concentration needed during swimming activities, which definitely requires exemplary conduct.

Conclusion

The article has attempted to confirm the existence of a relation between swimming performances in the 25-metres freestyle, 50-metres freestyle and 25-metres backstroke techniques and exemplary, good and poor student conduct on a sample of 101 first year students from Sisak Vocational School during a 4 year period. A multivariate analysis of variance did, in fact, show considerable differences. Swimming performances in the 25 and 50-metres freestyle techniques accounted for the greatest difference between students, whilst there was no statistically significant difference in the 50-metres backstroke. Some of the reasons may be attributed to students' mental and physical engagement in the swimming lessons, or simply better student conduct. A higher level of concentration makes adopting the freestyle technique much easier, which, due to the respiration factor, is technically more demanding than backstroke. Therefore, students with exemplary conduct showed better results in all 3 tests and in addition, the statistical data showed that major differences were present between the 25 and 50-metres freestyle, which requires not only innate abilities (speed), but also a certain degree of skills. Although students with exemplary conduct also had better results in the 25-metres backstroke test, the research did not yield a statistically significant difference as the style is less demanding and all students had relatively similar physical abilities (speed) and skills (backstroke technique) regardless of their conduct.

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THE RELATIONS AMONG THE FUN OF GENERAL PHYSICAL EDUCATION, THE INTENTION OF ADHERENCE TO EXERCISE, AND THE POSSIBILITY OF ADHERENCE TO EXERCISE IN UNIVERSITY

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Abstract

The objective of the present study is to explain the relations among the fun of general physical education, the intention of adherence to exercise, and the possibility of adherence to exercise in university. For this purpose, we chose the students of four-year universities in Seoul as the population, and selected 325 students through convenience sampling. Collected data were analyzed through frequency analysis, factor analysis, reliability analysis and multiple regression analysis using SPSS 14.0, and from this procedure were drawn conclusions as follows.

First, the fun of general physical education in university affects the intention of adherence to exercise. That is, the sub-factors of the fun of general physical education, which are physical-mental health maintenance, the development of sociality and the sense of achievement, were found to have an effect on the intention of adherence to exercise.

Second, the fun of general physical education in university affects the possibility of adherence to exercise. That is, the sub-factors of the fun of general physical education, which are physical-mental health maintenance, the development of sociality and the sense of achievement, were found to have an effect on the possibility of adherence to exercise.

Key words: *general physical education, students, adherence*

Introduction

Like that in high school, general physical education in university socializes ordinary students into indirect participants of sports (Yang Jae-geun et al., 2003). Accordingly, the purpose of general physical education is to raise people of whole personality and decent democratic citizens. Specifically, through physical education in university, students improve and maintain their health, develop morality, lead an active campus life and social life, and furthermore, acquire the attitude of participating in sport activities joyfully through their entire life (Park Yong-yeon, 1990). For this reason, general physical education is a stepping stone to lifelong physical education, and can work as a driving force for enhancing the quality of life. Accordingly, we need physical education strategies for increasing consumer-centered options. In order to provide various options for students' voluntary participation, we need to develop and distribute exciting and enjoyable subjects and to enhance students' participation in physical education classes.

Research on fun has been led by Scanlan and his research team (Scanlan & Simons, 1992; Scanlan, Stein, Ravizza, 1989). Fun in sports is "a positive emotional response to feelings from playing sports such as pleasure, fondness and interest" (Scanlan & Simons, 1992). Different from the view that fun is merely an indicator of internal motive (Csikszentmihayi, 1975; Kimiecik & Harris, 1996), this is a very comprehensive concept including the internal and external dimensions as well as the dimensions of achievement and non-achievement. Fun has been explained by many studies that explored the factors of fun in various sport situations including before and after a game (Chalip, Csikszentmihalyi, Kleiber & Larson, 1984; Passer & Scanlan, 1980), during the season (Brustad, 1988; Scanlan & Lewthwaite, 1986), and players' most competitive state during the days on the active list (Scanlan et al., 1989)

Moreover, researches on the intention and possibility of adherence to exercise have paid attention to the development of casual models on participation in sports (Spreitzer & Snyder, 1976) or made efforts to understand participation in sports using Sewell's social role system (Kenyon & McPherson, 1974), and some researchers analyzed the relation between motor perception and sport participation and proposed that individuals' high confidence in motor abilities induce them to participate in sports most effectively (Fox, Corbin, & Couldry, 1985). What is more, it was found that exercise experiences before adulthood have a positive effect on continuous exercise afterwards (Bucher, 1974; Curtis, McTeer & White, 1999; Howell & McKenzie, 1987; Kelly, 1980).

As presented above, general physical education in university is considered to be related to fun and the intention and possibility of adherence to exercise, but there has been no analysis or verification so far. Thus, the present study analyzed the relations among the variables by surveying university students who were attending general physical education class in order to provide basic materials for physical education classes in middle school, high school and university. Furthermore,

this study is expected to enhance the importance of school physical education and to induce people to take interest in physical education class. In particular, this study will arouse university students, who have their social life ahead, interest in exercise and may activate their attending of general physical education. Thus, this study purposed to explain the relations among the fun of general physical education, the intention of adherence to exercise, and the possibility of adherence to exercise in university, and for the purpose, we formulated research questions as follows.

First, how is the fun of general physical education related with the intention of adherence to exercise?

Second, how is the fun of general physical education related with the possibility of adherence to exercise?

Methods

Subjects

This study chose university students who were attending the general physical education class as the population, and sampled students from 4 four-year universities in Seoul. A total of 400 students were selected through convenience sampling, but 325 students were included in the final analysis. The subjects' personal characteristics are as in <Table 1>.

Table 1.

Characteristic		Sample size (n)	Percentage (%)
Gender	Male	222	68.3
	Female	103	31.7
Year	Freshman	100	30.8
	Sophomore	86	26.5
	Junior	82	25.2
	Senior	57	17.5

Research tools

In order to examine the relations among the fun of general physical education, the intention of adherence to exercise and the possibility of adherence to exercise in university, this study used a questionnaire titled <Survey on the Fun of General Physical Education in University and the Intention and Possibility of Adherence to Exercise> as a survey tool. The questionnaire was composed of questions on personal characteristics as antecedent variables, those on fun as an independent variable, and those on the intention and possibility of adherence to exercise as dependent variables.

In order to measure the relations among the variables and the degree of the relations, we measured all the variables except personal characteristics with interval scales, which are for continuous data. The questionnaire was designed based on relevant previous research and theories useful for the purpose of this study.

The scale of fun was prepared by adapting for this study the fun scale developed by Lee Chang-seop & Nam Sang-woo (2003) and used by Lee Dong-joon (2006). In the scale, each question used a 5-point scale ranging from 'Very uninteresting' (1 point) to 'Very interesting' (5 point).

The scale of the intention and possibility of adherence to exercise was prepared based on the questions on intention to participate in sports used by Seo Hee-jin (2003). Each question used a 5-point scale ranging from 'Absolutely not' (1 point) to 'Absolutely yes' (5 point).

Validity and reliability of the questionnaire

In order to test the validity of the questionnaire used in this study, a group of specialists reviewed the questionnaire and discussed the validity and adequacy of its contents, and the questionnaire was revised and supplemented as recommended by the specialists. In addition, the final validity of the questionnaire was tested through exploratory factor analysis using survey data. As presented in <Table 2>, when Bartlett's identity matrix was 1439.765, significance probability was .001 and Kaiser-Myer-Oklin's MSA was .832, showing that the data were adequate for factor analysis. Based on the data proved adequate, factor analysis was carried out for 10 questions on fun and as a result 3 factors were extracted, and the extracted factors appeared to explain 70% of the whole variation.

Furthermore, in order to see internal consistency among the sub-scales of each variable, this study extracted reliability coefficient Cronbach's α as in <Table 2>. Cronbach's α was .748 or higher, showing that the scale was relatively reliable.

On the other hand, because the intention of adherence to exercise and the possibility of adherence to exercise were asked with a single question, the validity and reliability of the scale were not tested.

Table 2.

Bartlett's identity matrix (χ^2=1439.765, df=45, p=.001)
kaiser-Myer-Oklin's MSA=.859

Question	Funs			Common variance (h^2)
Question No.	Physical-mental health maintenance	Development of sociality	Sense of achievement	Common variance (h^2)
4	**.802**	.239	.162	.727
6	**.780**	.212	.202	.694
7	**.763**	.254	.160	.672
5	**.741**	.128	2.66	.636
2	.238	**.865**	.112	.818
1	.211	**.854**	.103	.784
3	.202	**.745**	.207	.639
10	.122	.188	**.842**	.759
8	.301	.011	**.828**	.781
9	.278	.367	**.583**	.551
Eigenvalue	2.712	2.385	1.963	
Variance (%)	27.124	23.854	19.629	
Cumulation (%)	27.124	50.978	70.606	
Reliability	.843	.832	.748	

Data processing

In this study, the present researcher and assistants distributed and recollected questionnaires after obtaining the physical education professor's consent. The participants were instructed to answer all the questions by the self-administration method. Inadequately or unreliably answered questionnaires were excluded, and the finally obtained questionnaires were digitized and analyzed through frequency analysis, factor analysis, reliability analysis and multiple regression analysis using SPSS 14.0.

Results

Relation between the fun of general physical education and the intention of adherence to exercise

< Table 3> shows the results of analyzing the relation between the fun of general physical education and the intention of adherence to exercise.

Table 3.

Variable	b	SEB	ß	t	p
Physical-mental health maintenance	.259	.066	.241	3.917	.001
Development of sociality	.223	.062	.206	3.614	.001
Sense of achievement	.198	.064	.181	3.111	.002
F=38.193(p<.001)		R^2=.263			

As presented in <Table 3>, the fun of general physical education was found to have an effect on the intention of adherence to exercise. That is, physical-mental health maintenance, the development of sociality and the sense of achievement affected the intention of adherence to exercise. In addition, the degree of relative influence was high in order of physical-mental health maintenance (ß=.241), the development of sociality (ß=.206) and the sense of achievement (ß=.198). Variable 'the fun of general physical education' explained 26.3% (R^2=.263) of the intention of adherence to exercise.

Relation between the fun of general physical education and the possibility of adherence to exercise

< Table 4> shows the results of analyzing the relation between the fun of general physical education and the possibility of adherence to exercise.

Table 4.

Variable	b	SEB	ß	t	p
Physical-mental health maintenance	.263	.065	.239	4.059	.001
Development of sociality	.242	.060	.219	4.010	.001
Sense of achievement	.272	.062	.243	4.372	.001
F=51.671(p<.001)		R^2=.326			

As presented in <Table 3>, the fun of general physical education was found to have an effect on the possibility of adherence to exercise. That is, physical-mental health maintenance, the development of sociality and the sense of achievement affected the possibility of adherence to exercise. In addition, the degree of relative influence was high in order of the sense of achievement (ß=.243), physical-mental health maintenance (ß=.239) and the development of sociality (ß=.219). Variable 'the fun of general physical education' explained 32.6% (R^2=.326) of the possibility of adherence to exercise.

Discussion

General physical education in university plays an important role as a base of lifelong physical education. Accordingly, the present study is highly meaningful in that it provides basic materials for university physical education for students attending physical education and enhances the importance of physical education in school. This study purposed to explain the relations between the fun of general physical education in university and leisure satisfaction, between fun and the intention of adherence to exercise, and between leisure satisfaction and the intention of adherence to exercise. In addition, we discussed the relations among the variables based on the results of data analysis.

According to the results of this study, when the relation between the fun of general physical education in university and the intention of adherence to exercise was analyzed, fun was found to have an effect on the intention of adherence to exercise. That is, the intention of adherence to exercise was affected by the sub-factors of fun, which are physical-mental health maintenance, the development of sociality and the sense of achievement. This suggests that university students' decision on adherence to exercise is significantly influenced by funs such as weight control, stress relief, pleasure and fondness. This emphasizes that general physical education in university is an important factor in providing students with a motive for continuous participation in physical activities, which is one of the ultimate purposes of physical education. Furthermore, this result partially supports the previous report that exercise experiences in adulthood can have a positive effect on exercise participation afterwards (Scanlan, & Simons, 1992; Spreitzer, & Snyder, 1976). What is more, it is consistent with the result of previous research that exercise experiences during school days influence continuous exercise during adulthood (Lee Dong-joon, 2006; Curtis, McTeer, & White, 1999; Yang, 1997).

On the other hand, when the relation between the fun of general physical education in university and the possibility of adherence to exercise was analyzed, fun was found to affect the possibility of adherence to exercise. That is, the possibility of adherence to exercise was affected by the sub-factors of fun, which are physical-mental health maintenance, the development of sociality and the sense of achievement. This result partially supports the reports by Bonds (1980) and Shonstrom & Walker (1973) that those who participate in sport activities continuously have higher exercise satisfaction than those who have stopped participation in sport activities. As it is reported that long participation in physical activities is mostly because of fun (Harter, 1981; Wankel & Kreisel, 1985), it is believed that fun has a determinant effect on the possibility of adherence to exercise.

From the results of our analysis presented above is concluded that the fun of general physical education in university has a positive effect on the intention of adherence to exercise and the possibility of adherence to exercise. Accordingly, general physical education in university is regarded as a process of improving and maintaining students' health, upgrading the quality of campus life in terms of sociality and morality, and laying the base for future decent social life. Moreover, because physical education in university provides students with a motive for continuous participation in physical activities after graduation, it should reflect the opinions of students pursuing the fun of general physical education.

Conclusions and suggestions

The objective of the present study was to explain the relations among the fun of general physical education, the intention of adherence to exercise, and the possibility of adherence to exercise in university. For this purpose, we selected 325 university students through convenience sampling from four-year universities in Seoul. Collected data were analyzed through frequency analysis, factor analysis, reliability analysis and multiple regression analysis using SPSS 14.0. From the results obtained through this procedure were drawn conclusions as follows.

First, the fun of general physical education in university has an effect on the intention of adherence to exercise. That is, the sub-factors of fun, which are physical-mental health maintenance, the development of sociality and the sense of achievement, were found to affect the intention of adherence to exercise.

Second, the fun of general physical education in university has an effect on the possibility of adherence to exercise. That is, the sub-factors of fun, which are physical-mental health maintenance, the development of sociality and the sense of achievement, were found to affect the possibility of adherence to exercise.

On the other hand, this study limited its subjects to university students in Seoul. Thus, it is uncertain whether the results of this study can be generalized to university students in other areas. Accordingly, it is necessary to verify these results through additional research by sampling from the whole population of university students in the country.

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NEUROPHYSIOLOGICAL ASPECTS OF PRE-COMPETITIVE MENTAL STATES

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Abstract

One of the key variables for understanding the measurement procedures in finding out mental and pre-competitive states of athletes is anxiety. Anxiety as a state represents current emotional state of mind, connected with activation of the organism, that is showing in unbalanced reactions on the physiological, emotional and behavioral level. We are aware that we can not observe all reactions that are accompaning anxiety with our bare eye, that is why there are a lot of mechanisms for their observation: oscillograph, amplificator, to all different kinds of polygraphs. With them we can exactly register different physiological happenings or changes in heartbeat, in the brain, breathing, body temperature, toning of the muscles... The most sensible measurements are suppose to be, as different authors state, galvanic skin response and changes in the heart rate, blood flow and blood pressure. While working with athletes for the stress analysis and of controlling their pre-competitive states of mind we also use the peak achievement training, the polygraph and EEG feedback - neurofeedback. The later represents instrumental learning process, that is resulting in an improved control of EEG activity. This procedure comprehends the use of external EEG monitoring device, specially designed to convey individual electrical brain activity of the athlete. By observing appearances of a certain (tone) feedback display and the corresponding assorted mental state an athlete can learn to detect the changes and to regulate the connection between feelings and attention. That is possible because he is getting a feedback about his brain activity. Neurofeedback can strongly affect the peak performance of the athletes, specially in the sports where focus is very important (archery, golf, shooting skiing, ski jumping, track and field etc.). The results of neurofeedback training for achieving peak performance of the athletes depend on the length of the training programme and on the appropriate criteria for training that can be compared with other cognitive techniques used for enhancing performance of athletes.

Key words: *mental states, neurophysiology, sport physiology*

Stress and anxiety

Athlete's psychic characteristics are presenting a part of basic dispositions of athletes, that define his possibility for success in competition or in his career. One of the key variables for understanding the measurement procedures in finding out mental and pre-competitive states of athletes is anxiety. Practical psychology of sport actually started with anxiety. Anxiety represents negative feelings, that spread out on continuity from loose feelings of adversity and uncertainties to unbearable feelings of horror. They found already very earl, that anxiety influenced realisation of any task in the negative way. In the past there were a good deal of different comprehension of anxiety and stress. It is interesting that they defined both terms rather similarly. They characterised anxiety as stimulus so, as answer, instinct or as trait. Anxiety is explained as emotional state, which individual is experiencing like fear, also certain disturbances of physical functioning accompany her. Stress is unspecific answer of body on any need or demand. Stress indicates if there are demands and needs that limit or they are exceeding individual's adaptive reserves.

Interactive model of anxiety describes stress as situations variable and it emphasizes reciprocal impact between individual and situation. A certain objectively stressful situation can individual recognize as threatening or not. It depends upon whether such situation individual feels as dangerous or harmless and or he perhaps has experiences and knowledge how to control that situation. This model distingueshes evidently also between trait and state anxiety. Subjective, conscious emotion of fear and tension is characteristic for anxious conditions, that follows increased arousal or activation of autonomic nervous system. Trait anxiety is general predisposition of individual, that percepts certain situations as threatening, and answers these situations with different degree of state anxiety. Trait anxiety is concerned with feelings of anguish, discomfort and undecided fear. It is very important for people who work with the athletes to know that athletes are most of the time under impact of stress and they have to know, we recognize stress per some manner. It is verbal and non-verbal indicators here.

It is possible to watch anxiety on physiological, emotional and behavioural level. On physiological level it shows as psychic unrest and inability to relax. Changes appear also in cardiovascular and respiratory system. Increased frequency appears and amplitude of breathing is reduced. Disturbances appear in digestive system. Nutrition and sleep are also disturbed. On psychological level it reflects as concern, feeling of uncertainty, fear, restriction, helplessness, unrest. Also feeling of tiredness appears sometimes. Concentration and attention are worse. Still problems with memory are here.

Anxiety is being showed on behavioral level in physical poise, movement and mimicry. Tension of musculature is raised, even spasms occur sometimes. Movement can be restless, unsuitable and clumsy.

Emotions in sport

Emotions are processes, which are expressing human value attitude to outside world or alone itself. We speak about emotions when excited condition in human appears, but we are experiencing them only in subjective important circumstances. That is why it is not unusual thing, that people in similar circumstances experience different emotions (in quality and also in intensity) or they stay indifferent. Emotions manifest on field of emotional experiencing, of emotional knowledge and of physiological changes in body (case: blushing, quicker heart beat …). It is clear that emotions are not experiencing separated on each field, but certain emotion is result of reciprocal functioning of all of three fields. Even though preoccupation with emotions would be very interesting, limit especially on the third field of emotions – physiological changes in the body. We usually feel accelerated heart beat next to experiencing of fear, breathing quickened and paleness appeared. Because of changes in activity of heart, of blood veins, of breathing muscles, secretory glands etc. are some experimenters started to think, that you would be measuring out emotions only on these changes. Autonomic nervous system has the most important role in these processes. The regulatory activity of entire nervous system we can classify on intentional and unintended. One part of autonomic nervous system is called the sympathetic nervous system and the other is parasympathetic nervous system. The sympathetic nervous system is got together in two sets of gangliones from flank of spinal cord. The nerve fibres from spinal cord are coming to ganglionic cells and their name is preganglionic neurones. Only one of that neuron is connected with large number of sympathetic gangliones. The gangliones of sympathetic nervous system are connected with visceral organs. Whenever any part of sympathetic nervous system is provoked, a coordinated activity of visceral organs is occurring. It is explicitly activating activity and the body is prepared for the action. The parasympathetic nervous system works exactly on the contrary sympathetic nervous system and it calms. The activity of both system goes on at base of reciprocal innervation. If sympathetic nervous system accelerates the breathing, the parasympathetic nervous system calms it down.

We are aware that we can not observe all reactions that are accompaning emotions with our bare eye, that is why there are a lot of mechanisms for their observation: oscillograph, amplificator, to all different kinds of polygraphs. With them we can exactly register different physiological happenings or changes in heart beat, in the brain, breathing, body temperature, toning of the muscles... The most sensible measurements are suppose to be, as different authors state, galvanic skinresponse and changes in the heart rate, blood flow and blood pressure.

Pre-competitive and competitive state

The athlete's performance is consequence of many factors that arise from environment as well as from athletes themselves. Appearance and performance at the competition is goal for every sport practice and participation. It is the result and main motive, for which the athlete is pumping enormous amount of energy. Pre-competitive, competitive state and controlling of these conditions is doubtlessly the field, which is not employing only the athletes, but especially coaches and teams, that engage in top sport. It often happens, that otherwise very good athletes on important competition completely break down. They do not even realize the similar results as they are achieving on the training.

We can distribute pre-competitive behaviour and its characteristics in two parts. The first part explains the precompetitive behaviours. It is this, that competitor invests much more effort in competition than in training. The second part refers to characteristic of competitive behaviour. Certain tension occurs or even neurotic behaviour can be percieved. Everything around the athlete is making him nervous and he is also loosing self-confidence. For all disturbing factors there has to exist relevant strategy of coping with them. The athlete must above all know well how successfully to eliminate the tension and neurotic behaviour and how to deal with immoderate excitement and loss of self-confident. The athletes have to be taught about the controlling and managing with unpredictible circumstances, disturbances and problems which are happening in the middle of the competition. In this precompetitive period the athlete helps himself with mental training and with practise of concentration. Entirely precompetitive behaviour moves between two extremes. The "start apathy" is so called on one side, and on the other we can find optimal condition of all psychic processes – readiness for fighting. Somewhere on this continuity is also start fever. This is condition, where all negative dysfunctions of organism are expressed. Extraordinarily reduced condition of activation and total loss of motivation are occurring at start apathy. In such cases athletes usual do not care about the course of competition, their only wish is that competition would finish as soon as possible. They are not thinking about the result and success any more. At fighting readiness psychic and physiological processes are on such level that is allowing optimal functioning of organism and of course maximal successfulness. Entirely precompetitive behaviour varies from athlete to athlete, and also at certain athlete in different time periods. It is possible that athlete in only one competition goes from one to another extreme.

On the day of competition it is the most important for athletes to be higly motivated that they could concentrate on the opponent. Of extraordinary meaning is also ability of concentration and relaxation. In cases of good performance, the findings of different athletes are pretty similar. There are also important different mental states in cases of good and

bad performances as well. In cases of good performance athletes reported that they were completely relaxed but also full of energy, they did not feel anxiety or any kind of fear, and their experiences were full of enjoyment. They also felt very calm. All the things was happening automatically and they did not need to think about what to do. Time was running slowly, so they had always enough time for performance realisation. They had a feeling, that they can do whatever they want. Their experiences and feelings were positive. Focusing on performance was simple and athletes completely trust in themselves.

Sport psychologists wish to find out the important factors, that determine athlete's performance. The performance may not be dependent of coincidental feeling of athlete. We must find ways for systematic influence and cause creation of those competitive states, that are causing athlete's extremely better performance. One of the well-known contemporary model of precompetitive states is Hanin's (1993) IZOF model (Individual Zone of Optimal Functioning). This model represents one of the rare systematic approaches to diagnosing the optimal pre-competitive state of athlete.

Physiological correlates of pre-competitive states and the use of biofeedback

Brain and body issue has always been through the history a subject of constant interest. Green, Green and Walters (1970) have formulated psychophysiological principle as follows: "Every change in the physiological state is accompanied by appropriate change in the mental emotional state, conscious or unconscious, and conversely, every change in the mental emotional state, conscious or unconscious, is accompanied by an appopriate change in the physiological state." This statement reflects a very deep, firm view concerning the "eternal" brain – body issue (Michael Bar – Eli, 1995).

The term "biofeedback" refers to external psychophysiological feedback, physiological feedback, or augmented proprioception. The basic idea here is to provide individuals with information about what is going on inside their bodies, including their brains (Scwartz, 1979).

In general psychophysiology and biofeedback in particular are overwhelmingly and typically conducted in laboratory settings (Andreassi, 2000). Biofeedback devices are usually not designed for being used during real, stressful experiences, but rather for being used to train people to gain greater control of their physiological processes within the no stressful laboratory setting (Crews. Lochbaum, & Karoly, 2001).

Psychophysiology is unfortunatelly rarely used approach in sport psychology. It's a pity because these procedure allows universal view in to mental processes of the individual, because biofeedback can form basis of exceptionally efficient intervention (Collins, 1995).

Psychophysiology is defined as scientific study of cognitive, emotional and behavioral phenomena which applies and reflects through psychological principles and events (Cacioppo & Tassinary, 1990) approach that can enables objective and relatively non-invazive method of investigation complex processes, which are involved into sport performance. The atraction of this approach is obvious as an advantage of more ordinary self observed approach (Collins, 1995). Several researches (ex. Smith & Collins, 1991) prove, that importance of sport psychophysiology is a important part of researches interests.

Biofeedback is regulatory principle system where the operation is done by biological signals. That principle of regulation is going on in many biological systems and helps for maintaining balance i.e. the state homeostasis. The same principle can be used outside certain organism, it means that particular vital functions can be detected by artificial sensory systems, witch are attached to the organism, and information are sent to the regulation system or computer, which delivers the appropriate feedback through sensor organs back to organism.

The most common signal for acquisition is EMG (electromyogram – measuring of electric activity of muscles), where two electrodes are attached to the surface of the muscle being measured. EMG biofeedback is often used for muscles relaxing, that means for stress reduction: when the muscle tension is detected by the electrodes the visual or audio signal is presented to the athlete. EMG measurements (in micro volts) are readings of electrical voltage motorical nerve used as signalization of muscle tension. EMG biofeedback is using electrodes attached to the surface of the skin. Electrical activity of the particular muscles is presented to the individual by visual, audio or both of them. In sport psychology practice and the selection of electrode sites for various muscle groups must be carefully considered.

Several researchers (Blumenstein, Bar – Eli & Tenenbaum, 1995, 1997a: Zaichowsky & Fuchs, 1986) have proposed approximate guidelines, summarizided as follows:

1. A reading on the frontal muscle of 2 – 5 microV indicates that the monitored muscle is not relaxed.
2. A reading on the frontal muscle of 1 – 2 microV shows that the muscle tension is "normal" although deeper levels of relaxation can be obtained.
3. A reading on the frontal muscle below 1 microV indicates that the muscle is quite relaxed, and below 0.6 microV it is very relaxed.

The research has been done in controlling of autonomic nerve system and studies have showen, that the individual can reduce its own blood pressure, activate or relaxes muscles, to increase arm, palm temperature or any part of the

body temperature by using bioofeedback method. EEG activity of the brains or conscious beat of the hart, to reduce back pain,..

Beside EMG signals in biofeedback are frequently used also the galvanic skin response known as electrodermal response. In this case electrical conductivity of the skin is measured, which is conected with activity of sweat gland. Activity of the electrodermal feedback – GSR (galvanic skin response) or electrodermal activity (EDA) is based on the simple principle: when we are in emotional distress our sweat gland are more active and the conductivity of our skin is higher. It is useful for the foby curing, for reducing anxiety, over skin oversweating etc.

Biofeedback instruments have been developed that monitor various aspects of the psysiological activity. A skin conductance device applies a very small electrical presure (voltage) to the skin, typically on the volar surface of the fingers or the palmar surface of the hand (where there are many sweat glands), and measures the amount of electrical current that the skin will alow to pass. EDA has been recognized as distinctively sensitive to transitory emotional states and mental events, while often remaining more or less independent of other biofeedback mesures such as muscle tension and skin temperature (Blumenstein, 1995).

EDA and skin temperature biofedback may be used together (Zichowsky & Fuchs, 1988) and in conjunction with other relaxation technique to institute a relaxation response that might be used to combat precompetition anxiety (Goodspeed, 1983; Peper & Schmid, 1983).

The electroencephalogram, or EEG, is a complex bioelectric signal that reflects the functional status of large pools of cortical neurons and their modulation by subcortical regulatory influences. The interpretation of these signals requires a comprehensive knowledge of both the technical aspects of EEG recording and the neurophysiology of the central nervus system. Thus, the application of this modality in the biofeedback context must be conducted or supervised by a properly trained and experienced professional (Standards and Guidelines for Biofeedback Application, 1992).The human brain produces a continuous output of minute electrical signals. The magnitude of these signals is so small that it is measured in microvolts, or millionths of a volt. However, the signals can be accurately detected and recorded. To do this, the signals must first be picked up by electrodes attached to the surface of the scalp and then amplified and filtred many thousands of times before they can be analyzed. If these amplified signals are recorded by tracing pens of an electroencephalograph, the record will appear as a continuous wave of varying frequency and amplitude – the EEG.

The number of EEG cycles occurring within a given time interval is called its frequency and measured in hertz (Hz) or cycles per secon (CPS). The greater the number of cycles per second, the higher the frequency. The EEG appears to contain four major frequency bands: beta (above 13 Hz), alpha (8 – 13 Hz), theta (4 – 7 Hz), and delta (0.5 – 3.5 Hz). An EEG is not useful for determinig specific brain functions, but for discerning more general states of arousal, which are indentified as: dela: deep sleep; theta: period of dreaming; alpha: relaxed awareness; beta: full alertness (Walter, 1963).

Accordning to Petruzzello et al. (1991), the spontaneous electrical activity of the brain, recorded at the scalp and referred to as EEG, can be broken down into numerous bandwidths based on frequency components. The most frequently used bandwidth in biofeedback investigations has been the alpha bandwidth.

EEG feedback is an instrumental learning process whose end result is the fascilitation of voluntary control of EEG activity. This procedure involves the use of external EEG monitoring devices especially designed to convey to the individual ongoing information concerning the electrical activity of his/her brain. For example, the athlete may hear a tone, the presence of which indicates the occurrence of EEG alpha activity of 20 microV or greater. He may recognize that whenever this tone appears, he coincidentally experiences a relaxed "idling" mental state where he is not thinking about anything in particular. By sustaining this relaxed mental state he notices that the tone stays on for greather period of time. If he loses his concentration and is unable to sustain the state the tone disappears. By observing the tone (feedback display) and the corresponding "mental set", the athlete learns how to do shifts in feelings and attention. He can do this because he is receiving ongoing feedback of the processes involved.

EEG biofeedback – nurofeedback could effect athletic performance, specifically in target sports such as shooting, archery, and golf. For example, Hatfield, Landers, and Ray (1984) reported that as shooters prepare to shoot, there is a marked shift from left to right hemispheric activation. Crews (1991) found that golf performance, the greater left-to-right hemisphere changes in EEG spectral densities paralleled those found in archery studies (Landers et al., 1991). A series of studies (Collins, Powell, & Davies, 1990, 1991) with karate, soccer, and cricked has demonstrated an increase in alpha band activity in both hemispheres. Increases in temporal and central alpha power proceeded success, and failure was associated with decreased alpha activity (Collins, 1995). The results of EEG biofeedback training on performance can determine the length of training programs and appropriate training criteria, and can be compared to other cognitive behavioural techniques to enhance performance. Accordin to Petruzzello et al. (1991) the most frequently used bandwidth in biofeedback investigations has been the alpha bandwidth (8 –12 Hz).

Mental preparation techniques should fit into the specific requirements of each sport discipline. In ball games and combat sports (such as judo, boxing, wrestling, taekwondo and fencing) cognitive capabilities (e.g. attention and anticipation) are required. In sports that require speed and power (such as sprinting, jumping, and weight lifting), focusing and concentration are of primary importance. In aerobic sports (such as long-distance running and swimming), perception of rhythm, accuracy of movement, and pain tolerance are highly necessary.

The mental procedures with biofeedback are efficient method of learning to control one's emotions and shift arousal states accordingo to specific course of the competition. The frequency with which such shifts of mental states are required for performance maximization is dependent upon the unique determinants of each sport discipline (Blumenstein, Bar-Eli and Collins, 1995).

Biofeedback essentially involves a technological interface among external senses – the voluntary and autonomic branches of the central nervous system – in order to provide typically inaccessible information about biological states to the individual. It consists of training individuals to change various physiological indices (e.g., HR, muscle tension, brain activity) and to regulate physiological states with instrumentation, and then apply this ability to the situation without any instrumentation (whereas, ordinarily, the subjects would have been under exclusive autonomic control). Such autonomic control may also be transferred to performance settings when biofeedback is absent (Bamajian, 1983; Green & Green, 1977).

According to Dishman (1987), biofeedback, in contrast to other procedures, may be included into the group of somatic performance enhancement procedures, which minimize the role of cognitions in determining behaviour while emphasizing objective situations and responses. Blumenstein, Bar – Eli and Tenenbaum (1995) researched the mental techniques that were specifically associated with the mental rehearsal/imaginary of the performance task (100m run).

Goodspeed (1983) tested the efficacy of using electrodermal and temperature biofeedback as part of comprehensive mental training program (relaxation, imagery, cognitive strategies) with gymnasts. Peper and Smith (1983) studied the positive effects of temperature, EMG, and HR (cardiovascular) biofeedback with progressive relaxation, autogenic training, and imaginary on enhancing athletic performance in members of the US gymnastic team. This positive effects on members of US rhythmic gymnastic team training program included EMG, GSR and temperature biofeedback training with progressive relaxation, autogenic training, and imagery, in addition to home practice. The gymnasts reported the program to be highly beneficial, enhancing their athletic performance, integrating mental skills into their workouts, and using relaxation to reenergize and control their arousal states.

Biofeedback can teach athletes to reduce muscle tension and anxiety and control arousal, then their performance should increase. According to Zaichkowsky and Fuchs (1986), competitive stress results in excessive arousal, which leads to disruption of toughts, lack of concentration, confusion, and excessive body tension. Biofeedback interventions should theoretically result in decreased muscle tension, autonomic responses, and self-report state anxiety (Blumenstain, 1995). Recent application of HR and EEG biofeedback to target sports has also been reported to be effective (Collins, 1995; Landers et al. 1991; Crews et al. 1991).

We wanted to pointed out the importance of use of biofeedback method and all other physiological indicators of pre-competitive states. The period of self-reported feelings and psychogical preparation that is based only on self-perception, feelings, ideas etc. is over. We have the effective instruments that can detect what happens inside body in the stress situation, so we should use this methods to detect the processes and to teacht the athletes how to easily control these processes under pre-competitive situation.

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THE EFFECTS OF PROLONGED PHYSICAL INACTIVITY ON MOOD STATE AND PSYCHOLOGICAL WELL-BEING

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Abstract

Long-duration weightlessness simulated by bed rest represents an important model to study the consequences of physical inactivity and sedentarism on the human body. This study evaluated changes of mood status and psychological well-being in ten young male subjects during a 35-day horizontal bed rest. Participants were asked to complete psychometrical inventories before and after the bed rest experiment. The neurotic level was enhanced during the bed rest period according to the Slovenian version of the General Health Questionnaire, whereas mood states were relatively stable during the experiment according to the Emotional States Questionnaire. The scores in the Satisfaction with Life Scale did not change. The importance of this research was to provide evidence that the provision of favourable habitability countermeasures can prevent deterioration in the psychological state under conditions of physical immobilisation. Our findings have applied value in the field of health prevention and rehabilitaion.

Key words: *psychical health, satisfaction with life, bed rest, young healthy individuals*

Introduction

Different contemporary studies are confirming that fitness and physical/sport activity have an important role in the maintenance and enhancement of mental health (Landers & Arent, 2007; Salmon, 2001). Although the causality is not clear, the pattern of evidence suggests the theory that exercise training recruits a process which confers enduring resilience to stress.

Research establishing the effects of total physical inactivity on the mental state and feelings of individuals is practically non-existent. It is difficult to induce and monitor total physical inactivity in everyday life. An example of an experimental situation where such a state can be established is simulated weightlessness or *bed rest* (BR) research, which presupposes rest in the horizontal position and is today one of the methods most commonly used to monitor the consequences of long-term physical inactivity.

More recent studies report increased depressive and neurotic levels during BR periods (Ishizaki et al., 2000; Ishizaki et al., 2002; Styf, 2001). Similarly, the authors mentioned also established deterioration in the mood states "vigour" and "confusion" during the BR period, while the other aspects of mood "tension-anxiety", "depression-dejection", "anger-hostility" and "fatigue" remained relatively stable during the experiment (Ishizaki et al., 2002).

Extreme and prolonged confinement to bed and immobility resulting from simulated weightlessness might contribute to psychological changes reflected in greater stress, tension and alteration in mood status and behaviour. Another factor that plays an important role is isolation from the familiar environment and adaptation to experimental conditions. Previous bed rest studies involved significantly limited social contacts between subjects and the exterior environment, meaning that the subjects spent the majority of the BR days without seeing family members and friends. The lack of social contacts and isolation from familiar environments and people is expected to contribute greatly to psychological changes occuring during the period of BR.

The objective of the study was to evaluate the effects of immobilisation during bed rest on mood status, neurotic level and self-reported life satisfaction in participants.

Methods

SUBJECTS: Ten male subjects aged 21–29 (24.3 ± 2.6 years; mean ± standard deviation) volunteered to participate in the "Bed Rest – Valdoltra 2007" project, which was carried out under the aegis of the Institute for Kinesiology Research at the Science and Research Centre of Koper, University of Primorska, and in cooperation with the Jožef Stefan Institute, Ljubljana, Slovenia. The study was conducted at the Orthopaedic Hospital Valdoltra, Slovenia. Screening medical

examinations documented that the subjects were healthy. The purpose and procedure of the study were explained before the experiment. Written informed consent was obtained from all participants. The National Committee for Medical Ethics at the Ministry of Health, Slovenia approved the experimental procedure.

EXPERIMENTAL PROTOCOL: A 35-day bed rest was carried out in a strictly horizontal position reflecting total physical inactivity. Subjects performed all daily activities lying down. Physical activity was strictly forbidden throughout the experiment. Subjects were under constant video surveillance and provided with 24-hour medical care. Three times a week they received physiotherapy, which included passive exercise of the joints and gentle neck and back massage. During this time, subjects were allowed to read, watch TV, listen to music, and use computers and the Internet.

The participants were asked to complete psychological inventories during the pre-BR period (5 days before the experiment) and on day 33 of BR (after the experiment).

PSYCHOLOGICAL INSTRUMENTS: *The General Health Questionnaire* (*GHQ*-12; *Goldberg & Hiller, 1979*) is a measure of current mental health. The Slovenian version of the questionnaire consists of 13 questions relating to the recent feelings and experiences of the individual. The participant responds on a scale from 1 (not at all) to 5 (much more than usual). The overall result is the sum of all the answers. A high score indicates the presence of neurotic symptoms (e.g. the individual has problems sleeping, finds it hard to concentrate on his work, feels under pressure, cannot overcome difficulties, is unhappy, irritable and depressed, has lost self-confidence in himself and his abilities, etc.)

The Satisfaction with Life Scale (SWLS; Diener et al., 1985) is among the various components of subjective well-being focused on measuring the cognitive aspect of satisfaction with life. The result on the scale can be labelled as the individual's global assessment of quality of life with regard to personal criteria (the feeling that life has been and is good, that the current stage of life or life in general is full, meaningful and pleasant). The scale contains five statements to which the participant responds using a 7-point scale (1 – strongly disagree, 7 – strongly agree). The internal reliability of the original scale is 0.86 and of the Slovenian version 0.85.

To assess mood status, the *Emotional States Questionnaire* (*ESQ; Lamovec, 1988*) was used. The questionnaire includes 54 emotional descriptors, which are rated on a 4-point scale from "none at all" to "extreme". The individual responds in accordance with his current mood. The items comprise six emotional states: depression, contentment, agression, indifference (tendency to emotional rigidity) and self-concept (positive and negative).

STATISTICS: The data was analysed with the software package SPSS 14.0 for Windows. Differences in studied psychological variables before and after the BR experiment were calculated using a paired t-test.

Results

The mean (M), standard deviation (SD) and paired t-tests of the GHQ and SWLS scores and six-mood status of ESQ are shown in Table 1. No significant difference was seen in SWLS and ESQ scales (depression, contentment, agression, indifference, positive and negative self-concept) comparing the pre-BR with post-BR period. The significant increase in the scores of GHQ indicated that neurotic level was enhanced during bed rest (P=0.045).

Table 1. Differences in studied psychological variables before and after BR period

	Before BR M ± SD	***After BR M ± SD***	***Difference M***	***t(df=9)***	***P***
GHQ – neurotic level	20.50 ± 5.56	25.30 ± 4.90	-4.80	-2.27	0.045*
SWLS – satisfaction with life	23.30 ± 5.85	24.10 ± 3.57	-0.80	-0.77	0.462
ESQ – depression	14.20 ± 2.97	13.50 ± 2.99	0.70	0.48	0.642
ESQ – contentment	28.30 ± 6.36	26.20 ± 6.88	2.10	1.39	0.197
ESQ – agression	11.90 ± 1.29	11.70 ± 1.06	0.20	0.38	0.716
ESQ – indifference	9.00 ± 3.71	8.60 ± 3.83	0.40	0.65	0.534
ESQ – positive self-concept	17.70 ± 2.63	15.30 ± 3.68	2.40	1.80	0.106
ESQ – negative self-concept	6.50 ± 0.97	6.60 ± 0.84	-0.10	-0.56	0.591

Note: * - p<0.05

Discussion

To evaluate the effects of complete physical inactivity during a 35-day bed rest on mood state and psychological well-being in young male subjects, we conducted a survey using three types of psychometrical inventories.

On the basis of the results, we find that the mood states and subjective assessment of satisfaction with life did not change after a prolonged period of total physical inactivity. During the experiment there was an impairment of subjects' general sense of well-being (GHQ), manifested in an increase in neurotic symptoms (including the domains of anxiety, depression, somatic symptoms and social withdrawal). Even after the period of physical immobilisation, however, the expression of these symptoms remains relatively low and does not represent a risk to the mental health of the subjects.

The results of our research only partially overlap with the findings of previous similar research, where increased values for depressive and neurotic experiences and a worsening of mood after a prolonged period of horizontal bed rest are reported and more marked psyschological and behavioural changes are noted (Ishizaki et al., 2000; Ishizaki et al., 2002; Styf, 2001).

The higher degree of subject adaptability to the conditions in our study was attributed to the selection of subjects with optimal characteristics for adaptation to confinement and restricted mobility and to the highly favourable environmental habitability factors in our study relative to previous studies. These habitability factors included maintenance of a stimulating environment, the possibility to use various media (TV, radio, computer and Internet), acess to communications with friends and relatives, and absence of stuff/subject conflicts.

Our results suggest that favourable living conditions and the possibility of social interaction during a period of total physical inactivity represent a kind of safeguard against an impairment of mental state, or, in other words, that they mitigate the negative effects caused by prolonged physical inactivity.

Reasons for the impairment of mental state during the BR experiments may also be found in the numerous physiological changes that occur as a result of prolonged physical immobilisation. Cardiovascular and musculoskeletal changes might induce headache and sleep disturbances, which consequently could cause deterioration of psychological condition (e.g. problems of concentration, tension and irritability, depressive symptoms). We can assume that the impairment of psychological and mood state during our research was more the consequence of prolonged lying in a horizontal position and the accompanying physiological changes than of living conditions and psychosocial conditions during the experiment.

Conclusions

Research on the psychological aspects within bed rest studies potentially has a great applied value in the field of health prevention and rehabilitation. Namely, we could apply the findings in the study of the effects of physical inactivity on human mental health (post-operative conditions requiring long-term recovery; in cases of health indications requiring physical inactivity or bed rest; in lifestyles dominated by extreme physical inactivity) and anticipate the use of appropriate psychological interventions to prevent psychological stress and increase the quality of life under conditions of prolonged physical immobility.

The study of psychological and cognitive aspects under conditions of simulated weightlessness undoubtedly deserves special attention and in-depth consideration in the future. Our research represents a small, yet an important and valuable contribution in this direction.

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MOTIVATION AND SPORT DROPOUT: A PROSPECTIVE STUDY FROM SELF-DETERMINATION THEORY

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Abstract

Statement of problem: This paper aimed to analyse the predictive relationships between motivation and dropout. Motivations considered, ordered from more to less self-determined were: intrinsic motivation (IM) toward knowledge, MI toward accomplishment, and MI toward stimulation, extrinsic motivation (EM) of identified regulation, EM of introjected regulation, EM of external regulation and Amotivation. Also was considered the Self-Determination Index (SDI), calculated as a function of the different motivations.

Method: A prospective study was performed. We measured motivation towards competitive sport and after 19 months we measured the persistence or not, in the competitive sport practice. The sample consisted of 857 athletes aged 11-19.

Results: A Multivariate Analysis of Variance was performed with SPSS 15.0.

Conclusion: The study showed the great importance of IM to predict persistence or dropout. Moreover, the SDI showed its utility to simplify the analysis of the relationship between self-determined motivation and persistence-dropout.

Key words: *intrinsic motivation, extrinsic motivation, adolescence*

Introduction

A key variable in predicting sport dropout is motivation (Vallerand, Deci & Ryan, 1987; Vallerand & Losier, 1999; Vallerand & Rousseau, 2001) understood as "the hypothetical construct used to describe the internal and/or external forces that produce the initiation, direction, intensity, and persistence of behaviour" (Vallerand & Thill, 1993). Several research lines have proved able to predict sport dropout (Sarrazin & Guillet, 2001). Self-determination theory (SDT) (Deci & Ryan, 1985; Ryan & Deci, 2007) has proved very suitable in understanding motivational processes in physical activity and sport dropout (Pelletier, Fortier, Vallerand & Brière, 2001; Sarrazin, Boiché, & Pelletier, 2007; Sarrazin et al, 2002).

SDT departs from an intrinsic versus extrinsic conceptualization of motivation. First, people are viewed as typically having multiple motives, both intrinsic and extrinsic, all of which must together be assumed to determine the overall quality of motivation. Intrinsic motivation (IM) refers to the search for pleasure and satisfaction in the practice of sports, and extrinsic motivation (EM) refers to participating in an activity as a means to fulfil an external goal.

A distinction is made within IM, between IM toward knowledge (interest in progressing in the understanding of the activity), IM toward experiencing stimulation (interest in the activity due to the feelings experienced while performing it) and IM toward accomplishment (interest in to continue gaining skills). Extrinsic motives also may be differentiated in terms of how autonomous they are, varying from highly volitional, that reflects one's self, to others experienced as external to the self. Four progressively less self-determined types are identified. EM of integrated regulation, is related to the interest in practicing sports to perform behaviour that are fully incorporated into the repertoire of those that satisfy their psychological needs, EM of identified regulation, refers to the interest in practising sports to fulfil goals considered to be relevant by the subject in his/her personal development; EM of introjected regulation, refers to sport practice as a way not to feel guilty for not practising; and lastly EM of external regulation, considers the interest in participating in sports in order to get a prize or a reward. Finally, SDT also identifies the state of Amotivation (A) in which one is literally without motivation for an activity. In a number of research studies A has been associated with very negative experiences and consequences, fallen at the lower end of the continuum of relative self-determination (Pelletier at al., 1995).

Lastly, this theory argues that motivation gives way to important cognitive, behavioural, and affective consequences (Vallerand, 1997, 2001; Vallerand & Losier, 1999). While IM is associated with the most positive consequences, A is linked with the most negative ones, like waning performance, negative emotions, and dropping out, and EM with low internalization produces negative results when external goals are not achieved (Deci & Ryan, 1985). To sum up, the HMIEM model (Vallerand, 1997, 2001; Vallerand & Losier, 1999) puts forward a 4-stage causal sequence between motivation determinants and motivation consequences: "Social factors -> Psychological mediators -> Motivation types -> Consequences".

Pelletier et al. (2001) used a two-year prospective design to examine the last two stages of the model, analysing the effects of motivation on remaining in competition in adolescent swimmers. Self-determined motivation predicted participation at two stages (10 and 22 months later). A means comparison between those who persisted and those who dropped out showed that the former had a higher IM and EM identified, and a lower EM of external regulation and A, while no differences were found for EM introjected . In a subsequent study, Sarrazin et al. (2002) analysed a sport dropout model that combined the 4-stage causal sequence proposed by the HMIEM; perceived motivational climate, taken from the achievement motivation theory (Nicholls, 1989), was considered to be an antecedent of psychological satisfaction via activity. Moreover authors suggested that the intention to do sports, from the theory of planned behaviour by Fishbein and Ajzen (1975), was a mediating variable between motivation and dropout / persistence behaviour. These were the steps of the model: Task/Ego involving climate -> Psychological mediators -> Motivation types -> Intention to practise sports -> Dropping out. They followed the competitive practice of 335 female handballers for 21 months. Results from structural equation modelling analyses provided support for the model. The path from behavioural intentions to drop out behaviour was moderate ($\beta = .55$). Comparison of mean scores between persistent players and dropouts showed that the former perceived the motivational climate as being more task-involving, experienced greater satisfaction of their three psychological needs, and reported higher IM and lower A and intentions to drop out.

Our study sought to analyse the last two stages of the model, as it was proposed by Pelletier et al. (2001), (Motivation -> Dropout). It was proposed that the more self-determined motivations (IM and EM of identified regulation), and Self-Determination Index (SDI) would negatively predict sport dropout.

Method

Participants

The sample consisted of 857 Spanish athletes, 680 boys and 177 girls, participating in organised competitions, at a medium and high level, ages ranging from 11 to 19 (147 between 11 and 13; 474 between 14 and 16; 236 between 17 and 19). 132 of them practised individual sports (athletics, swimming, cycling, sailing, surfing, triathlon, skating, canoeing, artistic gymnastics, climbing, horse riding), 105 adversary sports (karate, taekwondo, chess, table tennis, tennis, fencing, judo, handball), and 620 team sports (volleyball, rugby, baseball, handball team, basketball, football, indoor football, water polo and hockey). After 19 months, 229 athletes had dropped out (26.7%) and 628 athletes persisted (73.3%).

Design and procedure

A prospective study was conducted over a 19 month-period. In the first stage (March 2006), a varied group of competition athletes were administered the instruments to measure the studied variables. This was done in their training sessions and with their previous consent. Nineteen months later (November 2007), at the beginning of the second following sport season, the researchers phoned the athletes and asked them if they continued practising their competitive sport.

Measures

Sport motivation was measured using the Spanish version (Guzmán, Carratalá, García Ferriol, & Carratalá, 2006) of the Sport Motivation Scale (Pelletier, Fortier, Vallerand, Tuson, Brière, & Blais, 1995). This scale measured 7 motivation types in the self-determination continuum: IM toward knowledge, IM toward accomplishment, IM toward stimulation, EM of identified regulation, EM of introjected regulation, EM of external regulation and A. Alpha coefficients for the different factors reached values over .70, with the exception of IM toward experiencing stimulation and ME of external regulation, having a value of .69.

We considered also the Self-Determination Index (SDI), which is based on the ordered pattern of existing correlations between the seven motivation sub-scales (e.g. Li & Harmer, 1996). SDI was calculated by giving each subscale a specific weight depending on the position held on the self-determination continuum. A number of studies support and validate this composite index (Ryan & Connell, 1989; Sarrazin et al., 2002; Vallerand, 1997; Vallerand & Fortier, 1998; Vallerand & Losier, 1999). It was calculated from the following expression: (((IM toward knowledge + IM toward accomplishment + IM toward experiencing stimulation)/3) x 2) + EM of identified regulation – ((EM of introjected regulation + EM of external regulation)/2) – (Amotivation x 2)), following Vallerand recommendations (Vallerand, 2007).

Sport dropout was determined through the athletes' answers by whether or not they continued with their competitive sport practice, measured 19 months later.

Results

A 2 (dropout or persistence) x 2 (gender) x 3 (age) was performed, including all the variables of motivation as dependent variables. Multivariate contrasts test's results showed significant effects to dropout (λ Wilks = .98; $F(7)= 2.40$; $p < .05$;

η^2= .020; 1-β= .87), gender (λ Wilks = .95; F(7)= 6.71; p<.001; η^2= .053; 1-β= 1.00), and age (λ Wilks = .94; F(14)= 3.84; p<.001; η^2= .031; 1-β= 1.00). No significant effects were found to interactions between the factors.

Results of the Inter-subjects effects test indicated that persistent athletes had higher MI of knowledge (p<.05; η^2= .005; 1-β= .52), MI of accomplishment (p<.005; η^2= .010; 1-β= .83), ME of identified regulation (p<.05; η^2= .005; 1-β= .55) and SDI (p<.05; η^2= .007; 1-β= .70). Results also showed that boys had higher MI of knowledge (p<.05; η^2= .009; 1-β= .77) and ME of external regulation (p<.001; η^2= .023; 1-β= .99). Finally, Amotivation increased with age (p<.005; η^2= .017; 1-β= .93) and SDI decreased with age (p<.005; η^2= .014; 1-β= .89). MI of knowledge (p<.05; η^2= .007; 1-β= .58), MI of stimulation (p<.05; η^2= .008; 1-β= .63) and ME of external regulation (p<.05; η^2= .008; 1-β= .65) also showed significant fluctuations with age, but not a tendency was displayed.

Table 1. Means, standard deviations, F and significant differences in terms of persistence, gender, and age

	Persistent	Drop out		Girls	Boys		Age 1	Age 2	Age 3	
Motivation	M (SD)	M (SD)	F	M (SD)	M (SD)	F	M (SD)	M (SD)	M (SD)	F
IM Knowledge	4.86 (1.24)	4.55 (1.18)	4.06*	4.86 (1.23)	4.47 (1.19)	7.35*	5.09 (1.20)	4.67 (1.28)	4.79 (1.10)	3.01*
IM Accomplishment	5.30 (1.06)	4.96 (1.16)	8.40**							
EM of identified reg.	5.05 (1.08)	4.71 (1.24)	4.33*							
EM of external reg.				4.28 (1.27)	3.68 (1.29)	20.27***				
Amotivation										
SDI	1.41 (8.31)	-1.73 (7.85)	6.23*							

(***) p<.001; (**) p<.005 ; (*) p<.05; (Ns) non significant

Discussion and conclusions

In view of the studies addressing sport dropout problems in adolescence, the need to further explore the variables that may account for this phenomenon is obvious. Some studies have studied dropout from a motivational perspective, self-determination theory being a framework that has shown capacity to predict the sport participation.

According to the hypothesis of the study, three of the more self-determined motivations (IM toward knowledge, IM toward accomplishment, and EM of identified regulation), showed significant differences between the persistent and dropout athletes. Moreover, as has been considered in different studies (Ryan & Connell, 1989; Sarrazin et al., 2002; Vallerand, 1997; Vallerand & Fortier, 1998; Vallerand & Losier, 1999) SDI showed to be a useful index to simplify the analysis of the relationships between motivation and persistence-dropout.

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PSYCHOMOTOR ACTIVITIES AND ITS EFFECTIVENESS ON SELF-PERCEPTION AND SELF-JUDGEMENT IN DANCE PERFORMANCE

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Abstract

The article contains parts of dissertation be concerned with effectiveness of psychomotorics on dance performance. The psychomotor activities were applied in training of 17 – 23 years old women dancers in rock and roll formation, divided in two groups – an experimental and a control one, consisting of 9 dancers in each group. Results of our research unequivocally point out the effectiveness of psychomotor activities on affective states, self-body perception, perception of surrounding space, and own motion and consecutive improvement in self-judgment in dance performance.

Key words: *psychomotorics, perception, body, movement, movement therapy, space, current emotional state, affective states*

Introduction

The dancer's performance is always related to fulfillment of movement tasks which is typical for its specific time, space, condition and coordination peculiarities that relate to perception of the own body. From the point of view of improvement of the dance performance we can say that with increasing of conscious control over the own body the motoric, concentration, muscle power, vegetative body functions, ability of relaxation as well as the ability of interception of the feedback information on the movement are getting improved. A conscious and particularly feelingful movement enables the dancer to analyze, adjust and develop own performance on a basis of acquired feeling. Also the actual emotional state of the dancer influences his performance. It is connected with the motivation of a dancer, it has impact on the ability to concentrate, perceive, it lowers or increases the feeling of exhaustion and tiredness. Exactly the psychometric exercises are the ideal means of gaining the sensation for the movements of own body and they positively influence the emotional state of the person (Hižnayová, 2007).

Methods

In our case we have carried out two parallel groups, one-factor pedagogic experiment. The research has been carried out from the 5th September 2005 till 15th December 2006 (with a break in the period of July and 10 days during spring concentration training) by including psychomotoric means and exercises into a training plan of dancers and that in the extent of 2 hours (2 x 70 min) weekly in an experimental group. For completing of the dates about the virtue of the psychomotorics on the psychical state of probands after consultation with a psychologist we have worked with the probands even in time from 2nd May till 18th May 2007.

Characteristics of the experimental factor

Based on an analysis of the available literature on psychomotoric problems we have created a training plan containing psychomotoric exercises with respect on didactic and methodological psychomotoric practices and principles. The particular exercises came from the following content compounds of psychomotorics:

1. relaxation and relaxation-concentration methods (breath techniques, relaxation imaginings, music relaxation, movement relaxation, stretching , ideomotoric imaginings)
2. psychomotoric movement games (games concentrated on knowledge of the own body scheme, games for balance and space-finding development)
3. dance (dance improvisation – creative dance, jazz dance)

During the 13 months of duration of the experiment we went through 112 psychomotoric trainings in duration of 70 min. with the probands. Within each psychomotoric training unit the probands went through 20 min of relaxation and relaxation–concentration techniques (10 min in the introduction and 10 min in the v closing part of the lesson). One

half, thus 56 training units in duration of 40 min included psychomotoric games and 56 trainings in duration of 40 min included creative dance (15 min) and jazz dance (25 min).

Group characteristics

In the experiment, there have participated the dancers of rock and roll formations who were actively taking part in competitions in the given dancing in the main A category. The formation consisted of 16 dancers aged 17 – 23 years – with identical training conditions and similar training activity. The group was divided into two halves – a control and an experimental one so that there would be probands of approximately the same age, performance and dancing age included in both groups. Both into the control one and the experimental one there was added one more proband who were practicing as alternates within the formations.

Methods of data gaining

Empiric methods: direct and indirect measurement, pedagogical observation, psychodiagnostic methods. Specific and exploration methods: a conversation (introspective methods), professional judgment, scaling of the movement utterance quality, comparison.

Methods of data interpretation

mathematic-statistic methods, also methods of logic analysis and synthesis with using of induction and deduction procedures, a description method. The obtained data were subject to testing by non-parametric Mann - Whitney U – test and non-parametric Wilcoxon – test.

Results and discussion

Efficiency of psychomotorics with respect to ability to feel deeply one's own body and its movements

Psychomotorics leads you to understand your body, to feel it deeply and to control it. Therefore, we have chosen an observation and record of changes in our female probands' realizing their own bodies before and after the experiment as one of our tasks. We have observed 6 factors: T1 – T6. T1 – pulse frequency subjective assessment. Expression of impressions, emotions, feelings and moods as another factor of realizing one's own body particularly from the emotional and psychic aspects has been evaluated by expert examination and judgment, and the level of expressivity has been recorded as factor T2 – dance improvisation with expressive performance. T3a – movements and spatial orientation. T3b – realizing the body in space as a part of spatial formations. T4a – the static balance. T4b – the dynamic balance. Factor T5 in our research corresponds with kinesthetic differential ability, namely the degree of accurate assessment of the same muscular effort re-exertion. Another factor of understanding and feeling deeply one's own body in our research is factor T6 – knowing the proportionality of one's own body. Factor T6a – abilities to assess one's height. Factor T6b – difference between the actual and assessed widths of arms stretched sideways. Statistically significant improvement in realizing one's own body (understanding, awareness, and control) among the experimental group probands has been observed in following factors: of one's own body scheme, mainly in perceiving and accurate assessing of individual parts proportions; of improvement of muscular tension and relaxation assessment; of improvement of ability to balance; of movements in space and of expression of impressions and feelings.

Efficiency of psychomotoric affect on probands' mental conditions.

Profile of Mood States – Questionnaire to evaluate affective emotional conditions.

Our experiment has used a short version of E - POMS (Stuchlíková – Hagtvet - Man, 2005) which works with a 32-item version generated by verification of a 37-item version. POMS is used to evaluate temporary affective states with duration ranging from several minutes to approximately a week. The POMS test has become particularly popular in the field of sports psychology (Terry – Lane – Fogarty, 2003), and is also used in the field of PE (e. g. Winklerová – Komeštík, 2006). As the probands' balanced emotional states, we have considered states with a high level of experiencing positively polarized emotions, with self-confidence and belief in one's possibilities, as well as with a high degree of motivation and determination, and with absence of negatively polarized emotions. The experimental group probands have shown a significant decrease in intensities of negative emotion experiencing, namely: stress and anxiety; depression and dejection; anger and hostility; exhaustion and inactivity; chaos and mental confusion, and, unlike the check group, the experimental group probands have not shown any decrease in intensities of positively polarized emotions: vitality and activity. In particular, the mechanism of expressional movement psychophysical dependence on intensity of emotional experiencing has proven. Expressional movements in psychomotorics not only express a formed experience, but through the fact that they are its direct participant, at the same time they also cause it to happen.

Efficiency of psychomotoric affect on abilities to accurately assess and consider one's own sports and art performance.

Psychomotorics is a form of movement activity which focuses on experiencing and feeling movements deeply. Therefore, another of our tasks has also been an evaluation of changes in abilities to carry out a self-evaluation after application of experimental factor. Dance performance in rock and roll formations is evaluated by members of a jury. Their evaluation parameters are based on objective rules; however, the evaluation itself is subjective. In our experiment, points of the jury subjective evaluations have been summed to get an objective result, and the main interest has focused on to what extent this objective evaluation corresponds with probands' subjective self-evaluation of their own performances, in other words, to what extent the probands can objectively evaluate their own performances. Through entry evaluations of the experimental group probands, we have observed an average correspondence of 39% with evaluations made by the jury. The check group entry evaluations have shown an average correspondence of 50%. Final measuring in the experimental group has shown an average correspondence of 72%, where all the probands, except L.Ř., have shown 75%; L.Ř.: 50%. Final measuring in the check group has shown an average correspondence of 50%, the same as entry measuring. Probands have reached correspondences of 25% - 75% in approximately same numbers. On the basis of improvement of one's own performance evaluation objectification and the fact that interviews with probands have proven a higher sensibility to one's own performance in the experimental group in comparison to the check group, we can observe a positive affect of experimental factor on abilities to accurately evaluate and consider dancers' own performances.

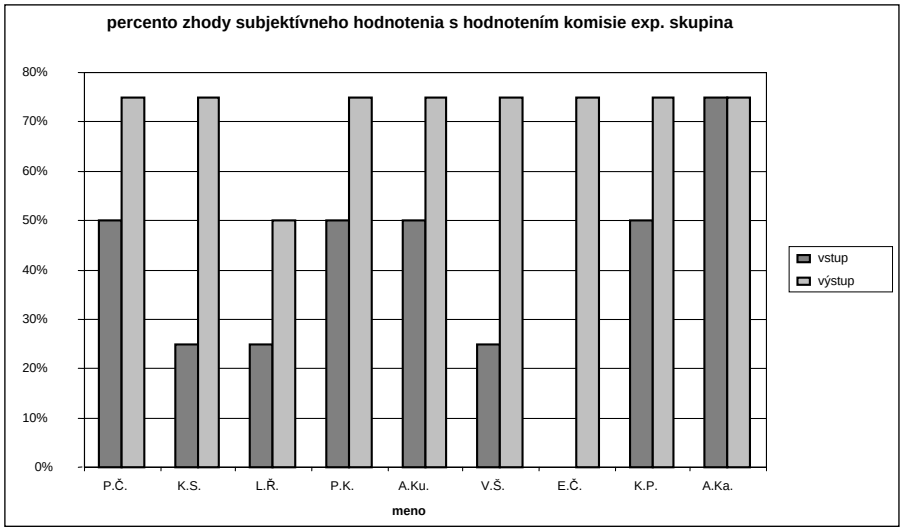

Fig.1

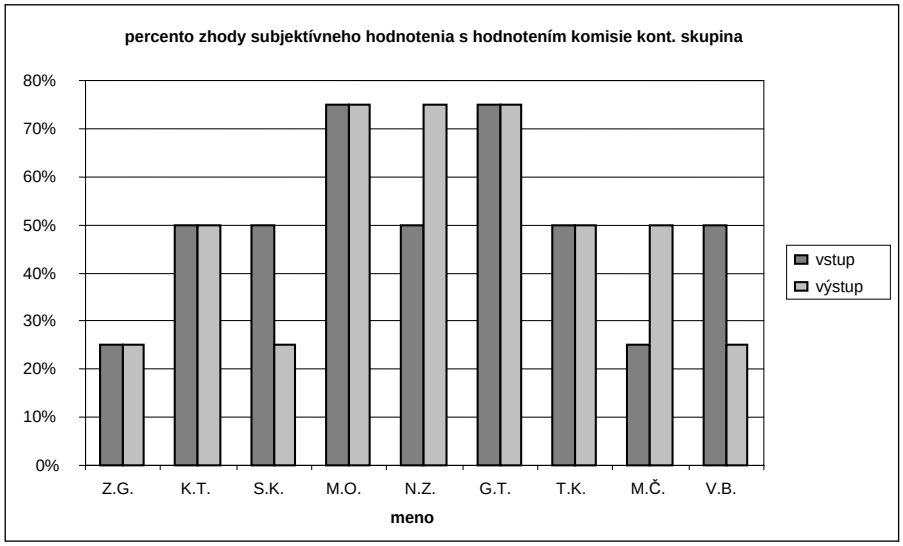

Fig. 2

(Description Fig.1 and 2: percentage of correspondence between subjective evaluation and evaluation by jury, experimental group (1)/check group (2). grey colour – entry, black – final. names.)

Conclusion

Self-evaluating abilities and particularly abilities to objectively consider one's own performance with an accurate recognition of defects and faults are an important factor in the process of dance performance improvement. The experiment has proven a positive affect of psychomotoric exercises, means and procedures on probands' emotional conditions, on realization and perception of one's own body, and subsequently on abilities of self-evaluation and one's own dance performance objective consideration and analysis.

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COMPARISON OF REASONS OF CAREER TERMINATION AND ADAPTATION TO SUBSEQUENT LIFE BETWEEN PROFESSIONAL AND AMATEUR FOTTBALL PLAYERS

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Abstract

The purpose of this study is to examine the existence of distinction in causes of careeir termination and psycho-social indicators of behaviour after football career termination between two groups of football players - professional and amateur. The sample of players used for the study consisted of 48 proffesional and 84 amateur football players who had finished their careers. The distinction between groups was examined using χ^2test. Significant differences were found regarding reasons of career termination. Profesionals end their carieers more often because of age and injury, where amateur players end their careers more because of financial and other reasons. There are no distinct differences regarding physical exercise, consumption of alcohol or cigarettes, participation in gambling, and adventures with women between the two groups after career termination.

Key words: *sports, career termination, football, professional players, amateur players*

Introduction

Theoretical perspectives of termination of athletic career

The first studies of causes and consequences of the termination of athletic career had the objective of conceptualizing this process and suggesting some clarifying models. Four main approaches to modelling athletic career termination have been formed. These are social-gerontologic, thanatologic, conceptual and transitional models (Cecić-Erpič, 2002).

Social gerontology emphasizes the role of ageing in the process of career termination and studies life satisfaction, which is conditioned by characteristics from the experience of practicing sports (Taylor and Oglivie, 1998). The connection between social gerontology with athletic career termination is noticeable in the terminology itself where the term retirement, which represents one of the main areas of gerontologic studies, is a part of the name of athletic career termination – athletic retirement.

The process of athletic career termination is compared based on the following social-gerontologic theories: these are activity theory, subculture theory, disengagement theory, continuity theory, social stratification theory and social change theory. (Lavallee and Wyllemann, 2000)

Theoreticians from the domain of sports psychology also consider the thanatologic model as appropriate for explaining career termination due to suitable comparison of career termination with the process of dying and death (Lavallee, 2000; Gordon, 1995). Several thanatologic theories have been proposed through which the process of retirement from sports can be viewed; these are the model of social death, social consciousness and gradual death. (Lavallee and Wyllemann, 2000)

Since thanatologic models and social-gerontologic theories consider athletic career termination more of a moment that a process, they are still not completely adequate for this field of investigation. Therefore, theoreticians proposed that the termination of athletic career should be viewed as a transitional process since it serves as a possibility for social rebirth and not social death. (Coakley, 1993).

Out of several transitional models, which were developed in order to examine the interaction between an athlete at career termination point and his environment, the two have been suggested as the most systematic: Sussman's (1972) analytical model and Schlossberg's (1981) model of human adaptation to transition (Lavallee and Wyllemann, 2000).

As the fourth approach to viewing the issue of athletic career termination, a conceptual model has been presented. The purpose of conceptualizing the termination of athletic career is the creation and formation of a detailed and comprehensive model of athletic career termination process as well as the complete process of athlete's adaptation to post-career life.

Taylor and Ogilvie (1993) claim that, in sports, a synthesis of causes and effects of career termination into a single model is unavoidable. Such a model must review all the particularities of athletic career termination and, apart from that, it must view individuals as complete personalities, including other psychological disciplines, which study it.

Causes of career termination

Many authors claim that there are four main causes of career termination. These are: chronological age, deselection, injury or free choice. In the first three causes, athletes cannot pursue their career due to a decrease in their abilities. But athletes do not have their free choice whether to retire or not in either of these causes, but they are rather forced to do it. Therefore the fourth cause of career termination is introduced by Taylor and Ogilvie (1994) - the free choice. Chronological age is responsible for a decrease in physical, but also other forms of athlete's abilities, and it is considered as a typical and primary factor responsible for the termination of athletic career. Deselection is connected with physiological consequences of aging and it represents the second major cause of athletic career termination. Unexpected and sudden termination of athletic career occurs very often due to injuries. Free choice is the cause of career termination that is frequently ignored (Coakley, 1983; Blinde and Greendorfer, 1985), and the athletes consider the free choice to terminate their careers as certainly the best possible "choice".

Methods

This study compares the causes of career termination as well, as the quality of adaptation to post-career life between groups of professional and amateur soccer players who played soccer primarily between 1950 and 1990.

The variables included questions on the reasons for career termination, as well as the questions on attitudes towards exercising, alcohol, smoking, gambling games and affairs with women after career termination, via a questionnaire. The respondents circled answers that were offered and here is an example of how the attitude towards smoking was examined.

A) I started smoking
B) I stopped smoking
C) I started smoking more
D) I started smoking less
E) I smoked the same as before
F) I have never smoked

The questions were answered correctly by 48 professionals and 84 amateur soccer players.

The subject of the paper is examining potential differences in the reasons for career termination, as well as the quality of adaptation to life after the career termination in each of the groups observed. The variables which will be used to define the quality of adjustment will be the indicators, and the objective of this study was to see whether there was a statistically significant difference in the reasons for termination and indicators of attitude towards exercising, alcohol, smoking, gambling games and affairs with women between professional and amateur soccer players after career termination.

Two hypotheses have been defined explicitly and they will be used as the bases for determining whether any differences between the observed groups exist.

Ho: There is no significant difference between professional and amateur soccer players in the reasons for career termination.

H1: There is no significant difference between professional and amateur soccer players in the indicators of attitude towards exercising, alcohol, smoking, gambling games and affairs with women after career termination.

Potential differences between professional and amateur soccer players have been examined on variables by χ^2 test.

Results

Table 1. Results of χ^2 on the reasons of career termination between professional and amateur soccer players

Pearson's χ^2 test	Value of χ^2 test	Degrees of freedom	Significance
age	5.903	1	.012
deselection	.194	1	.499
injury	7.219	1	.007
illness	.025	1	.621
family situation	.254	1	.398
weariness from soccer	.176	1	.420
financial situation	10.404	1	.000
continuing education	.067	1	.519
other reasons	4.107	1	.033

Table 2. The results of χ^2 test on the variables of the relationship towards exercising, alcohol, smoking, hazard games and affairs with women after career termination

Pearson's χ^2 test	Value of χ^2 test	Degrees of freedom	Significance
Attitude towards exercising	1.563	2	.458
Attitude towards alcohol	2.120	5	.832
Attitude towards smoking	4.654	5	.460
Attitude towards gambling games	3.675	4	.452
Attitude towards affairs with women	2.984	3	.394

Discussion and conclusions

From the results it can be seen that a statistically significant value of χ^2 test between professional and amateur soccer players has been obtained in four reasons for career termination. The analysis of result frequency leads to the conclusion that professionals end their career more often due to old age and injuries, while amateurs terminate their careers more due to financial and other reasons.

We can find a confirmation for these results in some other studies, which have reached the same or very similar results (Werthner and Orlick, 1986; Huang, 2002; Allison & Meyer, 1988; Mihovilović, 1968; Svoboda & Vanek, 1982), who mention old age and injuries as some of the predominant reasons for career termination with professional soccer players.

Considering the results of χ^2 test on variables indicating the attitudes towards exercising, alcohol, smoking, chance games, affairs with women after career termination, it is evident that there is no statistically significant difference between professional and amateur soccer players.

Based on the obtained results we can define that the first null-hypothesis can be rejected since a statistically significant difference has been found in the reasons for career termination between professional and amateur soccer players.

The second null-hypothesis is accepted since no statistically significant difference has been found in the attitude towards exercising, alcohol, smoking, gambling games, affairs with women after career termination in the groups observed.

The objective of this study was to examine potential differences in the reasons for career termination and psychological and social indicators of attitudes towards exercising, alcohol, smoking, gamibling games, affairs with women after career termination between two polled groups – professional and amateur football players.

A conclusion may be drawn that professional and amateur soccer players differ in the reasons of career termination, but there is no difference in the adaptation to life after career termination on the observed variables.

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DO TASK AND/OR EGO ORIENTATION INFLUENCE BETTER DANCE PERFORMANCE?

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Abstract

The purposes of the present research were to identify the possible influence of intrinsic and/or extrinsic motivation on English waltz performance through detecting possible gender and age differences of 9 ±1 (N=22) and 13 ±1 (N=27) year old pupils in their level of dance performance and their intrinsic and/or extrinsic approaches to learning standard dance (the English waltz). The results obtained (ANOVA) indicate significant differences for task (intrinsic) orientation only in the subjects aged 13(±1) in advantage for girls and, between age groups, in intrinsic and extrinsic orientation in advantage for younger subjects. Especially girls and pre-pubertal boys more likely define their dance competence on the basis of how well they improve their performance rather than comparing their performance to that of others. A better dance performance of the older subject's groups was expected and it is probably correlated with the relevant anthropologic characteristics and with the process of development. Task-oriented individuals would probably have a better dance performance when novices are considered but future, extended investigations are needed.

Kay words: *intrinsic and extrinsic orientation, gender differences, english waltz*

Introduction

According to Hoffman and Harris (2000) physical activity is always accompanied by subjective experiences. The experiencing of a physical activity means more than performing it. Dance, especially among other physical activities, generate some emotions. It is primarily a kinaesthetic sensory learning experience and performing dances can touch us at a deep emotional level. Goal orientations (task and ego) reflect the differences in how individuals construe their level of competence and consequently, define specific settings. A task (intrinsic) orientation implies a task master and/or personal improvement which reflect high competence and subjective success. One's perception of competence tends to be self-referenced if the individual is task-oriented. Those who are ego (extrinsic) oriented, in contrast, tend to construe their competence in reference to others. Demonstrating that they are better than those they compare themselves to, means high ability and perceived goal accomplishment (Duda, Olson and Templin, 1991). When children approach dance classes from an extrinsic standpoint they perform dances for a very practical (extrinsic) reason – to complete the task, to be better than others, to get a good mark, to socialize with other children, to exercise for health reason, to listen to good music or to become a dance competitor. Dancing simply because we enjoy the experience of the activity is an illustration of having an intrinsic approach to physical activity (Hoffman & Harris, 2000). Nevertheless, a subjective experience, from an intrinsic standpoint, is probably the decisive factor whether or not someone will return to it in the future. Previous investigations have already established that the efficiency of motor reactions is defined by the relations between motor information and level of abilities that act interactively but differently in the various stages of advancement: verbal – cognitive, motor and autonomous (Miletić, Katić and Maleš, 2004). Task duration and structure are crucial characteristics that influence the motor learning process and we already know that the defining knowledge of the performance level of dance skills, primarily with children and youth, must be in accordance with the motor learning process and the learner's age. But we do not know how the subjective experience (intrinsic and/or extrinsic orientation) of children participating in dance classes affects their level of performance. The intrinsic and extrinsic approach to physical activity, especially with dance beginners, needs to be investigated with a specific reason to detect their relations with successful performance. Another problem relevant for this investigation is to identify objectively and assess the quality of dance skill performance (basic steps of the English waltz) performed by 9(±1) and 13(±1) year old boys and girls. Namely, the characteristic 'rough-form performance' of the English waltz steps as required in the beginning of the teaching-learning process does not make rigorous evaluation suitable. Yet, differences in the performance quality, among pre-pubertal and pubertal boys and girls probably exist and must be defined and estimated somehow.

The purposes of the present research were to: (1) evaluated the role of extrinsic and intrinsic motivation in the efficiency of learning waltz steps;(2) Identify different approaches, which stimulate intrinsic or extrinsic motivation in standard dance learning process differently by gender and age of 9 (±1) and 13 (±1) year old pupils.

Method

Pupils of the private elementary school "NOVA"from Zadar (n = 49) participated in this experiment. The subjects were divided into four groups by age and gender. No subject had any previous experience with the English waltz dance steps or any other dance programme. The experiment lasted for 5 practice units, implemented five times a week. Each training session lasted 45 minutes.

All the subjects' were obliged to perform four basic figures (solo and in pairs) of standard dance the English waltz and to complete TEOSQ. The subjects' task was to learn to perform correctly the exact English waltz dance figures (solo and in pairs): (1) The Waltz steps forward/backward; (2) Waltz steps in a *square* figure; (3) Waltz turn forward; (4) Waltz turn reverse; (5) dance style – performing the steps and turns softly, continuously and slowly; (6) conformity with the music. The beat is 3/4, and the tempo is slow. In order to avoid any subjective assessment, all the subjects were firstly videotaped. Three independent judges evaluated afterwards the performances by watching the videotaped material. The authors tried to simplify the judging procedure. Scoring was based on giving a 0, 1, or 2 for each of the 6 segments based on skill. A 0 was given if a segment was missing from the performance. A score of 1 was given if the segment was performed incorrectly, while a score of 2 was given if the segment was performed correctly. To establish an overall performance score for each trial, the 6 segment scores were totalled. Thus, the final score could range from 0 to 12.

The Task and Ego Orientation in the Sport Questionnaire (TEOSQ) is an assessment of the dispositional achievement goal orientations. It is a 13-item scale asking participants to respond to task end ego statements following from the stem, "I feel successful in (dance) when..." Each item is answered on a five - point scale. Task orientation is assessed by statements revolving around the feeling of success derived from learning new skills, fun, trying hard, and practising. Assessment of ego orientation is based on the responses concerning doing better than friends, scoring most points, and being the best.

To establish sensitivity for all the applied variables, standard statistic parameters (Mean and Standard deviation) a KS test were calculated, separately by age and gender. To establish the objectivity of the estimation for the three judges (variables for assessing dance performance), Cronbach Alpha and Average Inter-item correlation coefficients were calculated separately by age. One way ANOVA was used to define the differences between the groups (defined by age and gender) in performing the English waltz and the intrinsic and extrinsic approach to dance. All the coefficients were considered significant for $p < 0.05$.

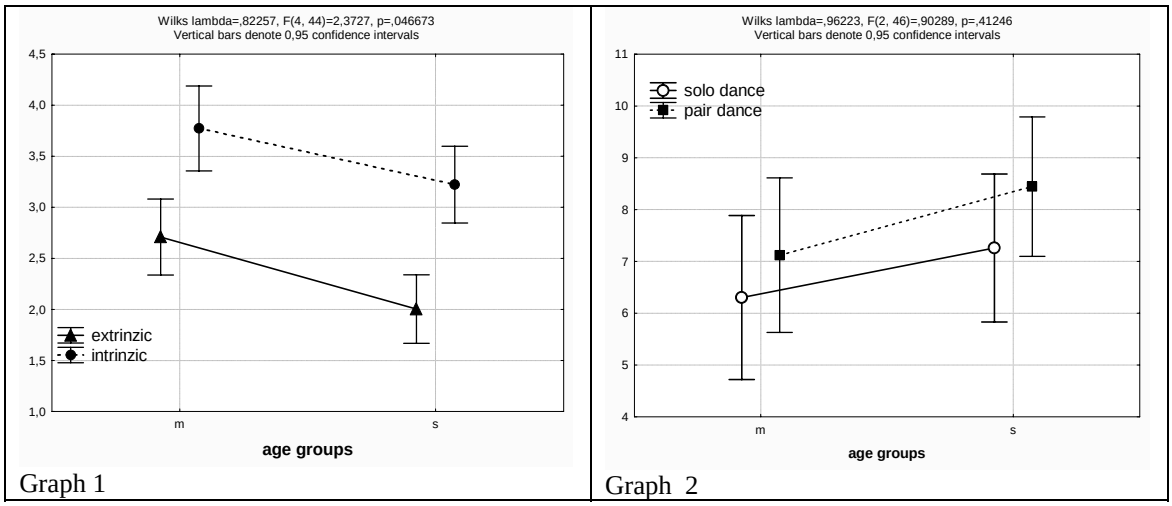
Results

Cronbach Alpha ranged from 0.96 to 0.99, and the Average Inter Item correlation coefficient ranged from 0.95 to 0.97 (Table 2) indicating the relatively high objectivity of the judges (variables for assessing level of dance performance). All data were analyzed for the normality of the distribution and Kolmogorov Smirnov test found no significant differences between the observed and expected normal distributions. ANOVA calculated between the age groups found significant differences in the intrinsic and extrinsic orientation in advantage for younger subjects (graph 1). Generally, 9(±1) years old subject's (boys and girls) scored higher results on the intrinsic, task orientation scale (Mean=2.7±1.0) then 13(±1) year old subjects (Mean=2.0±0.6). Analyzing the obtained results by gender in both age groups (Table 1) shows higher results scored by the boys in the younger age group and lower results scored by the boys in the older age group in both intrinsic and extrinsic orientation for dance. ANOVA calculated between gender groups found significant differences for task (intrinsic) orientation only in the subjects aged 13(±1) in advantage for girls (Table 1). There is no significant difference between the gender groups with 9(±1) years' old subjects neither with intrinsic or extrinsic variable scores. Analysis of variance (ANOVA) between age groups (graph 2) and gender groups for 13 (±1) and 9 (±1) years old subjects was calculated to examine the level of dance performance differences. No significant difference was found between the analyzed groups, but descriptive statistics (Table 1) shows a better dance performance of the older groups of subjects and especially the girls aged 13 (±1).

Table 1. Basic statistics (Mean ± SD) for all four group of subjects and ANOVA between gender groups (B=boys and G=girls)

	9 (±) 1 year old			13 (±) 1 year old		
	B+G (N=22) Mean ± SD	G (N=12) Mean ± SD	B (N=10) Mean ± SD	B+G (N=27) Mean ± SD	G (N=14) Mean ± SD	B (N=13) Mean ± SD
extrinsic orientation	2.7±1.0	2.5±1.1	2.9±1.0	2.0±0.6	2.1±0.4	1.9±0.8
intrinsic orientation	3.7±1.1	3.6±1.3	3.9±0.8	3.2±0.8*	3.6±0.7	2.7±0.7
solo dance performance	6.3±3.6	6.2±3.5	6.4±4.0	7.3±3.7	8.1±3.9	6.3±3.3
pair dance performance	7.1±3.6	7.6±3.2	6.5±4.0	8.4±3.4	9.1±3.2	7.7±3.5

* significant differences , according to One -way ANOVA, detected between gender groups (F=5.29; p<0.01)



Graphs. One-way ANOVA between age groups in: (1) intrinsic and extrinsic orientation of children participating dance classes and (2) level of performance of the English waltz dance steps (solo and pair performance)

Table 2. Kolmogorov-Smirnov test (K-S); Average Inter-Item correlation (I I r) and Cronbach Alpha coefficient **α**

	9 (±) 1 year old boys and girls			13 (±) 1 year old boys and girls		
	K-S	**I I r**	**α**	**K-S**	**I I r**	**α**
English waltz choreography - (solo)	.14	.96	.98	.16	.95	.98
English waltz choreography - (pair)	.13	.96	.98	.16	.97	.99

Discussion and conclusion

Previous studies examining the construct validity of TEOSQ via exploratory factor analysis have revealed a stable two-factor solution representing a task and ego orientation across the samples of youth sport (Duda et al., 1991.). In addition, the internal reliability of the two TEOSQ scales has been found to be adequate. Cronbach's alpha coefficients for the task and ego-orientation subscales were .82 and .80, respectively. In the present investigation all the groups scored higher results on task orientation, so the subjects probably approached dance from intrinsic orientation better than extrinsic. Especially the girls and pre-pubertal boys more likely define their dance competence on the basis of how well they improve their performance rather than comparing their performance to that of others. Intrinsic rather than an extrinsic approach in learning dances make more sense. Dance is much more likely to become meaningful for beginners if they develop an attraction to the intrinsic qualities. An intrinsic reason for participating in dance classes could be the reason why girls stay longer in dance activities for leisure, competition or self-expression shapes. Task - oriented girls learned the English waltz dance steps through their failures in order to reach optimal performance. They were preoccupied with the dance steps improvement and persistent in correcting errors and improving their final performance. It seems that, when a dance performance is an issue, enhanced capacity for co-operation and personal mastery are more important than beliefs that success in dance is related to some external factors. There is already evidence of gender differences in goal orientation among school children. Research of children in the fifth and sixth grades has also reported a higher task orientation among the girls (Duda et al. 1991; Fox, Goudas, Biddle, Duda and Armstrong, 1994). Better dance performance of the older subjects' groups in the same learning situation were expected and should be correlated with psychomotor coordination and all the relevant anthropologic characteristics, closely associated with the process of development which is individual in concordance with maturation. The maturity status influences physical performance (Beunen and Malina, 1998.) differently in boys and girls. More mature girls have a better physical performance than their less mature peers (11-13 years) and inter-individual differences in motor performance depend on growth and maturation especially in boys. The mean age at PHV (peak high velocity) in boys in Europe and America fluctuate on average between 13.4 and 14.4 years, while the mean age at PHV in girls fluctuate on average between 11.4 and 12.2 years. According to intrinsic goal orientation, maturation differences could be the reason for the better dance performance of the girls in the present study. Future studies based on the anthropologic features of pre-pubertal and pubertal boys and girls, correlated with detected results are necessary. The data revealed only a moment in time at a critical point in children's development. The behavioural consequences of sport motivation are likely to be dynamic and changing. The longitudinal research may provide a more complete indication of the impact of children's achievement profiles on their emerging patterns of sport involvement.

In conclusion, the fact that how physical activity makes us feel, will probably determine whether we will continue to engage in it. The task (intrinsic) oriented children along with the process of development, seems to provide a crucial

element for the high level of dance performance. High task and low ego approach to physical activity provides the most successful formula for schoolchildren (Fox et al.1994). The dispositional sport achievement, as dance competitors, of the analyzed subjects groups, are still in the early stages of the learning process and it is probable that the motivational and behavioural consequences have yet to be fully realized. The majority of girls still found dance attractive and this is an important finding of the presented data, particularly for girls, who unfortunately drop out of sport in their early teen years.

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DIFFERENCES IN PERSONALITY TRAITS IN MOTOR EFFICIENT AND INEFFICIENT FEMALE STUDENTS

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Abstract

The difference in character traits between motor efficient and inefficient students was examined by multivariant analysis of variance on the sample of 145 female students of Faculty of Philosophy. The results of the research reveal the existence of statistically significant differences between the group of motor efficient students and the unefficient ones, primarily in extroversion. The assumption drawn is that straightforward persons have decided to engage in sport as well as persons with bigger motor potential and emphasised need to move, and then the kinesiological activities themselves, in addition to submition to training and competition, contributed to further more emphasised extroversion.

Key words: *traits, motor activity, female students, extroversion*

Introduction

Quantitative definition of the human system is possible exclusively by measuring his anthropological features. An individual`s performance depend on the interaction of numerous components, abilities, features and characteristics which make his anthropological profile. Motor or psychomotor abilities are one of the most complexed and least researched components of the anthropological status. They are defined as the abilities to efficiently perform motor activities in relation to basic physical parametres such as time, space and force. They are particularly significant for efficiency in kinesiological activities, but in a man`s everyday life as well. Motor abilities depend to a large extent on other anthropological features to which they are inseparably bound, and thus on character traits. To some researches, traits or personal characteristics are relatively stable and largely genetically determined components of the anthropological status (Eysenck, H., J., Eysenck, S., B., G., 1994). On the other hand, some motor abilities are more subjected to genetic, and the other ones to social influences and kinesiological transformation procedures.

The importance of psychological characters and traits for success in kinesiological activities is becoming more and more noticeable. Namely, since top athletes are getting more equalled in many relevant elements of sport finess (condition, technical, tactical and other), psychological factors more and more frequently play an important role in competitions. Therefore, more significance is being given lately to athletes` psychological characteristics as important features of sport efficiency.

Former researches which dealt with relationships between certain traits confirmed a positive connection of the physical potential level and psychological stability, but also a positive influence of sport activity on stabilization of personal characteristics (Ismail, A., H., Young, J., R., 1976). Personal characteristics are somewhat subjected to cultural and social environment (Willimczik et al, 1986) as are on the level of intensity of performing a sport activity (Hošek, A., Momirović, K., 1987). Urged by an insufficient number of researches on the relation of motor efficiency and certain psychological features, the intention of this paper is to analyse differences in personal characteristics of motor efficient and inefficient female students.

Methods

The sample of subjects

The research has been done on the sample of 145 freshmen and sophomore female students of Faculty of Philosophy in Split, aged 18-20. The respondents are clinically healthy and physically fit to perform a kinesiological activity.

The sample of variables

Eysenck`s factor multidimensional personality questionnaire with 90 questions has been applied to assess conative traits. The advantages of the used questionnaire are economy, standard applying, objectivity, convenience and short and simple instructions. By the applied questionnaire, 4 prediction variables, i.e. conative factors, were analysed: extroversion, psychotism, neurotism and honesty (Eysenck and Eysenck, 1994; 2003). The questionnaire contains yes-no answers with an option to agree (yes) or disagree with a statement (no). In accordance with the ethic code of the Croatian Psychologists`

Association, the examining of personal characteristics was conducted by a qualified psychologist. Motor efficiency was assessed through seven following basic motor abilities tests: long jump from a spot (MSDM) to assess explosive power from the aspect of horizontal take-off, 20-metre sprint (M20M) to assess speed power, «japan» test (MJAP) to assess agility, training site excercise backwards(MPOL) to assess the coordination of the whole body, toch-toe astride (MRAS) to assess flexibility, hand tapping (MTAP) to assess the frequency of hand movements and lifting trunk (MPTR) to assess repetitive power of the frontal part of trunk.

Data processing methods

Within basic descriptive analysis, the following parametres were obtained: arithmetic mean (AM), minimum and maximum result values (MIN, MAX), standard deviation (SD), asymmetry (SKEW), and curvatureof distribution (KURT). The testing of distribution normality was done by Kolmogorov-Smirnova procedure (MAX D).

The differences in traits between motor efficient and inefficient female students were established through multivariant variance analysis (MANOVA). The respondents were categorised in two groups based on the results of the criterion variable as motor efficient (the respondents whose sum of the standardized Z values of results in all the tests is higher or the same as the arithmetic mean of the sample), i.e. motor inefficient (the respondents whose sum of the standardized Z values of results in all the tests is lower than the arithmetic mean of the sample).

Results

Table 1 displays basic descriptive parametre of the variables of the motor and the psychological domain. It is evident all the variables are normally distributed, i.e. they do not deviate significantly from normal distribution. Variables assessing psychotism and extroversion are on the bound of statistical significance, however, within limits, so the results are considered to be suitable for further multivariant processing.

Table 1. Basic descriptive parametres

VAR	AM	MIN	MAX	SD	SKEW	KURT	MAXD
MSDM	170,01	110,00	211,00	17,45	-0,12	0,25	0,05
M20M	4,34	3,65	5,35	0,34	0,63	-0,12	0,12
MJAP	18,78	13,90	23,33	1,63	0,17	-0,07	0,07
MPOL	12,23	7,95	22,24	2,53	0,91	1,27	0,08
MRAS	66,67	39,00	104,00	11,44	0,18	0,11	0,04
MTAP	35,83	19,00	50,00	4,20	-0,30	1,78	0,12
MPTR	23,30	11,00	34,00	4,15	-0,01	0,23	0,10
P	3,72	0,00	13,00	2,24	0,94	1,83	0,13
E	14,78	5,00	21,00	3,27	-0,62	-0,084	0,14
N	9,77	0,00	22,00	4,56	0,55	-0,19	0,11
L	10,03	1,00	17,00	3,53	-0,02	-0,50	0,08

TEST=0,14

Table 2 presents the results of variance analysis. By multivariant variance analysis, statistically significant differences in traits were confirmed between motor efficient and inefficient female students at the probability level 0,05.

Through univariant variance analysis, statistically significant difference in extroversion was confirmed between motor efficient and inefficient female students on the probability level 0,01.

Table 2. Multivariant and univariant variance analysis

Wilks` Lambda	Rao`s R	df 1	df 2	p-level
0,93	2,62	4	140	0,04

variable	X efficient (n=79)	X unefficient (n=66)	F	p-level
P	3,91	3,50	1,21	0,27
E	15,41	14,03	6,61	0,01
N	9,58	9,98	0,28	0,60
L	10,24	9,77	0,63	0,43

Discussion and conclusions

Obtained values (table 1) match, to a large extent, average results obtained through researches conducted on vast population of this age (Eysenck, H., J., Eysenck, S., B., 2003; Bratko, D., 2002). Compared to the test results of female students population in other researches as well as to normative values of motor abilities in high school female students (Findak et al, 1996), there are not any more significant differences, i.e. the results match average values of this population in the Republic of Croatia. Comparing the results of female students population to female athletes population (Rogulj et al., 2006), it is evident students are somewhat less psychotic and extrovert which was to expect due to specific qualities which are required in sport through long-term training processes and the fact that female athletes are more straightforward towards environment compared to ordinary population (Bratko, 2002; Kardum et al, 2004).

Extroversion is defined in literature by characteristics such as sociability, carelessness, dominancy, activity and heartiness, engagement and liveliness, and it significantly correlates with pleasant emotions such as joy and happiness. Some researches show that extroversion is connected with behaviours directed towards health (Jerram and Coleman, 1999), but also with some objective physical symptomes. Therefore, extroversion would be connected to blood pressure, by releasing adrenaline and noradrenaline and to citotoxicity of NK cells (Miller et al, 1999).

Extroversion is one of the most evident characteristics of the participants of kinesiological activities (Doucet, C., Stelmack, R., M., 1997). The participants of kinesiological activities are, in most of them, required to possess pronounced dynamism, communicative skills, straightforwardness and cooperation with other participants. Constant confrontation with an opponent or with physically demanding circumstances asks for a controlled and aimed impulsiveness and aggressiveness, willingness to take risk and react fast.

Motor activeness and engagement is naturally positively connected with extroversion since a motor engaged or a motor dominant person provokes and motivates with his appearance and motor ability all other mental (primarily perceptive), psychological and social impulses not only in himself, but in persons in his surrounding which stimulates and requires emphasised straightforwardness. In other words, kinesiologically active person ´radiates` and offers straightforwardness, and the fact that such a person is on the move in certain space and time, increases the probability of encountering and contacting other persons, much more than in a physically passive person.

This research cannot reveal whether the motor efficient female students are more extrovert because they were or they are now more kinesiologically engaged than the motor inefficient female students, whereby kinesiological activity produces not only greater motor efficiency, but straightforwardness as well, or is it because the straightforwardness itself is a hypothetically and to a large extent genetically determined characteristics which contributed to their motor efficiency (different inhibitions and social aspects of the test).

The differences can merely be established. The cause may be found in more factors, primarily facts that sociable persons are naturally and most frequently selected in sport and persons with bigger motor potential and an emphsised need for movement. It is assumed that mostly such students have decided to engage into kinesiological activities, and then kinesiological activities themselves and submition to training and competition contributed to further emphasised extroversion.

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SPORT MOTIVATION – A COMPARISON BETWEEN ADULT FOOTBALL PLAYERS COMPETING AT DIFFERENT LEVELS

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Abstract

The purpose of this study was to compare the achievement goal, self-determination and beliefs about the nature and determinants of sportive competence in function of competitive level in 3 groups of adult football players: Professionals (n=105), Semi-Professionals (n=156) and Amateurs (n=78). There were no significant differences in motivational orientations as a function of a competitive level. Amateur players, when compared with Professionals, presented significantly higher levels of amotivation and strongly believed that their sports competence was stable; nevertheless, they reported lower levels of identified regulation. On the other hand, Professionals and Semi-Professionals when compared with Amateurs revealed significantly higher levels of introjected regulation and strongly believed that their competence for the practice of football was due to learning and able to be improved.

Key words: *achievement goals, self-determination, competitive sport*

Introduction

In the context of football, the motivation is one of the concepts most referred amongst the reasons that justify the success and very often, the failure of players and of teams. Frequently coaches, players and audience associate the collective and individual performance to different motivational states. There have been a considerable number of studies that investigated the application of self-determination theory (Deci & Ryan, 1985) and achievement goals theory (Nicholls, 1989) to sport and exercise settings; however, there has been little investigation in what concerns athletes' beliefs relative to sport competence.

In accordance with achievement goal theory (Nicholls, 1989), there are two goal states of involvement that are adopted by individuals in achievement contexts, namely task and ego. When an athlete is task involved, the perception of success is self-determined. These individuals worry especially in improving or learning new ways of doing it. Conversely, an athlete ego involved is characterized by his way of defining success in a prescriptive or socially comparative way, essentially trying to show his capacity up before others.

On the other hand, the theory of self-determination (Deci & Ryan, 1985) mainly proposes that human motivation varies in function of the autonomy (self-determination) or of the controlled form that individuals reveal when they are involved in activities. Behaviors and actions that are autonomous are initiated freely and emanate from within oneself. In contrast, when behavior is controlled, it is regulated by an external force. On the basis of these distinctions, the central aspect of the theory of self-determination proposes that the different forms of motivation vary in a continuum in accordance with different levels of self-determination. The cognitive evaluation theory predicts that in the context of elite sports, characterized especially by focusing in winning and in great financial incentives, leads to the promotion of lower levels of self-determination and, consequently, lower levels of intrinsic motivation. On the other side, it is also expected that the athletes who compete in more elevated levels, present higher values for ego orientation (Mallet & Hanrahan, 2004). In spite of the numerous studies which prove these hypotheses with children and individuals in school age, the same does not happen with the adults' participation in sports teams, where the investigation is still very scarce (Etnier et al., 2004).

Using another perspective, a French-English group of investigators (Sarrazin et al., 1995) developed an instrument to evaluate the beliefs of individuals relatively to the nature and determinants of the perceived competence. Taking into account this investigation, we can keep the existence of several dimensions next to the nature and determinants of sports competence. In this way, whenever we speak in beliefs we will allude particularly to the conceptions of the individuals who refer to it: to the possibilities to develop the skill along time (subject to improvement or stable); to their determinants (has genetic predisposition, or if it needs to be learned); to its relative generality (as a general skill, or as a specific skill to a situation). So far, we do not know of any study that analyses the beliefs of athletic competence in function of the competitive level of athletes.

As such, and considering the limited number of studies that approach these motivational constructs in teams of high competitive levels and especially in teams of adults, with this work we wish to contribute to a better understanding of

some aspects referring to the motivation in Portuguese football players, namely in what concerns their achievement goals, perceived autonomy and beliefs about the nature and determinants of sport competence. It is also our goal to analyze these motivational determinants regarding the competitive level of these athletes.

Methods

Sample

The participants were 339 senior football players (≥19 years old, M=25.23, SD=5.26) from 21 football teams. Six teams competed in the professional championships (P) of 1st and 2nd League (N=105), nine teams competed in the national championships of the second and third division (SP) (N=156), and in the regional championships (A) competed six teams (n=78).

Procedures and measures

Data were collected during the 2005/2006 season. The involvement of the participants was volunteer and to all who agreed to collaborate the secrecy of the answers was secured. The process was supervised by the author who, previously, explained to the athletes the main goal of the study and the way to answer the questionnaire. Data collection was carried out prior to the players' training session.

Participants completed the following tools: Task and Ego Orientation in Sports Questionnaire (TEOSQ), Self-Regulation Questionnaire (SRQ), and Questionnaire relative to Beliefs about the Nature and Determinants of Sports Competency (QCNHS). The participants supplied relevant demographic information, including age, sex and competitive standard.

Descriptive data (*mean* ± *SD*) were recorded for all variables. The internal consistency of the various subscales was determined by calculating Cronbach's Coefficient Alpha. Analysis of variance (ANOVA) was used to analyze the differences between the three groups; post hoc comparisons were done using the Tukey test ($p < .05$).

Results

Reliability of measures

Internal consistency reliability (Table I) was adequate for all subscales of the TEOSQ and RAI. Relatively to the QCNHS, the obtained Cronbach alphas for the stable (0.46) and specific (0.40) dimensions showed an internal low consistency like the study carried out by Sarrazin et al. (1995) where a value of 0.46 for the "specific" dimension was obtained. We tend to consider these two dimensions in our study, highlighting from the start that all the analyses carried out regarding these ones will have to be a target of a more close attention. As it is an instrument still little used in national context especially in football, we consider this as the most relevant solution, like did Sarrazin et al. (1995).

Differences between groups as a function of competitive level of play

There were no significant differences in task and ego orientations as a function of competitive level of play. Relatively to the values attributed to a continuum of self-determination, the professionals presented significantly lower levels of amotivation (p=.04) when compared with the amateurs, and significantly higher levels of introjected regulation (p=.02), and identified regulation (p=.01). Semi-professional football players showed significantly higher levels of introjected regulation when compared with the amateurs (p =.01).

In what concerns the beliefs about the nature and determinants of sport competence, the professionals and the semi-professionals, when compared with the amateurs, tended to show significantly higher beliefs that sport competence resulted from learning (p=.03 and p=.00, respectively) and is subject to improvement (p=.04 and p=.00, respectively). The amateurs, when compared with the professionals, showed higher levels on the belief that sport competence for the practice of football is stable (p=.02).

Table I. Descriptive Statistics, ANOVA (One-Way) and Internal Reliability for the Professionals (Prof.), Semi-Professionals (Semi-Prof.) and Amateurs (Amat.)

	Prof. (P)	Semi-Prof. (SP)	Amat. (A)	ANOVA	p		Alpha
Task	4.14 ± 0.59	4.19 ± 0.52	4.02 ± 0.60	F=2.18	0.12		0.87
Ego	2.58 ± 0.95	2.63 ± 0.83	2.65 ± 0.88	F=0.15	0.86		0.89
Amotivation	1.42 ± 0.60	1.46 ± 0.74	1.69 ± 0.93	F=3.24	0.04	*P/A	0.78
External R.	1.96 ± 0.74	1.85 ± 0.74	1.77 ± 0.75	F=1.32	0.27		0.75
Introjected R.	3.53 ± 0.82	3.52 ± 0.85	3.19 ± 0.76	F=5.03	0.00	*P/A – SP/A	0.70
Identified R.	4.38 ± 0.66	4.31 ± 0.62	4.10 ± 0.69	F=4.40	0.01	*P/A	0.75
Intrinsic M.	4.11 ± 0.72	4.19 ± 0.62	4.12 ± 0.75	F=0.54	0.59		0.73
Relative Autonomy Index (RAI)	0.85 ± 0.41	0.93 ± 0.39	0.93 ± 0.46	F=1.14	0.32		0.71
Learning	4.47 ± 0.57	4.56 ± 0.42	4.25 ± 0.71	F=7.71	0.00	*P/A – SP/A	0.76
Improvement	4.14 ± 0.68	4.25 ± 0.61	3.89 ± 0.85	F=6.66	0.00	*P/A – SP/A	0.72
Specific	3.80 ± 0.69	3.98 ± 0.68	3.87 ± 0.73	F=2.08	0.13		0.42
Gift	3.40 ± 0.81	3.34 ± 0.85	3.33 ± 0.92	F=0.20	0.82		0.78
Stable	2.39 ± 0.63	2.53 ± 0.65	2.66 ± 0.80	F=3.64	0.03	*P/A	0.48
General	2.07 ± 0.81	2.09 ± 0.81	2.11 ± 0.89	F=0.08	0.92		0.79

*= stands for p≤0.05

Discussion and conclusion

The analysis of the different motivation determinants in function of the competitive level provided some interesting results. Importantly, there were no significant differences in the motivational orientations regarding the level in which the football players were competing, as previously found by Etnier *et al.* (2004). Our results disagree with the available (White & Duda, 1994), which shows that football players who compete in the higher levels are more ego orientated than those who compete at lower levels; in our sample of adult footballers competitive level was not a determinant of task/ego scores.

Also surprising was the fact that amateur football players had reported higher levels of amotivation when compared with the professionals. Self-determination theory (Deci & Ryan, 1985) suggests that athletes who compete in higher levels, characterized especially by focusing on winning, probably will be less self-determined and will present superior levels of amotivation and introjected regulation when compared with athletes who practice this sport at lower competitive levels. Our study however, does not confirm this premise, since those who presented superior levels of amotivation were amateur football players. Considering the relations that have been established between amotivation and persistence in sport practice, these footballers would be at higher risk to drop out from this competitive sport.

Taking into account the results related to the introjected regulation in the different groups and what self-determination theory suggests (Deci & Ryan, 1985), we think that the athletes who were competing at higher levels had a tendency to report more the external contingencies (such as, being obliged to practice this kind of game or the will to please the others) like primary fountains of motivation when compared with the athletes with less success. Considering the social context in which these athletes were in, this seems reasonable to happen, since those athletes who were depending on the practice of the sport to survive would probably feel more intensely the popularity that the leading sport in Portugal was giving them. On the other hand, these data suggest that the perception of eventually obtaining undesirable results or of being defeated by an adversary could influence in a certain way the performance of the football players.

An interesting fact that could lead to a better understanding of the results obtained in our study, concerns the results from the investigation carried out by Wilson *et al.* (2004). These authors concluded that in the female gender, introjected regulation was an important motivational force, because it appeared to strongly predict behaviours such as persistence, importance and effort put on a physical activity. Besides having concluded that a more autonomous regulation predicted more positive motivational consequences, the authors also suggested that the quality of external motivation is important and valuable for a better understanding of the behaviours in a sports context.

An interesting result is related to the fact that professional athletes had attributed significant higher levels of identified regulation when compared with the amateur players. Based on past research and cognitive evaluation theory, we expected that the professional players would exhibit a less self-determinate motivational profile than amateur players. More specifically, when compared to amateurs, we expected professional players to demonstrate lower levels of self-determined forms of motivation, that is, less intrinsic motivation and less identified regulation. However, it seems to us natural that the professional athletes consider this kind of sport important for them, considering they identify themselves

with it, and they value it more than the amateurs. Besides the above-mentioned, the fact that the football players who participate in higher competitive levels probably have more objectives in the long term should also be considered (e.g., to compete in superior levels).

As suggested by the literature (Mallett & Hanrahan, 2004), professional players were characterized by multiple motivations and, in particular, self-determination. Participation in an elite sport does not always undermine self-determined motivation. One explanation may be that after a period of time, financial rewards for elite athletes will make them lose their controlling influence, and the pursuit of becoming someone special in the sport being a more powerful motivator.

In relation to the beliefs of sport competence, the fact that professional and semi-professional players strongly believe that their competence is a result of learning and is subject to improvement when compared with the amateurs seems to be a desirable tendency. That is, as soon as they detain a perception of bigger control of development of their sport competence than those who compete in the amateur championships. The fact that amateur football players consider their own sports competence more stable than professional players suggests that the former are less likely to engage in specific work to change this construct.

The differences found concerning the several motivation determinants in function of the competitive level, underline the existence of a complex relation between the competitive level and motivation. If the indicated differences concerning the several motivational determinants reflect specific characteristics of the football players with more success, it becomes important to ascertain which athletes intend to reach a higher step of performance, so that more developmental programs of intervention are applied on the basis of this specificity.

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EMOTIONS AND POSTURAL STABILITY

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Abstract

We aim to find the relationship between the ability to control **emotions** induced by emotionally biased pictures and the **postural stability** in biathletes. We propose that the reaction to emotionally biased situation depicted on the picture causes changes in postural behavior. For the purposes of this experiment, two pilot studies have been conducted so far that are discussed in this paper. According to the results of the pilot study 1, we identified a set of pictures that were reported to be emotionally arousing either in positive or negative way to a sample of university students of sport. The set of pictures was used in the pilot study 2 as visual stimuli consequently. The results of the pilot study 2 revealed four major setting problems regarding the intensity of the exposure to visual stimuli. Here, additional changes in setting are suggested for the purposes of the pilot study 3 in order to increase the intensity of exposure to emotionally biased stimuli.

Key words: *Induced emotions, stabilometry*

Introduction

Emotions in sport represent one of the major determinants of highest performance. For athletes, the emotional regulation means the ability to monitor and control their emotions in psychologically demanding situations (Moran, 2004). Effective emotional regulation often contributes to perfect performance. Although the significance of emotions in sport achievement has been emphasised lately, the studies on the differences of emotional experience in expert athletes and novices issues are lacking (Janelle, Hillman, 2003). Simultaneously there is a lack of knowledge of the different process of emotional regulation in expert athletes and novices. The other question is into what degree the knowledge of physiological differences may serve as the estimate of the level of athlete's mental toughness in relation to his or her performance. We ask whether athlete's highest performance is influences by physiological changes. For example, the postural stability in shooters get worse because of physiological changes and that may lead to shooting error. Shooting is considered emotionally demanding situation in biathlon. One of the most important determinants of successful shooting is stability – the ability to achieve it and maintain it during shooting phase especially in standing position. The stability of the body in certain position in the space is called postural stability.

We aim to detect the correlation between biathlete's postural stability in shooting position in upright stance. Next, we aim to find the differences between "novices" and "experts" concerning the quality of postural stability during exposure to emotionally biased visual stimuli. Third, we want to examine the criterion validity of platform stabilometry as a screening psychodiagnostic tool of emotional expertise in biathletes in comparing to coach report about the athlete. The results of our study will contribute to the basic research knowledge of emotion and its influence on athlete's motor behaviour, a key determinant of his or her performance. For the purposes of this study, two pilot studies have been conducted so far.

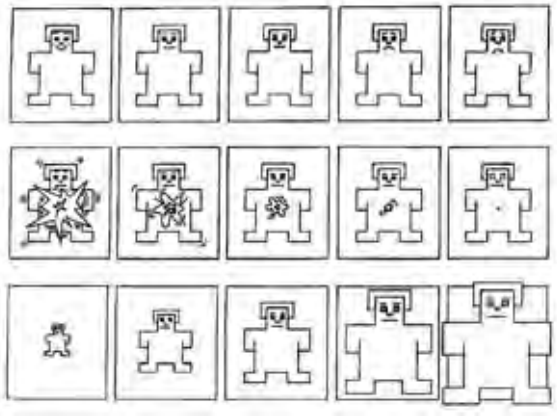
The relationship between postural stability and emotions has been examined by means of induced emotions. The results of the study with general population sample showed that the body sway increased when the individual was exposed to emotionally biased visual stimuli (Hillman et al., 2003). Other researchers (Azevedo, 2003) suggested that extremely negative emotional stimuli causes so called "freezing phenomenon" when the body sway decreases. Both phenomena may be explained by neurophysiological theory of the influence of emotions on postural stability. This theory is based on the principal of postural stability central control. Extreme stimulation of limbic system structures causes higher stimulation of hypothalamus and centers of equilibrium which is reflected in deterioration of postural stability (Hinoki, 1981).

Methods: Pilot Study 1 – Induced Emotions

The sample of 31 Physical Education (PE) students (4 women, 27 men) of Faculty of Physical Education and Sport participated in the study (mean age 21.5, SD 1,5). The study was conducted in 7 x 5 m room. Appropriate visibility was adjusted from every seat. The pictures were presented by means of the data projector. The screen size was 1.7 m x 1.5 m. The participants were seated in 3 – 4 m distance. Participants were instructed about the principal of ratingl.

The pictures included positive scenes such as sport, portraits, nature; negative scenes such as physical injuries, attacking animal, attacks; neutral scenes such as objects of daily living – furniture, appliances etc. Each category included 10 pictures, i.e. 30 pictures in total. The order of negative, positive and neutral pictures was random. Each picture was announced by separate slide presented for 5 s. The picture was presented for 6 s and black screen followed for 15 s. During this period the participants rated the picture in all three dimensions. The cycle of one picture lasted for 26 s, i.e. 13 minutes in total for 30 pictures.

The method of assessment of emotion by means of emotionally biased pictures (Lang, Bradley, Cuthberth, 2005) is based on the dimensional theory of emotions (Wundth, 1898, Mehrabian, Russell, 1974, Tellegen, 1985 *In* Lang, Bradley, Cuthberth, 2005). According to this theory two primary dimensions of emotions are defined: "valence" (pleasant – unpleasant) and "arousal" (calm – excited), and one secondary dimension: "dominance" or "control", (dominant – controlled). The evaluating system Self Assessment Manikin (SAM) is used to evaluate the induced emotion with respect to those three dimensions (Lang, 1980). The system includes rating cards where graphic ures depict the values of each dimension (see ure 1). The first line represents the "valence", the second represents "arousal", and the third represents "dominance". The individual can select one of the five ures in each dimension or put a mark between any two ures. Thus, the 9-point scale is available to rate the emotion. The value 9 represents the highest rate in each dimension (e.g. the most pleasant, most arousing, most dominant). The value 1 represents the lowest rate in each dimension (e.g. the most unpleasant, calmest, most controlled).

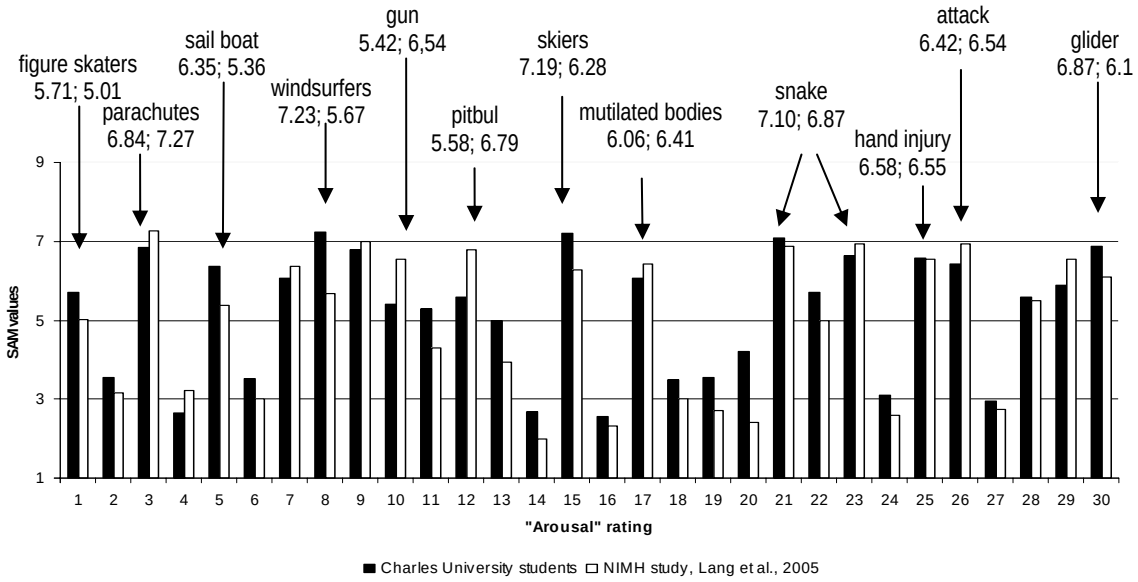


ure 1. Self Assessment Manikin rating card (Lang, 1980)

Results: Pilot Study 1 – Induced Emotions

The results of pilot study one suggest that there are not significant differences in rating between the participants of Lang's study and PE students in the valence dimension. The most different mean rating that was higher then middle value 5 was found in picture number 13 (runner) and 30 (glider). The mean rating value for picture number 13 was 6.81 in PE students and 5.96 in participants of Lang's study. 29% of PE Students rated the picture with value 9. The mean rating for picture number 30 was 7.48 in PE students and 6.71 in NIMH general population. 39% of PE Students rated the picture with value 9.

The differences were more expressed in arousal dimension. As we expected, PE students rated the sport scenes higher than participants of Lang's study (see ure 3). The highest values that exceeded middle value 5 were found in pictures number 1, 3, 5, 6, 15 and 30. On the contrary, the negative pictures such as attacking pitbul (PE students mean rating 2.90; Lang's study 3.55) or aimed gun (PE students mean rating 3.97; Lang's study 2.83) were perceived as less arousing in PE students than in Lang's study. Other negative scenes such as physical injuries, mutilated bodies, and spider were perceived in the same intensity of arousal in both groups. Those pictures that induced intensive positive and negative emotions in PE students were used in the pilot study two.



ure 3. Rating in "Arousal" dimension (mean rating of PE students; mean rating of participants of Lang's study)

Methods: Pilot Study 2 - Stabilometry and Emotions

One subject – student of the Faculty of Physical Education and Sport, 21y of age was assigned in this study. Two stabilometric methods were used: static force platform Kistler and dynamic force platform RS Scan. The postural stability was measured for 30s. One 30s test without exposition to stimuli was used to set the baseline of postural stability of the individual.

The third method used was induction of emotion by means of IAPS (Langet al., 2005) according to the results of pilot study 1: a) triplets of pictures with counterbalanced order of negative and positive scenes, and b) single pictures depicting positive or negative scenes. The pictures in triple sets were presented for 6s followed by black screen for 5s. The single pictures were presented for 8s followed by black screen for 22s. The pictures were presented by means of 19 inch LCD monitor. The monitor was placed 84 cm in front of the individual.

The stabilometric measurement and picture presentation were synchronized by means of stop-watch. The position of feet was a) standard stance – feet 20 cm apart, in 15˚ external rotation, and b) narrow stance – feet attached, inner ankles untouched.

First, the static force platform Kistler was used for the test 0 lasting 30s without visual stimuli. After that, the subject rested aside the platform for 2 minutes. Then, the test 1 was run with visual stimuli – the first triplet of pictures. The order of the scenes regarding valence was: negative – positive – negative. The 2-minute-rest followed. During the test 2, the single negative scene 8-second presentation was shown and 2-minute-rest followed. During the test 3 the same procedure was run with positive scene. Second, the dynamic force platform was used for the test 0, test 1 in standard stance using two triplets of pictures, and test 2 in narrow stance using other two triplets of pictures.

Results: Pilot Study 2 - Stabilometry and Emotions

The objective of the pilot study 2 was to test the measurement procedure of measurement using two methods – stabilometry and induced emotions. The Kistler measure showed to be irrelevant in connection with induced emotions because the record used average values in time. It is not able to monitor the moment of emotional stimuli exposure. The dynamic force platform RS scan measure showed to be able to recognize the change in postural behavior after exposure to emotional stimuli. However, the subject in pilot study 2 was very stable and thus it was extremely difficult to identify the start of postural reaction to emotional stimuli. The most significant change in anterior-posterior deviations was found in test 2 when single picture of attacking snake was presented. The deviation of COP as well as the speed of deviating increased.

Discussion and conclusion

In pilot studies we aimed to retest the experimental procedure using induced emotions and stabilometry that was suggested by previous studies. We encountered several problems during the pilot study 2 that lead us to suggest different experimental setting in pilot study 3.

1. The stimuli caused appropriate emotions according to scene's content. However, the intensity of the emotions was not high enough to generalize the reaction in postural system.
2. The size of projection of pictures was perceived as too small to cause arousing reaction though the pictures were perceived as arousing regarding their content. Thus, the stabilometric methods used were not sensitive enough to monitor the change of postural behavior.
3. Standard stance with feet apart provides very god support of the individual. Therefore, the COP deviations are very low.
4. Static scenes that are shown in pictures were perceived as less arousing though their content is perceived as emotional, either negatively or positively.

In order to standardize the method for practical use, further studies including validity and reliability estimation need to be conducted. In the nearest future, the pilot study 3 using both, the stabilometry and induced emotions will be conducted. The experimental setting will be adjusted in order to increase the intensity of exposure to emotionally biased stimuli.

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CHILDREN AND YOUTH PHYSICAL SELF PERCEPTION PROFILE: STEP ONE IN CROSS-CULTURAL ADAPTATION PROCESS

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Abstract

This paper refers on the results of the translation phase of cross-cultural validation of the Czech version of the Children ad Youth Physical Self Perception Profile questionnaire (CY-PSPP) (Whitehead, 1995). The original English version of CY-PSPP was modified from the Physical Self Perception Profile developed by Fox and Corbin (1989 a,b). A combination of two translation methods was used. A group of 19 children, the students of the third and fourth grade of Prague basic school (9,4y of age, SD 0,9) was included in the pilot study. The objective of the study was to establish the content validity of the translation in terms of semantic and normative issues for the Czech culture and the population of young children.

Key words: *direct translation, random probe technique, post-assessment narrative*

Introduction

Physical self-concept, as a part of general self-concept, has been extensively studied in the last 20 years. Perceptions of physical aspects of self have been understood as very important in self-esteem that starts to form in early childhood. Yet two-years-old children show a reasonable knowledge of his or her characteristics regarding sex differences as well as the differences between children and adults. The self-description in pre-school children includes physical traits, property, and preferences. However, the ability to make general assumptions about "self" is not missing entirely. Such ability is more prominent in young school children when they start to reflect emotions (e.g. sadness) or social coherence. Furthermore, the school children are often reported to compare their abilities and achievement with children of their age (Vasta et al., 1992). In youth, the self-description works with formal mental operations and more abstract terms. The attitudes and attributes of their personality are developed as well as presumptions of solution of hypothetical situations. The adolescents are reported to be more disclosed about their bad characteristics since those are considered as less significant in comparing to the good ones.

Our body, through its appearance, attributes and abilities, provides the interface between the individual and the world; it is the major vehicle for social communication. Physical self perception has been associated with choice of physical activity and health-related behaviors (Fox, 2000b). Thus, it may be considered a determinant of healthy lifestyle. The enhancement of physical self perception in physical domain has been a common objective of various exercise programs that were designed to increase the adherence to active and healthy lifestyle during the life span.

The Children and Youth Physical Self-Perception Profile – CY-PSPP (Whitehead, 1995) is a modified version of PSPP (Fox et all., 1989). The subscales of the CY-PSPP are consistent with the original measure. Six subscales related to physical concept are included: Sport competence, Condition competence, Attractive body, Physical strength, Physical self-worth, and Global self-worth. The two subscales "Self Competence" and "Global Self-worth" are implemented from the Manual for the physical self-perception profile for children (Harter, 1985).

Since there is no testing instrument in the Czech Republic that can provide the insight to the perceptions physical self issues and related behaviors in children and youth, we have started a cross-cultural adaptation process of CY-PSPP. We presume that such psychometric tool may serve as a great source of information about effectiveness of various education approaches especially for the PE teachers, coaches etc.

Methods

The procedure of the pilot study was divided into four phases. In the phase 1, four independent Czech experts translated the items of CY-PSPP. A combination of two translation methods was used including multiple direct translations by four experts and post-assessment narrative. The experts were experienced in the area of PE education of children and youth or sport psychology. All of them had excellent knowledge of Czech and English. In the phase 2, the researcher summarized

of all translations, sent it to the translators and organized a meeting where the content of translations was discussed. The most appropriate formulation of each item was found or re-formulated from the four translations and the first Czech version of the questionnaire was completed including instructions for participants. In the phase 3, the independent expert, a Czech language teacher, reviewed the translation with regard to Czech grammar and stylistics. In the phase 4, the reviewed version was administered to a group of 19 school children (9,4y of age, SD 0,9, 11 girls, 8 boys). The children were informed about the questionnaire and the purpose of the study and instructed how to fill out the questionnaire. All children participated voluntarily with the permission of their supervisors. The use of the instrument was approved by the ethical committee. The approximate duration of filling out the questionnaire was 20 minutes. After the children finished the questionnaire, two researchers discussed with some of them the items that were misunderstood, perceived unclear, doubled or peculiar in any way in terms of meaning, wording etc. The information collected in discussions were analyzed by researches and implemented in reviewed version of the questionnaire.

Results

The analysis of the reports showed that most of the respondents understood the content as well as the formulation of most of the items. Only one of the participants had difficulties with the questionnaire because of dyslectic problems and the other one apparently did not understand the instructions considering the way of working with the items. The post-assessment narrative revealed that item number 10 where the Czech expression of collocation "children of your age" was often reported as unintelligible. The word "physical" was also perceived as difficult to understand (e.g. items number 23, 24). Third formulation considered problematic was "strong muscles". Items number 8 and 32 were perceived as similar in terms of meaning as well as items 24 and 30. The perception of similarity was also reported in items 20, 22 and 23. Items number 3 and 25 we perceived as weird for unreported reason. The outcomes of the analysis will be used in creating the final version of the questionnaire.

Discussion

The process of cross-cultural adaptation of measuring tool of self-report type requires several important issues to be deliberated. Not only the ethnic but also language diversities need to be considered because of potential threats to content and criterion validity they may cause. Lately, a great number of experts have discussed the problem of legitimacy of intercultural adaptations (Banville, 2000; Behling, et al., 2000; Van de Vijver et al., 1996). According to one group of disputes, the adaptation of measurement tool in social sciences, especially those developed for North American culture, is not acceptable. On the other hand, others argue that the two types of constructs need to be distinguished: ethics – cross-culturally identical or similar and thus transferable, and emics – culturally specific thus non-transferable (Berry, 1969). However, some constructs may be considered a combination of both types of constructs. They comprise ethic core and emic components (Brislin, 1973). Physical self-esteem may be considered as such – the perception of self may be found worldwide. At the same time significant diversities may be expected across ethnics with respect to historical roots of cultural and social norms.

The decision to use the combined method of translation process in our pilot study was based on the methods used within the cross-cultural validation study of PSPP (Tomesova, 2005). In accordance with the outcomes of the validation study of the PSPP, some items had to be adjusted with respect to strength of expression perceived in the Czech culture. The literal translation would distort the semantic content of the item. Simultaneously, all translators encountered difficulties with translating words such as: feel uneasy, feel good, or feel confident. The difficulties were mainly associated with subtle semantic difference when used in Czech in the context of the item. Other reason could be that the words are not used in this context at all. The intelligibility for children was also an issue. Therefore, sometimes same words needed to be used to ascertain compatible and clear meaning. This was unfortunately reflected in several formulations across items that were perceived as doubled. Those items increase the reliability of the tool and therefore the wording of those is extremely important so that the respondent would not skip them as already answered.

Several formulations such as "strong muscles", "children of your age", and "physical" were perceived as problematic. In Czech, the meaning of the first formulation would be rather expressed as "big muscles". However, some children stated that there might be a difference between the size of muscles and strength of muscles. Therefore, we decided to maintain the literal translation of "strong". The translation of the other two expressions can be used in two ways in Czech. The word "physical" is used in two forms in Czech different in terms of meaning into some degree. The first has Greek root and is used to express issues connected with body and its abilities and capacity. The second is and original Czech word and is used to express issues of the body regarding appearance rather than abilities. The one with the Greek root seemed to be more difficult to understand. However, the children seemed to perceive the meaning of both ways identically. Therefore we need to consider the use of the Czech original word instead of the one with Greek root. Some items (e.g. 3 and 25) were perceived as "weird" for unreported reason which implies consideration of wording of these items. The collocation "children of your age" has literal and one-word translation. The one-word translation seemed to be less understood than the literal one.

Furthermore, for the future use of the questionnaire, a pre-screening would be helpful to monitor limitations such as dyslexia, dysgraphia etc. In order to enable those kids to disclose, an assistant may help them to fill out the questionnaire by reading the text or scoring. Similar considerations should be done in children with optical or other sensual difficulties that might limit the disclosure.

Conclusion

The first step of the cross-cultural adaptation process of the CY-PSPP has been done. The pilot study conducted with 19 participants revealed several translation and wording problems that need to be addressed for the purposes of the second version of the instrument. In the next step further study will be conducted in order to establish the reliability and construct validity of the Czech version. However, we are aware of the limitation with regard to translation equivalence. The knowledge of this basic limitation will prevent us from misleading inferences about differences and similarities of the original sample and the one with the Czech cultural background.

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Research Methodology

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NOTATIONAL ANALYSIS OF SOCCER

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Abstract

Hughes and Franks (2004) suggest that notational analysis is primarily concerned with the analysis of movement, technical and tactical evaluation and statistical compilation. Thus notational analysis is a technique for analysing different aspects of performance through a process which involves producing a permanent record of the events. This mirrors one of a soccer coach's main tasks i.e. to analyse sports performance, so that feedback may be given to players and future training sessions planned. Not surprisingly the majority of published notational analysis work in soccer derives from academics with an interest in soccer and they are not necessarily involved in the coaching process, although many are. This paper will present and assess some of the best known soccer research studies before identifying methodological issues that need to be addressed by all practising notational analysts. Over the next 10 years it is likely that the process of analysing performances will become significantly easier. This is likely to be achieved in the software with the use of some form of interactive help whilst also removing the need to have a degree in computer programming, statistics and artificial intelligence. Also with the growing popularity of notation analysis in professional sport so to is the need to adequately educate sports scientists in this area. Currently UWIC, Liverpool John Moores, Loughborough and Swansea Universities have teaching and research programmes in place with others developing courses and the expertise to meet the demand. This demand will strengthen notational analysis as a discipline leading to better research by way of methodological advances, more appropriate statistical procedures and simpler output formats. These advances will in turn be fed back into sports organisations and companies to the benefit off all prospective notation analysts.

Key words: *notation, analysis, soccer*

Introduction

Hughes and Franks (2004) suggest that notational analysis is primarily concerned with the analysis of movement, technical and tactical evaluation and statistical compilation. Thus notational analysis is a technique for analysing different aspects of performance through a process which involves producing a permanent record of the events. This mirrors one of a soccer coach's main tasks i.e. to analyse sports performance, so that feedback may be given to players and future training sessions planned. It would seem therefore that notational analysis would be a useful technique for soccer coaches. To determine whether this is the case however, it is necessary to demonstrate some added value that notational analysis brings to the traditional methods employed i.e. subjective observations, employed by coaches. In this respect, Franks and Miller (1986) demonstrated that international level soccer coaches could only recollect 30 per cent of incidents that determined successful performance with significantly better recall of set piece play than any other situation. This pivotal research likened coaches' observations to eyewitness testimony of criminal events and suggested that reliance on such observations is not only unreliable but also inaccurate. This evidence has been widely used to promote the need for an objective and reliable mechanism for recording sports performance with some form of notational analysis thus being recommended.

Olsen and Larsen (1997) reported that nearly all premier league soccer teams in Norway used match analysis in one way or another. Given Olsen's position as National coach this view obviously had some authority. More recently Blaze *et al.* (2004) reported that of the 10 English Premier League managers who responded to a questionnaire, 9 used hand or computerised notational analysis with further responses via semi-structured interviews suggesting that notational analysis was widespread, see also Groom and Cushion (2005). In the English leagues all matches are currently video recorded and a copy given to the managers of each team immediately following the end of the match. Of course the extent to which these recordings are used is largely unknown as any subsequent analysis remains unpublished as the data and analyses remain secret to all but the authorised personnel within the club. However the current UEFA Pro Licence which is the mandatory higher qualification in all the major football countries (http://falearning.thefa.com, accessed 20th July 2006) includes an element of sports science in its curriculum including match analysis (as do the UEFA "A" and "B" badges). Clearly the administrators of soccer coaching see the need for training match analysis although then techniques used by coaches in the field are less well known.

Not surprisingly the majority of published notational analysis work in soccer derives from academics with an interest in soccer and they are not necessarily involved in the coaching process, although many are. This paper will present and assess some of the best known soccer research studies before identifying methodological issues that need to be addressed by all practising notational analysts.

Hand notation of soccer

Patterns of play

An alternative approach towards match analysis was exemplified by Reep and Benjamin (1968), who collected data from 3213 matches between 1953 and 1969. They were concerned with actions such as passing and shooting rather than work-rates of individual players. They reported that 80% of goals resulted from a sequence of three passes or less. Fifty per cent of all goals came from possession gained in the final attacking quarter of the pitch.

Bate (1988) found that 94% of goals scored at all levels of international soccer were scored from movements involving four or less passes, and that 50-60% of all movements leading to shots on goal originated in the attacking third of the field. Bate explored aspects of chance in soccer and its relation to tactics and strategy in the light of the results presented by Reep and Benjamin (1968). It was claimed that goals are not scored unless the attacking team gets the ball and one, or more, attacker(s) into the attacking third of the field. The greater the number of possessions a team has, the greater chance it has of entering the attacking third of the field, therefore creating more opportunities to score. The higher the number of passes per possession, the lower the total number of match possessions, the total number of entries into the attacking third, and the total chances of shooting at goal. Thus Bate rejected the concept of possession football and favoured a more direct strategy. He concluded that to increase the number of scoring opportunities a team should play the ball forward as often as possible; reduce square and back passes to a minimum; increase the number of long passes forward and forward runs with the ball and play the ball into space as often as possible.

These recommendations are in line with what is known as the 'direct method' or 'long-ball game'. The approach has proved successful with some teams in the lower divisions of the English League. It is questionable whether it provides a recipe for success at higher levels of play, but these data have fuelled a debate that continued through several decades. Hughes and Franks (2002) tried to demonstrate that perhaps these analyses of the data were too simplistic and that broader non-dimensional analyses gives a different answer.

Pollard et al. (1988) used Reep and Benjamin's (1968) method of notation in order to quantitatively assess determinants and consequences of different styles of play. It was suggested that elaborate styles relied upon multi-pass sequences of possession and that direct styles of play significantly relied on long forward passes and long goal clearances. In addition it was found that there was no relation between the degree of elaborate style and the use of width. Pollard et al. concluded that it was important for the coach to build up a style profile of each opponent for future analysis by using this type of quantitative assessment of playing style.

A hand notation system developed by Ali (1988) recorded 13 basic factors of the game: dribbling, short pass, long pass, goal, off-side, shot on target, ball intercepted by goal keeper, header on target, header off target, intercepted short pass, intercepted long pass, shot off target and the position of the restarts. The system attempted to ascertain whether there were specific and identifiable patterns of attack and how successful each pattern was in influencing the result of the match. It thus considered only sequences in the attacking half of the field, these patterns were recorded on the prepared pitch diagram in graphic form. The data was entered into a computer in terms of X and Y co-ordinates on the pitch diagram and compared in relation to pattern and constituent. The final action of each type of pattern was analysed to determine its influence on the game. Ali found that attacking patterns that proceeded along the length of the wing were more successful than those through the centre, the most likely result of a long pass is off-side, and that plays involving a great number of passes increased the likelihood of a goal.

Ali (1992) went on to analyse patterns of play of an international soccer team by considering five matches played by Scotland during 1986-89. He identified five types of attacking patterns of play, each of these types of patterns represented large numbers of attacks. Nine different types of final action were also defined and the analysis showed that there were significant relationships between final actions and patterns of play. Ali claimed that the large number of attacks for each pattern overcame the low number of matches analysed, citing numbers in the mid to high forties, but with nine possible final actions, this leaves the ratio of frequency of attack to final action to be about five. This would seem low for statistical significance.

Harris and Reilly (1988) considered attacking success in relation to team strategy and the configuration of players around the point of action, by concentrating mainly upon the position of attackers in relation to the defence and overall the success of each attacking sequence. This was a considerable departure from many of the systems previously mentioned which have tended to disseminate each sequence into discrete actions. Harris and Reilly provided an index describing the ratio of attackers to defenders in particular instances, while simultaneously assessing the space between a defender and an attacker in possession of the ball. These were analysed in relation to attacking success, whereby a successful attack

resulted in a goal, an intermediate attack resulted in a non-scoring shot on goal, and an unsuccessful attack resulted in an attack ending without a shot. Successful attacks tended to involve a positive creation of space, where an attacker passes a defender -an unsuccessful attack involved a failure to use space effectively due to good organization of defensive lines.

Olsen and Larsen (1997), the former was the coach to the Norwegian team, discussed the need for closer links between the "academic" and the "practical", and he cited this as a key reason for Norway's success in international football in recent years. Their aim behind doing the analysis was:

1. To measure the team's effectiveness through counting scoring opportunities.
2. To measure the types of attacks and their efficiency.
3. To gain more knowledge of the match syntax in general.
4. To have a quantitative and qualitative analysis of each player.

It was particularly refreshing to appreciate the views of Olsen, coming as they were as, from someone who was not just a theoretician, but the data was from such a practical and applied source.

Rico and Bangsbo (1996), in designing their notation system for soccer, clearly delineated their operational definitions - an excellent example of how to utilise a well-designed system. They used examples of the Danish soccer team in the European Championship (1992) to demonstrate the analyses. Potter (1996a) also presented a system for notation of soccer and presented a database of the 1994 world cup in soccer (all 52 matches). The validity tests in this paper are sound and very clearly explained and the data presented in such a way that it is hoped that other researchers might follow.

These examples represent the different purposes that notational analysis can fulfil. More recent research using hand notation tends to use a data gathering system and then process the data in a computerised database. Pettit and Hughes (2001) used a hand notation system to analyse all the matches from the 1998 World Cup, through the aid of a database into which the data were entered. The system was designed in an order, like a flow chart so as each action occurred the operator imputed the data from field to field, for example, firstly the time was inputted then the event that led to the cross, crossed from and to, and so on. If a shot was taken the data were added, otherwise the process was started again to input the data for the next cross. Abbreviations were used to help speed up the process of inputting the data. The system, designed to analyse crossing and shooting, was based on that used in the study by Partridge and Franks (1989a and b). All 64 matches from the 1998 World Cup were notated post event over a period of 90 minutes plus injury time, although extra time and penalty shootouts were omitted from the analyses. The time the cross occurred, events leading up to, team, area crossed from, area crossed to, type of cross, in front or behind the defence, result of cross, if applicable: whether or not a pass was made, number of passes in sequence, shot type, height of shot, direction in relation to goalkeeper, speed and intent of shot, contact, direction GP, Outcome and Possession, were analysed, which enabled the frequency of the actions to be recorded. A chi-square test was used as a statistical process to determine if differences occurred between the 1986 and 1998 World Cup Finals.

Penalty kicks

Penalties are now a subject of myth, romance, excitement, dread, fear and pressure – depending upon whether you are watching or taking them. They have either helped careers of footballers or destroyed them. Yet little research has been completed on penalty kicks. Using a hand notation system Hughes and Wells (2002) notated and analysed 129 penalties with an intention to examine:-

the time in preparing the shot;

the number of paces taken to approach the ball;

the speed of approach;

the pace of the shot; and,

its placement and the outcome.

In addition, the actions of the goalkeeper were notated – position, body shape, movements as the player approached, his first movements and the subsequent direction, the outcome. Not all video recordings enabled all of these data to be notated, so in the subsequent analyses some of the totals were 128 and 127.

A summary of their findings are presented below.

- One in five penalties were saved (20%; 3/15), one in fifteen missed (7%; 1/15) and three in four resulted in a goal (73%; 11/15).
- Players using a fast run up had 25% of their efforts saved, because the player then tried either 50% or 75% power.
- Best success ratios are from an even run up of 4, 5 and 6 paces.
- There is no laterality in the success ratios – left footers and right footers have the same success %'s.
- No shots above waist height were saved.
- In every case, the goalkeeper moved forward off the line before the ball was struck.

- Although there is only a small data set, the goalkeepers who did not dive to either side while the striker approached the ball, had the best save and miss ratios.

This is a good example of hand notation providing accurate data in this age of computers, in fact the data was then entered into Access, and analysed through this database, a method used more and more. In addition, because of the nature of these data, and a performance analysis of what is virtually a closed skill situation, the data analysis provides a clear picture of the most efficient ways of penalty taking and saving.

Movement analysis in soccer

Brooke and Knowles (1974) conducted a study into the description of methods and procedures for the recording and subsequent analysis of field movement behaviour in soccer, and to consequently establish the reliability of that method. Shorthand symbols were utilized to represent variables and parameters to be measured. Validation of the system was never clear and some of the data has to be questioned.

The definitive motion analysis of soccer, using hand notation, was by Reilly and Thomas (1976), who recorded and analysed the intensity and extent of discrete activities during match-play. They combined hand notation with the use of an audio tape recorder to analyse in detail the movements of English First Division soccer players. They were able to specify work-rates of the players in different positions, distances covered in a game and the percentage time of each position in each of the different ambulatory classifications. They also found that typically a player carries the ball for less than 2% of the game. Reilly (1997) has continually added to this database enabling him to define clearly the specific physiological demands in soccer, as well as all the football codes. The work by Reilly and Thomas has become a standard against which other similar research projects can compare their results and procedures.

A very detailed analysis of the movement patterns of the outfield positions of Australian professional soccer players was completed by Withers et al. (1982). They classified players into four categories: full backs, central defenders, midfield and forwards (n=5, in each group of player positions). Players were videotaped whilst playing, at the end of the match they were informed that they were the subject and were then required to `calibrate' the different classifications of motion. The subject was video taped whilst covering the centre circle as follows from a walking start of 3-5m.:walking, jogging, striding, sprinting, moving sideways, walking backwards and jogging backwards. The average stride length was then calculated for each of these types of locomotion. The data produced by Withers et al. agreed to a great extent with that of Reilly and Thomas, 1976, both studies showed that players spend 98% of the match without the ball, and were in agreement in most of the rest of the data, the only difference being that the English first division players (Reilly and Thomas) were stationary a great deal more (143 secs.) than the Australian players (45 secs.). Withers et al. went on to link their very detailed data analysis with training methods specific to the game and position.

Computerised notation

Using computers does introduce extra problems of which the system-users and programmers must be aware. Increases in error possibilities are enhanced by either operator errors, or hardware and software errors. The former type of error is when the system-user unintentionally enters incorrect data, e.g. presses the wrong key on the keyboard. Any system is subject to perception-error where the observer misunderstands an event, or incorrectly fixes a position but the computer-operator interface can result in the operator thinking the correct data is being entered when it is not. This is particularly so in real-time analysis when the data must be entered quickly.

Hardware and software errors are introduced by the machinery itself, or the programs of instructions controlling the operation of the computer. Careful programming can eradicate this latter problem.

To minimise both of these types of problems, careful validation of computerised notation systems must be carried out. Results from both the computerised system and a hand system should be compared and the accuracy of the computerised system quantitatively assessed.

Computers have only recently impinged on the concept of notation analysis. Franks et al. (1983a) maintained that this form of technology is likely to enhance manipulation and presentation due to improved efficiency. This postulation is supported by the work of Hughes (1985).

Four major purposes of notation have been delineated they are:-

1. Analysis of movement
2. Tactical evaluation
3. Technical evaluation
4. Statistical compilation

Many of the traditional systems outlined above are concerned with the statistical analysis of events which previously had to be recorded by hand. The advent of on-line computer facilities overcame this problem, since the game could then be digitally represented first, via data collection directly onto the computer, and then later documented via the response to queries pertaining to the game (Franks et al 1983a). The major advantage of this method of data collection is that the

game is represented in its entirely and stored in ROM or on disk. A database is therefore initiated and is a powerful tool once manipulated.

Team sports have the potential to benefit immensely from the development of computerised notation. The sophistication of data manipulation procedures available can aid the coach in their efforts to ameliorate performance. Many of the traditional systems outlined above are concerned with the statistical analysis of events which previously had to be recorded by hand. The advent of on-line computer facilities overcame this problem, since the game could then be digitally represented first, via data collection directly onto the computer, and then later documented via the response to queries pertaining to the game.

The information derived from this type of computerised system can be used for several purposes as suggested by Franks et al. (1983a):-

(i) immediatef eedback;
(ii) development of a database;
(iii) indication of areas requiring improvement;
(iv) evaluation;
(v) as a mechanism for selective searching through a video recording of the game.

All of the above functions are of paramount importance to the coaching process, the initial raison-d'etre of notational analysis. The development of a data-base is a crucial element, since it is sometimes possible, if the data-base is large enough, to formulate predictive models as an aid to the analysis of different sports, subsequently enhancing future training and performance.

One of the first major developments in computerised notation has been the development of a mini system devised by Franks et al. (1983a). Franks configured a keyboard on a mini-computer to resemble the layout of a soccer field and designed a program which yielded frequency tallies of various features of play. The path of the ball during the game was followed, so off-ball incidents were considered extraneous. A video was time-locked into the system so that relevant sections of the match could be replayed visually alongside the computer analysis.

Mayhew and Wenger (1985) calculated the time spent by 3 professional soccer players in different matchplay activities by analysing videotapes using a specially designed computer programme. The results indicated that soccer is predominantly an aerobic activity, with only 12% of game time spent in activities that would primarily stress the anaerobic energy pathways. The mean time of 4.4sec for such high intensity work indicated the lactic acid energy supply system was the anaerobic system of primary importance. The interval nature of soccer was partly described, and suggestions for the design of soccer specific training programmes were offered. The work did not extend in any way the previous efforts of Reilly and Thomas (1976) or Withers et at. (1982).

Evaluation is an essential component of sport because it provides the coach with a means of establishing norms from the model based on the 'post mortem' in order to fulfil selection and scouting needs as illustrated in Fig. 5.04. An essential prerequisite of evaluation in that it must be carried out as objectively as possible, Franks et al (1983a) maintained that:-

"'if it can be measured - it is fact, if it cannot be measured - it remains opinion', also applies to the coaching arena." (p. 77)

One of the major conclusions related to previously noted observations (C. Hughes, 1987) concerning the number of passes leading to a goal. It was suggested as a result of the analysis, that it would be extremely beneficial to performance if coaches could advise players to keep the number of passes in sequence down to three of less. This application of the research could be improved an a more thorough analysis of the parameters required to enhance the result. Minimal consideration was given to the number of games to be notated prior to the establishment of a recognized system of play. This is an important point, since any fluctuation in the patterns and profile will affect the deduced consequences, particularly with reference to the match outcome. Teams may also vary their system and pattern of play according to opponents, although these factors are not considered. Furthermore, the existence of patterns of play peculiar to individual players was not illustrated. It is in this area that the study by Church and Hughes (1986) concentrated, in an attempt to investigate the presence of patterns of play in a soccer team and whether any reasons can be found to explain the results.

Church and Hughes developed a computerised notation system for analysing soccer matches using an alternative type of keyboard, called a concept keyboard. This is a touch sensitive pad that can be programmed to accept input to the computer. This permitted pitch representation to be graphically accurate and action and player keys to be specific and labelled. This considerably reduced the learning time of the system, and made the data input quicker and more accurate. The system enabled an analysis of patterns of play on a team and player level, and with respect to match outcome. An analysis of six matches played by Liverpool during the 1985/6 season resulted in a number of conclusions, the most important of which were:

1. A greater number of passes were attempted when losing than when winning.
2. Possession was lost more often when losing.
3. A greater number of shots were taken when losing than when winning.

Hughes, Robertson and Nicholson (1988), used the same concept keyboard and hardware system developed by Church and Hughes (1986), but with modified software, to analyse the 1986 World Cup finals. Patterns of play of successful teams, those teams that reached the semi-finals, were compared with those of unsuccessful teams, i.e. teams that were eliminated at the end of the first rounds. A summary of the main observations is as follows:-

1. Successful teams played significantly more touches of the ball per possession than unsuccessful teams.
2. The unsuccessful teams ran with the ball and dribbled the ball in their own defensive area in different patterns to the successful teams. The latter played up the middle in their own half, the former used the wings more.
3. This pattern was also reflected in the passing of the ball. The successful teams approached the final sixth of the pitch by playing predominantly in the central areas while the unsuccessful teams played significantly more to the wings.
4. Unsuccessful teams lost possession of the ball significantly more in the final one sixth of the playing area both in attack and defence.

Lewis (1988) extended this work, analysing attacking plays only, to examine whether such unsuccessful teams use different attacking patterns to successful teams. An attack was defined as any move or sequence of moves that culminated, successfully or otherwise, in an attempt on goal. A total of 37 individual action variables and 18 different pitch divisions were employed in the data collection programme. The data analysis programme employed chi-squre test of independence to compare the frequency counts of each action available, with respect to positon on the pitch, between successful and unsuccessful teams.

It was concluded that successful teams passed the ball more than unsuccessful teams when attacking, particularly out of defence and in the final attacking end of the pitch. As in the previous work by Hughes et al., the successful teams used the centre of the pitch significantly more than unsuccessful teams. Further differences demonstrated that successful and unsuccessful teams used patterns of play that vary significantly in attack. Implications were drawn with respect to the optimisation of training and preparation for success in elite soccer match-play.

Partridge and Franks (1989a and 1989b) produced a detailed analysis of the crossing opportunities from the 1986 World Cup. They carefully defined how they interpreted a cross, and gathered data on the following aspects of crosses:

1. Build up
2. Area of build up
3. Area from which the cross was taken
4. Type of cross
5. Player positions and movements
6. Specific result of the cross
7. General result, if the opportunity to cross was not taken.

Fifty of the fifty two games of the competition were analysed from video tape, using specifically designed software on an IBM XT Microcomputer that enabled each piece of information relating to crossing opportunities to be recorded and stored. The programme recorded the time at which all actions took place during the match, for extracting visual examples post analysis, in addition to the usual descriptive detail about the matches, i.e. venue, teams, etc. A second programme was written to transform and down load this data into dBASE III+. After which, this data base was queried to reveal selected results. The authors summarised their results by considering, what they termed, `key factors'. These were as follows:

1. Take the opportunity to cross the ball if a) a target player can contact the cross, b) you have the chance to play the ball behind defenders and eliminate the goalkeeper.
2. The cross should be played a) first time, where possible, b) behind defenders, c) past the near post, d) without loft and hang time.
3. Target players should be in position to contact the cross by a) individual moves to get goal side of the marking defender, b) being as direct as possible, c) not running past the near post to contact the ball, d) always making an attempt to contact the ball.
4. Supporting players should position themselves to a) seal off the top of the penalty area, b) seal off the backpost area (not allow any ball to go through the backpost area).
5. Crosses should not be taken from areas close to the corner flag. Instead, the crosser should dribble toward the goal and either win a corner or get into the penalty area and cross to a particular player.

In conclusion the authors related their results to the design of practices to aid players understand their roles in the successful performance of crossing in soccer.

At the World Congresses of Science and Football a considerable amount of work on computerised analysis of football has been presented; this is all collated in the proceedings (Reilly et al., 1988; Reilly et al., 1993; Reilly et al., 1997). Similarly the proceedings of the World Conferences in Notational Analysis of Sport (Hughes, 1996; Hughes, 2000;

Hughes and Tavares, 2000; Hughes and Franks, 2001; O'Donghue and Hughes, 2004; Dancs, O'Donghue and Hughes, 2006) offer a large amount of work on analysis of soccer. A number of these have already been considered because of their contribution to the development of hardware and software as well as their contributions to research. The more significant applications will be reviewed.

Gerisch and Reichelt (1993) used graphical representation of their data to enable easier understanding by the coach and players. Their analyses concentrated on the one-on-one confrontations in a match, representing them in a graph with a time-base, so that the development of the match could be traced. Their system can also present a similar time-based analysis of other variables, interlinking them with video so that the need for providing simple and accurate feedback to the players is attractively achieved. Despite the limited amount of data presented, the results and their interpretation were very exciting in terms of their potential for analysis of the sport.

Winkler (1993) presented a comprehensive, objective and precise diagnosis of a player's performance in training and match play using a computer-controlled dual video system. This was employed to assess physical fitness factors employed in training contexts. In addition, he used two video cameras, interlinked by computer, to enable a total view of the playing surface area. This, in turn, permitted analysis of all the players in a team throughout the whole match, on and off the ball- something that not many systems have been able to produce.

Dufour (1993) presented an analysis, using computer assisted video feedback and a specific algorithm for the statistics, of an evaluation of players' and team performance in three fields: physical, technical and tactical. He demonstrated the ability of his computerised systems to provide accurate analysis and feedback for coaches on their players and teams. Yamanaka, Hughes and Lott (1993), using an updated version of the systems used by Hughes et al. (1988), demonstrated the ethnic differences in international soccer by analysing the 1990 World Cup. They defined four groups, British Isles, European, South American and Developing nations and by analysing the respective patterns of play in matches with respect to pitch position were able to conclude on the different playing styles of these international groups. They also presented data in a case study of Cameroon who had had such a successful World Cup, comparing their data to that of the other groups to examine the way in which they had developed as a footballing nation. Jinshan et al (1993) completed an analysis of the goals scored, and the techniques used, in this world cup and compared these with those scored in the 1986 world cup. They found few differences between the two competitions. Partridge et al (1993) used a digitisation pad similar to that used by Hughes et al (1988) and used this sophisticated system to compare the world cup with the world collegiate championships. They found significant levels of differences in the skill levels of the two sets of players, particularly in dribbling and passing, and made positive suggestions to coaches at the collegiate level.

A sophisticated analysis of the definition of playing space in which players perform (Grehaigne et al, 1996) introduced new ideas and directions for research in soccer. A more practical approach by Tiryaki et al (1997), demonstrated how analysis can help some sides achieve unexpected results, this research team had worked with the Turkish team that surprised Switzerland and qualified for the 1996 European Championship finals. Another practical example of the uses of noatational analysis as a form of feedback, Partridge & Franks (1996) researched the actual effect of feedback on performance. Although limited by the number of subjects, the research demonstrated that the feedback did produce beneficial changes in nearly all the subjects, and that the best aspect of the feedback was the change in attitude of the players in thinking about and analysing their own performances.

In international tournaments, teams are judged on their ability to win matches. To achieve these victories, the teams must have effective ways to win the ball, create successful attacks first by reaching the attacking third of the field, create scoring chances and to complete them by scoring goals with a high efficiency. Luhtanen et al (2001) selected offensive and defensive variables of field players and goalkeepers in the EURO 2000 competition and attempted to relate the results to the final team ranking in the tournament. The final ranking order in the WC '98 tournament was explained by calculating the rank correlation coefficients between team ranking in the tournament and ranking in the following variables: ranking of ball possession in distance, passes, receptions, runs with the ball, shots, interceptions, tackles and duels. Selected quantitative and qualitative sum variables were calculated using ranking order of all obtained variables, only defensive variables and only offensive variables. The means and standard deviations of the game performance variables were calculated and ranking order in each variable was constructed. Spearman's correlation coefficients were calculated between all ranking game performance variables. Only the variable of successful passes at team level explained the success in the EURO 2000.

France was the best team in the performance of passes, receptions, runs with ball and tackles. In percentage of the successful passes, France was the top team. The strengths of Italy were in defence. The Italians were best in interceptions and third best in tackles. In the passing activity their position was 15th, but in the percentage of successful passes 2nd. In the over all ranking taking into account all analysed variables, Italy was 13th. This analysis would give Holland a better place than third. Holland was 1st in ball possession (9.9 km) and 2nd in the amount of passes and shots and also close to the top place in the corresponding successful executions. Because Holland controlled the ball a lot, it didn't have many chances to interceptions or duels. This can be seen in the amount of interceptions and duels. Germany was traditionally strong in having the ball in possession (2nd), in passing play (2nd) and in the number of goal scoring trials ((4th). However, the weaknesses were found in defence activity of interceptions (16th) and tackles and duels (15th).

Usually, notational analysis uses numerical data to study and assess the quality of a match. As far as the analysis of the tactical aspects of the game is concerned, there is a dearth of published research with regards to their theoretical bases. Grehaigne et al (1996) tried to construct a knowledge base about soccer using some qualitative observational tools. In a soccer match, structures and configurations of play should be considered as a whole rather than examined a piece at a time. Systems with many dynamically interacting elements can produce of rich and varied patterns of behaviours that are clearly different from the behaviour of each component considered separately. To that effect, effective space game, action zone, and configurations of play were examined to show that this type of analysis is complementary more than opposed to the numerical data analysis systems. This work demonstrates the growing awareness of the need for qualitative factors investing the quantitative nature of notation data with a far greater wealth of relevance to an overall performance.

Luhtanen (1993) carried out a statistical evaluation of the offensive actions at the 1990 World Cup. He compared the number of offensive actions and the efficiency of these actions between teams in respect to their final ranking in the competition. The results showed that 69% of attacks were not lost (free-kick, corner, throw-in or penalty won in the attacking third), 28% of attacks produced a scoring opportunity, and 9% resulted in a goal. They also found that successful teams (with the exception of Argentina), mastered the game in terms of numbers in the attacking third, and created greater scoring opportunities than the unsuccessful teams. The World Cup winners, Germany, proved to have the greatest efficiency when attacking, as they possessed the highest number of attacks, the lowest number of lost attacks and the highest number of scoring opportunities. Partridge and Franks (1993) also found that they lost the highest percentage of possession in the attacking third (61%), and the lowest percentage in the defending third (7%).

Tiryaki et al (1997) completed an analysis of offensive patterns of Switzerland during the 1994 World Cup. Matches against USA, Columbia, Romania and Spain were analysed using a computer notation system developed in the Notational Analysis Centre at Liverpool John Moores University. The study found that the Swiss team were more successful in midfield and less effective in offensive areas. Notational analysis can aid some sides achieve unexpected results. For example, Tiryaki et al (1997) worked with Turkey and surprised Switzerland to qualify for the 1996 European Championships Finals.

Luhtanen et al (1997) used a new notational analysis system to compare Brazil and their opponents during the 1994 World Cup. A video recording based system was constructed to input data of different time, space and manoeuvres per player. The qualitative manoeuvre variables include:

1. The number of successful attacking trials for the attacking third;
2. Scoring chances created in the vital area;
3. Scoring trials; and
4. Goal standardised for the normal playing time.

The qualitative variables included:

1. Cumulative time of the ball in possession for each team; and
2. Distance covered by the ball under control of each team.

The results found that Brazil had the highest number of successful attacking trials in the attacking third, the highest number of scoring opportunities in vital areas, and the highest number of shots from scoring opportunities. They also found that the highest number of successful attacks originated from interceptions in the middle third of the field; they used more change-over when passing; used a free style of play with less long passes; used long runs with the ball; and used more overlap and wall passing than their opponents.

Although soccer has received a major share of the research by notational analysts over the last five decades and substitutes have been positively or negatively affecting the results of soccer matches since the change in the rules in the sixties, no analyses had been completed on this critical area of the game until Pearce and Hughes (2001) analysed substitutions during the European Football Championships 2000. The study was divided into two sections. Firstly, general characteristics were recorded from all 176 substitutes that were made during the tournament. Secondly, 24 substitutes were analysed to assess their impact on the teams' performance and whether the substitute's performance was better than the player they replaced.

The research was carried out using a computerised notation system in conjunction with video, post analysis. Data collection involved gathering data from a match 15 minutes prior to the substitution and 15 minutes post substitution. The data were analysed by comparing the number of actions that occurred by a team / individual during the first 15 minutes, to the number of actions that occurred in the second period of 15 minutes. A total of 24 matches were selected from Euro 2000, and substitutions chosen so that the respective teams were equally balanced in winning, losing and drawing situations. Performances between the two periods were evaluated by the use of an evaluation matrix that enabled variables to be ranked in order of importance. These matrices were then applied to both the team performance and the respective individual performances for 15 minutes before and after substitution.

The majority of substitutions took place during the second half of the match and primarily for tactical reasons. The most frequent position for substitutions was in midfield, possible reasons for this could include the large work-rates

associated with these positions. Results also suggested that substitutions might influence teams performances with 60% of substitutions analysed having a positive influential effect on performance. There was little difference found comparing the actions of the substitute and the actions of the player replaced. The findings suggested that substitutes play an important role in their contribution towards team performance and can provide coaches with greater flexibility.

Previous investigations of strategies in football have compared specific behaviours either at a competition level e.g. frequency of runs with the ball made during Euro 96 and 2000 (Luhtanen et al., 2001) or at the team level e.g. Yamanaka et al., (1993) compared International teams competing at the 1990 World Cup. In order to further these works Hughes et al. (2001) suggested assessment of an individual team's strategies to establish meaningful normative profiles. James et al. (2002) analysed individual behaviours for one team playing in European and Domestic competitions and found play was characterised by different patterns between the two competitions suggesting team strategies were evident. The aim of Hewer and James (2004) was to extend this work by assessing performance indicators present during the possession leading to a goal being scored. All matches in both domestic and European competitions for one British Premier League football team over three seasons were analysed using a hand notation system. Reliability was assessed at the level of the subsequent analyses as suggested by Hughes, Cooper & Neville (2002) with no errors greater than 4.8% found. The first analysis concerned the areas of the pitch used and individual player contributions. European matches were characterised by relatively more goals (24%) created from the pre-defensive area (James et al., 2002) than the pre-offensive area (19%). In contrast these frequencies were reversed in domestic matches (17% and 25% respectively). Consequently the defenders made more assists domestically (22%) than in Europe (9%). Furthermore attacking moves occurred more frequently down the left side of the pitch in domestic competition whereas the right was favoured in Europe.

The second analysis compared passing movements and the number of touches made by each player. In comparison to the domestic matches, games in Europe tended to have a greater number of passes per goal, a higher proportion of goals were scored from outside the penalty box (12%) and the goal scorers used more touches. Goals were found to occur more frequently during the second half in both competitions. The findings give further support to the notion that a team can exhibit different attacking strategies for European and domestic competitions although more research is needed to determine how much influence the opposition has on these strategies.

The differences in playing patterns of soccer teams has been, and remains to be, one of the largest areas of post-match performance analysis within association football. Many studies try to encapsulate the multiple facets of play and consequently only provide limited detail in any one area (Hughes, Robertson and Nicholson, 1988). Scoulding and James (2004) aimed to provide a more detailed insight into passing during the 2002 World Cup whereby post event analysis of six group matches was undertaken (3 each for a successful and an unsuccessful team, based on qualification through the group stages, Stanhope, 2001). The resulting passes (>4000) were analysed for start and finish positions (for length of pass), whether they were played to a player or space, played first time or after a dribble and some outcome was recorded e.g. possession lost or retained. The coding process was designed and recorded using a computerised notational analysis software package, the Noldus Observer Video-Pro (Noldus Information Technology, 2001). The data were then transferred to SPSS v11.01 (SPSS Inc.) for statistical analysis (Chi Square).

Reliability measures were conducted at the level of the subsequent analysis, as suggested by Hughes, Cooper and Nevill (2002). In this respect all defined performance measures provided good reliability estimates (<5% error) with a further assessment of the time coding process (built into the Observer) measuring the time from when the player received the ball to when the pass was made. This resulted in a low average error of 0.08 seconds but a relatively large spread (± 1.08 s).

The passing strategy for the successful and unsuccessful teams did not differ (types of pass employed) suggesting that this performance indicator does not easily discriminate teams at this level. The only apparent difference existed in the pre-defensive area of the field (near the halfway line, James, Mellalieu & Holley, 2002) where the unsuccessful team tended to play significantly more passes. This observed difference was thought suggestive of a difference in total possession in this area rather than indicative of a strategy difference. The findings thus suggested that there was no difference in passing ability between the two teams within this study even though they differed markedly in terms of success in the tournament. Consequently it is suggested that either the criteria used were not sensitive enough to detect differences in passing or the teams were of a similar standard and other factors determined match outcomes.

A great deal of research has been carried out on creating goal-scoring opportunities after regaining possession, but all these investigations have focused on play within the midfield and attacking thirds of the field. Fleig and Hughes (2004) carried out a detailed analysis of counter-attacking during the 2002 World Cup where possession has been regained within the defensive third of the field and results in entry into the attacking third. Data were collected and analysed, using a computerised notation system, from pre-recorded games, by a total of 9 researchers. A comprehensive intra-operator and inter-operator reliability study was carried out and data were compared statistically using chi-square ($P<0.05$) to identify differences between successful and unsuccessful attacks. A counter attack was defined as a possession that moved the ball, form the defensive third to the attacking third (>50 m) in less than 50 s. Fifty two matches were analysed, involving 30 different teams, which resulted in 137 counter attacks by this definition. A successful counter-attack (75) was described as an attack producing a cross, shot on goal or award of a free kick or corner in the final third in which further advantage

could be gained. The term unsuccessful counter-attack refers only to the final outcome. In many respects, each of the 137 attacks could be categorised as 'successful' as they all achieved entry into the attacking third of the field. The 40 attempts at goal realized 6 goals, a goal/shot ratio less than 1:7, which is a very efficient ratio. Each possession averaged just over 4 actions/possession, the main actions being passes (316), runs (166) and dribbles (55). Further in-depth analyses of these data, examining penultimate actions, final actions, time of actions, laterality of attacks, reasons for the attack failing, FIFA ranking of the teams and their counter attacks. It was concluded that successful counter-attacking relied on accurate passing within the defensive and midfield thirds, with the utilisation of width and skills such as dribbling and running with the ball as play moved towards the attacking third. The findings identify the importance of controlled attacks that utilise quick inter-changes of passing rather than direct passes from deeper areas of the field that resulted in end of possession. The highest frequency of successful attacks involved 2-4 players and a total of 4-7 actions, highlighting the importance of controlled attacks that adopt quick inter-changes of passing rather than direct passes from deeper areas of the field that resulted in end of possession. Counter-attacking was a technique employed most by lower ranked teams, although success was dependant upon individual ability levels rather than overall team performance. Success is very much dependant upon individual ability rather than overall team performance, and performed effectively, counter-attacking is a productive way of creating goal-scoring opportunities.

Early research into how goals were scored in association football (Reep and Benjamin, 1968) may have shaped the tactics of British football. Most coaches have been affected, to a greater or lesser extent, by the tactics referred to as the 'long-ball game' or "direct play", which was a tactic employed as a consequence of this research. Data from these studies, published in the late sixties, have been reconfirmed by analyses of different FIFA World Cup tournaments by several different research groups. Hughes and Franks (2005) pooled their respective databases and the number of passes that led to goals scored in two FIFA World Cup finals were analysed. The results conformed to that of previous research, but when these data were normalised with respect to the frequency of the respective lengths of passing sequences, there were more goals scored from longer passing sequences than for shorter passing sequences. Teams produced significantly more shots per possession for these longer passing sequences, but the strike ratio of goals from shots is better for "direct play" than for "possession play". Finally, an analysis of the shooting data for successful and unsuccessful teams for different lengths of passing sequences in the 1990 FIFA World Cup finals, indicated that for successful teams, longer passing sequences produced more goals per possession than shorter passing sequences. For unsuccessful teams neither tactic had a clear advantage. It was further concluded that the original work of Reep and Benjamin (1968), although a key landmark in football analysis, led to only a partial understanding of the phenomena that was investigated. This paper has not only cleared up the 'mystery' of the long ball data, but has also led to considerable work on analysing performance indicators (Hughes and Bartlett, 2002; Taylor et al., 2006; O'Donoghue, 2005).

Methodological issues relevant to soccer notational analysis

Sample size

One pertinent issue regarding notational analysis studies is the sample selected for analysis. It is usual to select matches on the basis of some common theme e.g. World Cup, a domestic league or one particular team. This is sensible with respect to providing summary statistics and assessing trends for a team or teams but care should be taken not to assume that the findings are necessarily relevant for future matches. For example, Tenga and Larsen (2003) suggested that Norway played with a high pressure tactic for the first 15 minutes of a match and low-pressure for the next 15 minutes. This paper analysed one match between Norway, hypothesised as adopting a direct attacking strategy, and Brazil, an indirect strategy, to see whether notational analysis techniques would demonstrate this difference. This would seem a reasonable match to analyse given that these two teams are very well known for their playing styles which are commonly thought to be somewhere near the two extremes on the direct-indirect continuum. However there is always an inherent danger in only analysing one match because incidents during the match e.g. an injury to a key player, may cause unusual events to occur which, because of the limited data set, may produce an unrepresentative picture of the way a team typically plays. Hence a true account of the match may have little predictive use of how a team typically plays. In this study Tenga and Larsen collected 23 attacking and 18 defending variables and identified 8 variables where relatively large differences existed between the two teams and 8 where there were relatively small differences. Of greatest surprise was the almost identical incidence of fast build up attacks through midfield. This attack is where the ball is passed along the ground as opposed to over the heads of opponents (which Norway used almost 3 times as often as Brazil). The question that springs to mind is whether the incidence of fast build up attacks seen in this match was a unique finding. It is possible that Norway and Brazil may never again exhibit the same frequency of fast attacks through midfield. For example, Norway may have played many more of these attacks than normal or Brazil played far fewer than normal because of some one off incident peculiar to this game.

Hughes, Evans and Wells (2001) suggested that a reasonable number of matches for performance to be considered representative of typical performance was 6 matches, although this number is dependent upon the typical variability of the performance between matches. Indeed every match is a unique event and therefore any collection of matches is deemed to

be a random (stochastic) sample of a population of matches (all matches pertaining to the team or teams being analysed). Thus any small sample has the potential of not accurately reflecting the variability inherent in all of the performances of a team or teams which in themselves may not display stable properties (O'Donoghue, 2004).

Figures 1 and 2 show the variability in one performance indicator over two sets of 6 matches (shots on target) as presented to a professional soccer team (James, 2006).

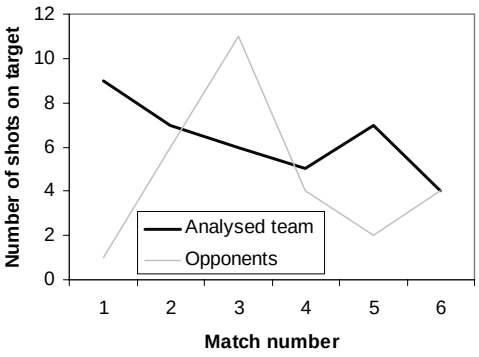


Figure 1. A comparison of shots on target on a match by match basis (matches 1 – 6)

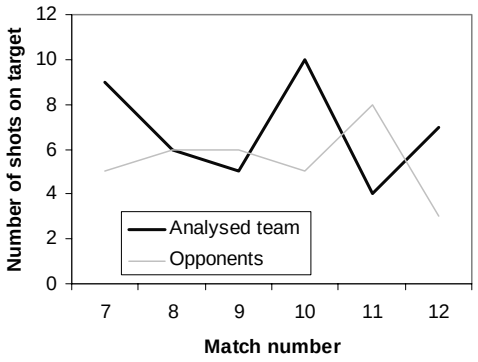


Figure 2. A comparison of shots on target on a match by match basis (matches 7 – 12)

The analysed team exhibited less variability (SD = 1.75) in the first six matches than the opponents (SD = 3.56) but slightly greater variability (SD = 2.32) in the second six matches compared to the opponents (SD = 1.64). Clearly it is dangerous to read too much into the results from the first six matches alone for this particular variable.

Operational definitions

Whenever notational analysis is undertaken there should be an initial query regarding the extent to which the analyst is coding the events correctly (validity). In other words when an analyst codes an event as say a shot was it in fact a shot? Any systematic mistake by the analyst e.g. coding a pass as unsuccessful when it actually was successful reduces the validity of the analysis. This type of error is typically as a result of misinterpreting the operational definitions i.e. statements describing how events should be coded, presuming that these were accurate in the first place. The published notational analysis literature tends not to feel the need to include the details of operational definitions (see James, Mellalieu & Hollely, 2002 for an exception) which is unfortunate. It must certainly be the case that different studies use different definitions on occasion and this may never change, but without knowledge of these differences it is difficult to assess whether definitions are good or poor. Thus operational definitions may never be amended for the better which hinders the progress of notational analysis in general.

A further reason for considering operational definitions as being vitally important is that poor or vague definitions make it likely that the analyst may consistently i.e. reliably, code events incorrectly. This may have been the cause of the inter-operator systematic bias reported earlier in the O'Donoghue (2004) time-motion study. The only way of dealing with this potential problem is to firstly ensure the operational definitions are well thought out and understandable by all analysts and secondly to check all analysts codes for a match against a 'gold standard' coding for the match. A 'gold standard' coding is deemed to be the actual coding and therefore as correct as possible. The only way to achieve this degree of accuracy is to have all interested parties i.e. coaches and analysts view the match and agree the correct coding for all events. Clearly this level of detail is not realistic on a day to day basis and is therefore easy to overlook. However in practical terms if the coaches and analysts agree the operational definitions at the outset then some of the analyses can be checked via recordings of these matches in a slow and methodical manner. As long as the operational definitions were precise and no ambiguity included then this methodical approach should be accurate enough to produce a 'gold standard' coding for the matches involved and hence the validity of the analysts can be checked.

This topic also pertains to reliability in so far as an analyst cannot reliably code events if there is ambiguity in the definitions determining event classification. Thus, one analyst may consistently i.e. reliably, code events in one way and another analyst consistently code events in another way. Thus the coding would be deemed unreliable due to misunderstanding of the operational definitions.

Performance over time

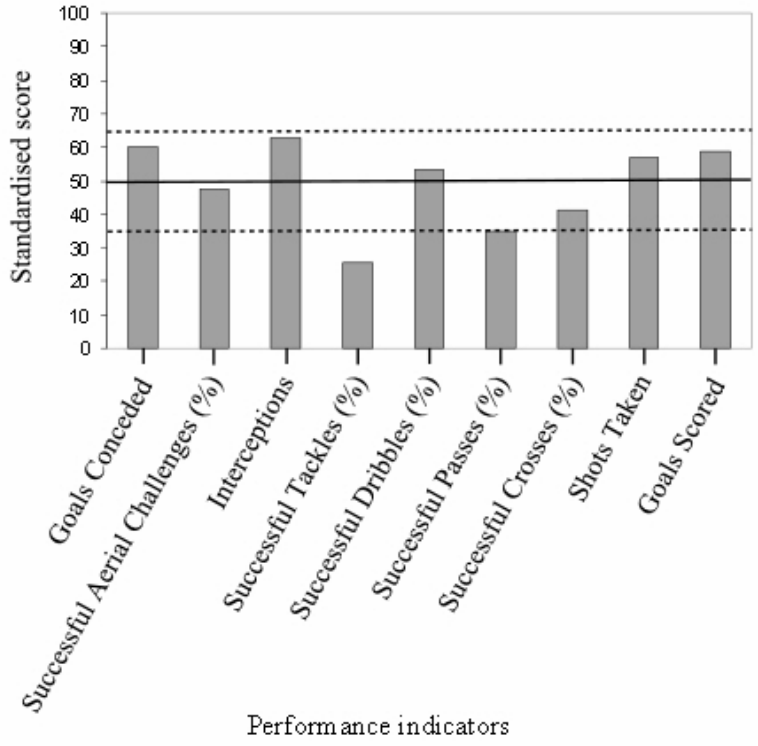
In order to ascertain how a performance compares with other performances a systematic record of a team, or teams over a number of matches needs to be compiled. Jones, James and Mellalieu (under review) have recently proposed a

methodology for achieving this. Firstly a selection of performance indicators, defined by Hughes and Bartlett (2002) as "a selection, or combination, of action variables that aim to define some or all aspects of a performance" (p.739) are selected. Data collected for each performance indicator during a match is then standardised against previous matches and presented on one 'form' chart.

Presenting a team's match performance relative to previous performances allows the analyst (or coach as the form chart is designed to be easy to interpret) to see which aspects of the games were unusual very easily. To illustrate this procedure 10 matches for a British professional soccer team were analysed (post-event) using the Noldus 'Observer Video Pro' behavioural measurement software package (Noldus Information Technology). Nine performance indicators were arbitrarily selected from a study by Taylor et al. (2004) and the data for the tenth game transformed relative to the previous 9 matches (see Jones et al. for comprehensive details of this). The formula for this transformation is shown in equation 1 (taken from James et al., 2005):

$$Transformed\ score = 15*\left(\frac{x-Mdn}{IQR}\right)+50 \qquad (1)$$

Where x = the PI value for the 10th match, *Mdn* = the median and IQR = the inter-quartile range for the previous 9 matches.



Performance Indicator	Actual Match Value	Median (9 Matches)
Goals Conceded	3	2
Successful Aerial Challenges (%)	50%	52%
Interceptions	23	15
Successful Tackles (%)	58%	75%
Successful Dribbles (%)	76%	73%
Successful Passes (%)	70%	75%
Successful Crosses (%)	25%	29%
Shots Taken	18	13
Goals Scored	4	2

Figure 3. Form chart of the 10th match compared against performances from the previous nine matches for a professional British soccer team.

Whilst the calculations are relatively simple the theory behind the above transformation is a little more complex but is beyond the scope of this paper (see James et al., 2005 for details), with the main principle advocated being the use of distribution free (non parametric) statistical techniques for notational analysis. The resultant form chart (Fig 1) is quite simple to interpret with a standardised PI value of 50 indicating performance at the same level as previous matches. Standardised values greater than 65 indicate performance was at least above the 75th percentile and less than 35 at least below the 25th percentile. The reason for the lack of precision being the unknown degree of skewness in the data set, which, for extreme values, results in the values given above. I.e. with less skewed data a standardised score value of 65 would be equivalent to a slightly higher percentile rank than the 75th and 35 slightly lower than the 25th.

The team analysed won the match represented in Figure 9.4 by 4 goals to 3 (see actual match values given in the Table incorporated into Figure 9.4). There were two reasons for including actual match values along with previous median values underneath the standardised score bar chart. The first was because some confusion can take place regarding whether a performance should be reverse scored or not. Take for example the number of goals conceded. The form chart indicates a higher value than normal (standardised score = 60) as there were more goals conceded (3) than the previous median value (2). However some people might suggest that since this is a worse performance for the analysed team the bar representing this PI should be lower than the median value to represent poorer performance. Both the presented style and the alternative have merit and therefore having the actual values enables the coach or other interested party in clarifying, where doubt exists, the actual situation. The second reason for the inclusion of the actual values was as a result of feedback from coaches who liked to have this information in conjunction with the bar chart so that they could communicate this information to players easily.

Inspection of the performance indicators suggests a very low number of successful tackles were made (58% success rate compared to an expected performance around 75%) and may have contributed to the high number of goals scored against them. This could thus be deemed an 'alerting variable' such that the coach would need to consider why this occurred and perhaps focus on this area of the game in training. The fairly high number of interceptions (n=23) is a positive feature but the underlying reasons for this are unclear. Either the coach's knowledge of the game or further analysis would be needed to ascertain whether this was a result of poor passing by the opposition, better movement by the analysed team than previously or as a consequence of the tactics employed.

Invariant behaviour

Trying to predict future performance on the basis of previous performances is an important goal for notation analysts. This is known as "performance modelling" and can be attempted in a number of ways. Typically the basis for any prediction model is that performance is repeatable, to some degree. In other words events that have previously occurred will occur again in some predictable manner. If this was not the case then prediction would obviously be impossible. The question therefore arises as to what extent are performances repeated? Consider two examples. In a team sport like soccer there are 22 players interacting, performing a high number of different actions in different areas of the pitch. This complex situation is not likely to provide easy to see repeated situations. Squash on the other hand involves just 2 players, discounting the game of doubles, in a relatively small court with a more limited number of actions (shots) available. Scientists have thus, unsurprisingly, tried to assess repeatability of performance in sports like squash before considering sports like soccer. Unexpectedly, repeatable performance, or invariant behavioural responses to similar situations, has largely not been found (e.g. McGarry and Franks, 1996). The reason for this is perhaps the complexity of the analysis has not matched the complexity of the sporting situations examined. Alternatively it may be the case that elite sports players do not necessarily respond in the same way to similar situations but have more than one response which they alternate to confuse the opposition. This creates a complex pattern which is far more difficult to ascertain.

Recently new software called Theme (www.noldus.com) has been developed which is seemingly able to recognise complex repeated patterns (called T-patterns) from within complex data streams. A T-pattern is defined as "a combination of events in which the same events occur in the same order with the real-time differences between consecutive pattern components remaining relatively invariant" (Borrie et al., 2002). The published work that has used Theme so far been primarily focused on animal behaviour with the exception of Borrie et al. (2002) who looked at on the ball behaviours in soccer. They identified some within team patterns e.g. one pattern, which occurred three times during the first half of a European Championship qualifying match in 1998, consisted of the ball being passed through four (of 18) pitch zones. They suggested that this type of pattern is not easily discernable, without this type of aid, and concluded that many temporal patterns exist in soccer. It will be interesting to see how this approach develops and the extent to which it can discern the complex patterns of expert players.

Perturbations

The difficulty of assessing complex sporting performance for consistent patterns of play has led some researchers to re-evaluate the methodologies used. One such approach is to assess sporting contests as a 'dynamical system'. This term is used to describe a system whose behaviours have self-organising properties i.e. regularity is thought to be as a result

of changes within the system as opposed to being imposed by external influences (McGarry and Perl, 2004). The classic exemplar being the gait patterns (walk, trot and gallop) exhibited by quadrupeds for different speeds. Thus the system (legs in this instance) exhibit a stable pattern of behaviour at a given speed, this behaviour is disrupted when a different speed is required only for the system to reorganise and become stable again albeit displaying a different pattern.

Although most of the work in this area has looked at racket sports (e.g. McGarry et al., 1999) where perturbations i.e. transitions in the system between stability (invariant) and instability (variant behaviour), have reliably been discriminated and significantly better ($p<.01$) by experts than non-experts, the possibility of sports contests possessing dynamical systems properties has been proposed. Hughes and colleagues assessed the existence of perturbations in soccer, described as incidents that change the rhythmic flow of attacking and defending soccer e.g. a decisive pass or dribble. They suggested that there were on average 88.2 (SD = 22.1) unsuccessful perturbations per match during a sample of 15 matches in Euro ’96 i.e. not leading to shots on goal (Hughes et al., 2000b) and approximately 30 successful perturbations that did lead to shots (Hughes et al., 2000a). Hence of the resultant 120 odd perturbations about 90 of these incidents result in a return of the system to stability as a result of an action such as an interception or defensive tackle.

The theory behind the existence of perturbations and the change of system state between variance and invariance has a number of followers although the existence of a decisive action (perturbation) does not, I think, necessarily relate to the system state. McGarry et al. (1999) seem to suggest that this is the case that the definition of a perturbation relates to the state of the system and causes a change from one state to another. I feel that it is the nature of expertise to try to maintain stability or invariance in some circumstances e.g. when trying to defend a decisive pass whereas the opposite is true in other situations e.g. when dribbling with the ball the maximum uncertainty needs to be in the mind of the defender and therefore the most variant behaviour is desirable. At high levels of skill therefore changes in system state are not inevitable as I believe McGarry et al. propose.

Possible future directions in notational analysis research

Some of the research studies outlined above have been novel attempts to consider soccer matches in a different way. Instead of treating all behaviours equally the idea that some (perturbations) are perhaps more important than others is proposed. This seems a reasonable view and findings from this type of investigation challenge us to consider how relationships between opponents and within teams develop and thus may lead to new conclusions regarding playing profiles or consistent behaviours within different sports.

Since sport, in particular team sports, involves many facets e.g. tactics, motor skills, strategy to name but a few, scientists attempts to understand, model and make predictions about how all of these components fit together to produce the finished product have involved many different approaches. This paper has sought to comment on some of these methods but does not claim to be exhaustive. Indeed new approaches are developed constantly, usually borrowing methods and ideas from other disciplines. However, particularly in the early stages, these new techniques can appear both complex and sometimes rather obtuse. The early findings are often disappointing in terms of finding that an experimental hypothesis does not hold true rather than making some great discovery or the conclusion rather simplistic and offer little in terms of novelty for sports coaches. However the potential for these new methods to rationalise our understanding of complex sports situations should not be disregarded.

One relatively new method for sports analysis whose objective is to arrive at a definite conclusion from complex and ambiguous decision-making is called fuzzy logic. Originally conceived as a way of processing data by allowing partial set membership rather than absolute set membership or non-membership, it was only in the 1970’s when computers became available to process vast quantities of data that this rule based (IF X AND Y THEN Z) solution became useful in many different contexts. Recently these techniques have been applied to sports e.g. Wiemeyer (2003) used fuzzy logic to evaluate soccer players to determine which position best suited their player profiles. Wiemeyer argued that a coach may apply some rules for assigning a player to a tactical position e.g. if a player has a good goal getting and ability, good heading ability and is a good risk taker then striker may be the most appropriate position to play. This kind of reasoning i.e. applying a rule (IF THEN) to uncertain criteria (how is good defined?) is the same logical structure as fuzzy logic. This technique would thus seem to have a lot to offer with respect to complex decision making although in practical terms the complexity of applying a fuzzy logic computer program requires a great deal of investment in terms of time and computer expertise. The formulation and management of rules also requires input from sports experts and the extent to which they would agree on the relative weightings is questionable. Thus future developments in this area are only likely from academic institutions and at the time of writing fuzzy logic approaches have not developed sufficiently to be directly useful for coaches.

A weakness of fuzzy logic systems is the need for the analyst, probably in conjunction with coaches or other experts in the sport, to define the rules for group (set) membership. Although the strength of the method is the ability to handle different rules for different criteria the rules still need to be formulated by the scientific team. A computational model which takes this process one stage further is known as an artificial neural network (ANN). Developed on the principles of nerve cells and their interactions this type of model has the ability to identify new relationships based on previously

encountered ones (e.g. Perl, 2002). Like fuzzy logic this new, at least in the sporting context, technique has great potential but for the near future is likely to remain an academic research tool rather than one used for coaching. Indeed, Bartlett (2004) revisited his 1995 predictions regarding artificial intelligence (fuzzy logic, ANN and most recently genetic programs) and concluded that whilst the potential remains high actual research output remains low. One of the reasons he gave was the relatively high costs associated with developing such systems compared to the lower amount of research money available to academics working in sports research.

Conclusion

The field of performance analysis in general has expanded and progressed greatly over the last 20 years. As with most things technology and research have lead the way in terms of development, particularly for notation analysis systems. Currently the most advanced systems may be desirable but the cost is likely to be prohibitive to all but the wealthiest and by logical extension successful sports teams. The main development over the last 10 years has been the lowering cost of computers and video cameras which has led to the formation of a number of companies selling specialist software for different types of performance analysis. Currently most sports teams and individuals can afford the equipment necessary to record and analyse their performances. However having the equipment and using it effectively is not necessarily the same thing. Over the next 10 years it is likely that the process of analysing performances will become significantly easier. This is likely to be achieved in the software with the use of some form of interactive help whilst also removing the need to have a degree in computer programming, statistics and artificial intelligence. Also with the growing popularity of notation analysis in professional sport so to is the need to adequately educate sports scientists in this area. Currently UWIC, Liverpool John Moores, Loughborough and Swansea Universities have teaching and research programmes in place with others developing courses and the expertise to meet the demand. This demand will strengthen notational analysis as a discipline leading to better research by way of methodological advances, more appropriate statistical procedures and simpler output formats. These advances will in turn be fed back into sports organisations and companies to the benefit off all prospective notation analysts.

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RESEARCH METHODOLOGY IN ZAGREB KINESIOLOGY CIRCLE

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Abstract

In this paper development of research methodology in Zagreb kinesiolgiy circle is presented. It is stated that form 1960's Zagreb kinesiology circle kinesiology was developing as contemporary science of human movement. It is based on the principles and methodological developments appropriate to the research problems imposed and resolved. As a central and dominant figure of methodological developments is recognized prof. Konstantin Momirović PhD. (1932-2004). "He made kinesiology into a research field" as noticed by prof. Ingram Olkin (2008). Multivariate data analysis and statistics had been a core of his research methodology considerations. His role of active contributor to both the theoretical and applied developments is stressed. Development of ideas on research methodology and multivariate data analysis, in kinesiology as a science, it is presented trough several recognized phases. In the first, initialization phase, methodological topics had been treated as an act of assimilation of ideas and techniques from close related and more developed social scientific disciplines (i.e. psychology etc.). In the second phase "Zagreb Methodological and Multivariate Data Analysis Circle" at the University of Zagreb (Institute of Kinesiology at the Faculty of Physical Education and at the University Computing Centre - SRCE) had been established, where completely new ideas emerged. In the third phase he influenced and organized various productive groups of researchers, so the circle became a school which influenced other social sciences too. Within these three periods some sub phases and several areas of interest are relatively easy recognized. Evolution of some of the most influential ideas, algorithmic solutions and program implementations are demonstrated. Finally, his contributions and influences are divided in the same way as they are grouped and incorporated into the SPSS macro language coded library of seven hundred and sixty macro programs (Prot, F., A. Hosek, K. Bosnar, V. Luzar-Stiffler, V. Hljuz Dobric, Z. Bekić, M. Gredelj (2008)). This short overview is the core of a more elaborate presentation scheduled for Key note speech to the Research Methodology section of 5th . International conference on Kinesiology at Zagreb 2008.

Key words: *Research methods in kinesiology, Zagreb kinesiology circle, Konstantin Momirović, Multivariate data analysis, Robust Methods, Measurement Theory, SS Statistical System*

Introduction

From its early beginnings in 1960 Zagreb kinesiology circle have been developing around the contemporary science of human movement based on the methodological developments appropriate to the research problems imposed and resolved.

Based on his biography and extensive bibliography professor Kosnstantin Momirović (1932-2004) has been recognized as a central and dominant figure of methodological developments in kinesiology as it have been started to develop in Zagreb academic and sport communitiy, "He made kinesiology into a research field" as noticed by prof. Ingram Olkin (2008) a professor form Stanford University. He had been an active contributor to both the theoretical and applied developments.

From the very beginning Momirović (1968) presented the importance of scientific foundation of applied fields in area of physical culture ("Utjecaj naučne zasnovanosti fizičke kulture na njenu društvenu afirmaciju" i.e. "The Influence of the scientific foundations of physical culture on its social affirmation"). Kinesiology along with mathematics, biology, physiology, psychology and sociology have been recognized as one of fundamental sciences in are of phenomenology of physical culture.

Phenomenological complexity urges multivariate approach in research. So, Multivariate data analysis had been a core of research methodology considerations. From the point of view of development of ideas on research methodology and multivariate data analysis, in kinesiology as a science, it is possible to recognize several phases. In the first, initialization phase, he worked on methodological topics as an individual assimilating and developing contemporary ideas. In the second phase, he influenced and became the originator and principal figure in the so called "Zagreb Methodological and Multivariate Data Analysis Circle" at the University of Zagreb (Institute of Kinesiology at the Faculty of Physical Education and at the University Computing Centre - SRCE) where completely new ideas emerged. In the third phase he influenced and organized various productive groups of researchers, so the circle became a school influenced other social sciences too. Within these three periods some sub phases are recognized, as well. In each of these phases and sub phases

several areas of interest are relatively easy to recognize. Evolution of some of the most influential ideas, algorithmic solutions and program implementations are demonstrated. Finally, his contributions and influences are divided in the same way as they are grouped and incorporated into the SPSS macro language coded library of seven hundred and sixty macro programs (Prot, F., A. Hosek, K. Bosnar, V. Luzar-Stiffler, V. Hljuz Dobric, Z. Bekic, M. Gredelj (2008)). This short overview is the core of a more elaborate presentation scheduled for Key note speech to the Research Methodology section of 5th . International conference on Kinesiology at Zagreb 2008.

It seems that the easiest way to introduce Konstantin Momirović (1932-2004) to the interested reader is through his personal biography, as follows: *Born in 1932 in Tetovo (Macedonia). Graduated from elementary and high school in Belgrade. He received his BS degree in psychology from the Faculty of Philosophy of the University of Zagreb in 1955, and his PhD in psychometrics from the University of Zagreb in 1963. From 1955 to 1959 he was employed as clinical psychologist and head of the Laboratory for Applied Psychology at the Military Hospital in Zagreb. From 1960 to 1966 he acted as head of the Laboratory for Experimental Design and Statistics at the Institute for Developmental Problems of Children and Youths in Zagreb. He was Assistant at the Faculty of Physical Education from 1960 to 1963; Assistant Professor from 1963 to 1966; Associate Professor from 1966 to 1971; Full Professor of Psychology and Quantitative methods from 1971 to 1990 at the same faculty. In the period from 1971 to 1990 he acted as Head of Research and Development Division and as General Manager (1979-1983) of the University Computing Centre - SRCE at the University of Zagreb. From 1991 to 1997 he was Full Professor of Statistics at the Faculty of philosophy of the University of Belgrade, and from 1991 on he acted as Scientific Consultant and Chief Project Manager at the Institute of Criminological and Sociological Research.*

His visiting positions include: Professor of Statistics and Computer Programming in graduate and postgraduate studies at the Faculty of Mathematics and Mechanics of Moscow University, Faculty of Applied Mathematics and Cybernetics of Moscow University, Faculty of Medicine of the University of Zagreb, Faculty of Defectology of the University of Zagreb, Faculty of Philosophy of the University of Zagreb, Faculty of Economics of the University of Sarajevo, and faculties of Physical Education at Universities of Belgrade, Ljubljana and Novi Sad. He mentored MA, PhD, MD and BS degree students at Universities of Zagreb, Belgrade, Ljubljana, Sarajevo and Novi Sad.

The main fields of scientific interest of Dr. Momirović are statistics, mathematical psychology and criminology. He published 38 books and around 500 scientific and professional papers in scientific journals or monographs of statistics, computer science, psychology, sociology, biological anthropology and kinesiology. Dr Momirović is a member of International Statistical Institute, Psychometric Society, European Anthropological Association, International Association of Statistical Computing, Statistical society of Serbia and Anthropological Association of Yugoslavia.

Konstantin Momirović (1932-2004), alias Stojan Hadžigalić, among his close friends and colleagues known as "Kosta" has been an exceptionally active and productive contributor to the theoretical and applied developments of multivariate data analysis since the very beginning of his research career in early 1960's, as can be seen from his rich bibliography (Prot, F., A. Hosek, K. Bosnar, V. Luzar-Stiffler, V. Hljuz Dobric, Z. Bekić, M. Gredelj (2008)) and autobiographic and biographic reports prepared for promotions and rewards, such as in Momirović (1976), Kališnik, Goričar and Ulaga (1979), Bujas, Petz, and Mraković (1983), Momirović (1989, 2004), or in published or unpublished In Memoriams (see e.g., Fajgelj (2004), Macura (2004), Prot (2004), and Vlahović and Kovačević (2005)).

It is possible to recognize several phases of development of Momirović's ideas on research methods and multivariate data analysis and statistics in kinesiology: In the first, initialization phase, from 1957 to 1970 he worked on methodological topics as an individual assimilating and developing contemporary ideas. His contribution to the design of Statistical System (SS) prepared the ground floor for the organized and systematic work; In the second phase, from 1971 to 1990, he became an originator and principal figure of the so called "Zagreb Methodological and Multivariate Data Analysis Circle" at University of Zagreb (Institute of Kinesiology at the Faculty of Physical Education and the University Computing Centre - SRCE) where completely new ideas emerged; In the third phase, from 1991 to 2004, he further extended and developed his research ideas in his new working environment. In each of these phases and sub-phases several areas of interests are rather easily recognized.

One of the first available real evidence of his familiarity with multivariate data analysis is his state-of-the-art (for the time being) and extensive overview of methods for factor analysis, which makes a substantial part of his doctor degree thesis titled "Factor structure of neurotic symptoms" (Momirović,1963, chapters 3 and 4, pages 71 – 195). He concluded his thesis with reaffirmations of modified multi group method (Thurstone, Holtzinger, Burt, Horst, Harman, Momirović) as a mean for structural hypotheses testing in the field of data analysis. Additionally, he fully developed and applied hierarchical algorithm for the modified multigroup method up to the third level of extracted factors (Momirović,1963, chapter 5, pages: 196 – 317).

The most obvious demonstration of his familiarity with interrelated problems and their treatment (by applying various multivariate data analysis methods) can be found in his investigation of validity of psychological tests and measurements (Momirović K., 1966; in Krković, A., K. Momirović, and B. Petz, 1966). Early on, his research interest focused on interrelated application of various methods for factor analysis (including multi group method) as means for

estimating construct validity. On the basis of degenerated, simple summation method, algorithms for pseudocanonical correlations analysis, regression analysis and discriminant analyses were developed as methods for establishing pragmatic i.e. predictive and classification validities of measurement instruments. In this phase he examined equivalences between canonical discriminant and Q method of factor analysis, the problem of usefulness of factor scores in canonical discriminant analysis. He presented modified iterative Q method of factor analysis (and the accompanying algorithm) for determination of psychological types to psychologist and to a group of researchers in the emerging field of Kinesiology. Stimulated with the problem of penology treatment evaluation he proposed to evaluate structural changes using the canonical correlation (alienation) model and hierarchical factor solutions where he investigated relations between manifest variables and multidimensional higher-order factor spaces (Momirović, K.; 1969, 1969, 1969). These were research problems which prepared him to open a new stage of systematic research in the field of multivariate methods for transformation and condensation in data analysis (Momirović, K. (1972), "Methods for transformation and condensation of kinesiological data"). On page 303 it was stated that all of the methods and algorithms are going to be coded in FORTRAN IV for IBM series 1130 and 370/165 electronic computers. It had been realized that a collections of statistical and data analysis subroutines (once developed) should be interrelated into a general statistical language.

The research program incorporated in "Methods for transformation and condensation of kinesiological data" resulted in very interesting contributions which considerably influenced algorithm and application development. Full assimilation of Guttman and Harris ideas results with new treatment of problem of initial metrics of variables. The problem of latent structures of manifest variables have been analyzed considering the specific properties of initial metric of variables, and a series of new criteria for determining the number of retained factors were proposed (e.g., PB ("Plum Brandy") criterion (Momirović, K. and J. Štalec, 1971)). The concept of images of variables in Guttman sense has been extended to generalized image transformations of one set of variables to the another set of variables and vice verse (Momirović, K., J. Štalec, E. Zakrajšek, 1973). This theoretical contribution anticipated developments in data analysis which will extend and relax already established dominance of classical canonical correlation model as a general and fundamental model for variety of methods for data analysis. Guttman's Image theory and its extensions were also applied to the problems of homogeneity, representativeness and reliability of psychometric measurements. Above mentioned and other related developments were incorporated in real research environment in various areas of applications. Influential (classical) books on multivariate analysis (Anderson, 1958; Harman; 1960, 1967; Horst, 1965; Rao, 1958, 1973; Cattell, 1966, Morrison, 1967; Cooley and Lohnes 1971; Mulaik, 1972; Bock, 1975) have further stimulated deeper insight and research in the area.

On this occasion only a few of Momirovic's achievements and contributions will be covered in detail, especially some of those which were accomplished while he had been an active researcher at the Institute of Kinesiology and University Computing Centre - SRCE of the University of Zagreb and which were further developed later on during his extraordinary successful career.

Some Influential Methodological Contributions

Methodological research and achievements after 1971 could be divided into the following three areas of data analysis:

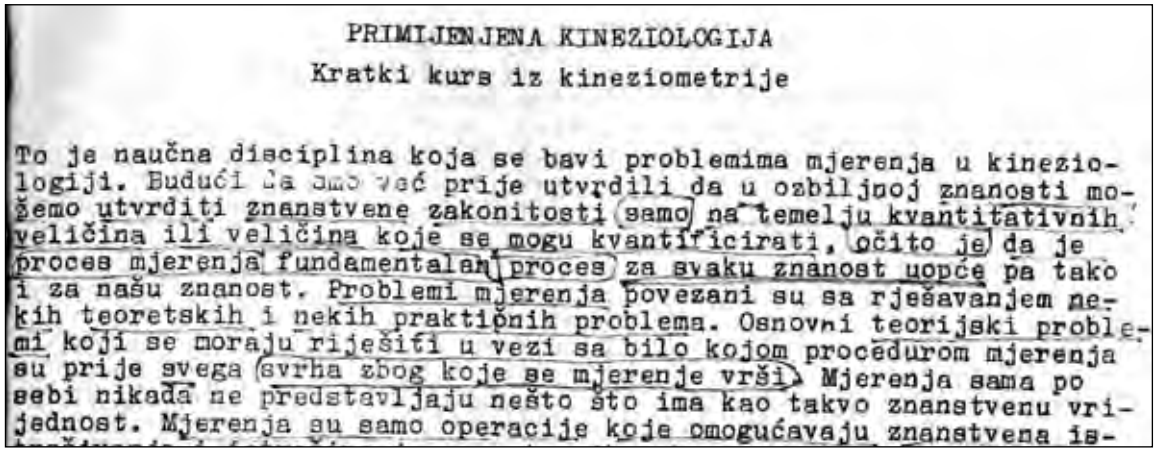
1. Kinesiometrics (development of new theoretical and applied measurement models in the field of measurement theory)
2. Multivariate data analysis and statistics (new models, methods and algorithms for data analysis)
3. Informatics (a field of computer science related to the development of new software for information systems, data analysis and management)

Proposed names and labels of these sub-fields were introduced and became part of the standard terminology used in the curricula at graduate and postgraduate studies.

Kinesiometrics

(development of new theoretical and applied measurement models in the field of measurement theory)

It was K. Momirović, who introduced the term "kinesiometry" in his lecture notes for the course entitled "Short course in kinesiometry"("Kratki kurs iz kineziometrije"; 88 pp) conducted at postgraduate study of Kinesiology during 1971/72, as illustrated in Figure 1. The term had been included in the Anić and Goldstein dictionary (Anić and Goldstein, 1999) at page 675, as illustrated in Figure 2.

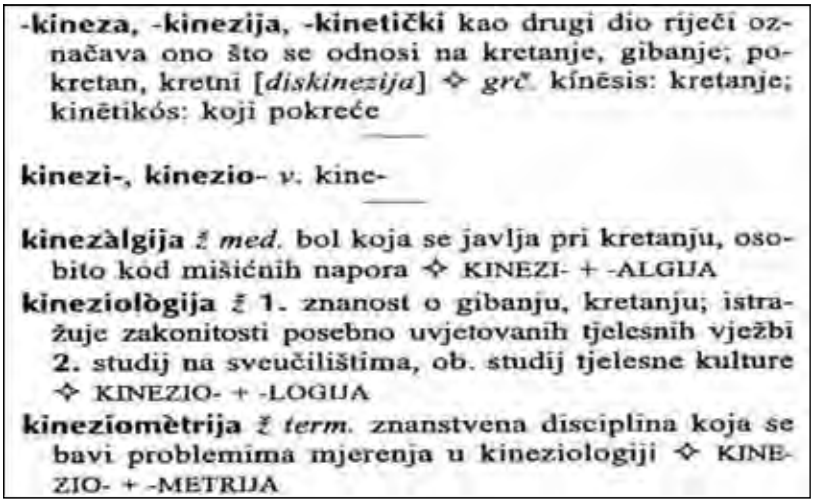


PRIMIJENJENA KINEZIOLOGIJA

Kratki kurs iz kineziometrije

To je naučna disciplina koja se bavi problemima mjerenja u kineziologiji. Budući da smo već prije utvrdili da u ozbiljnoj znanosti možemo utvrditi znanstvene zakonitosti samo na temelju kvantitativnih veličina ili veličina koje se mogu kvantificirati, očito je da je proces mjerenja fundamentalan proces za svaku znanost uopće pa tako i za našu znanost. Problemi mjerenja povezani su sa rješavanjem nekih teoretskih i nekih praktičnih problema. Osnovni teorijski problemi koji se moraju riješiti u vezi sa bilo kojom procedurom mjerenja su prije svega svrha zbog koje se mjerenje vrši. Mjerenja sama po sebi nikada ne predstavljaju nešto što ima kao takvo znanstvenu vrijednost. Mjerenja su samo operacije koje omogućavaju znanstvena is-

Figure 1. A part of the first page of student notes for the course on Kinesiometrics ("kineziometrija") at postgraduate study of Kinesiology, years 1971/72 at the College of Physical Education (today Faculty of Kinesiology).



-kineza, -kinezija, -kinetički kao drugi dio riječi označava ono što se odnosi na kretanje, gibanje; pokretan, kretni [*diskinezija*] ✧ *grč.* kínēsis: kretanje; kinētikós: koji pokreće

kinezi-, kinezio- *v.* kine-

kinezàlgija *ž med.* bol koja se javlja pri kretanju, osobito kod mišićnih napora ✧ KINEZI- + -ALGIJA

kineziològija *ž* **1.** znanost o gibanju, kretanju; istražuje zakonitosti posebno uvjetovanih tjelesnih vježbi **2.** studij na sveučilištima, ob. studij tjelesne kulture ✧ KINEZIO- + -LOGIJA

kineziomètrija *ž term.* znanstvena disciplina koja se bavi problemima mjerenja u kineziologiji ✧ KINEZIO- + -METRIJA

Figure 2. The term kinesiometrics "kineziometrija" was introduced to Anić-Goldstein's dictionary at page 675 (Anić and Goldstein, 1999).

In measurement theory alternative approaches to classical test theory are constantly being examined. These alternative approaches were applied (by K. Momirović and his associates) in construction and reconstruction of composite measurement instruments (composite tests and questionnaires) (see e.g., Momirović (1966, 1969, 1972, 1974); Zakrajšek, Momirović and Dobrić (1976, 1977); Momirović and Gredelj (1980); Bosnar (1980); Momirović, Gredelj and Dobrić (1981); Momirović, Pavičić and Hošek (1984); Momirović (1988)). A new general model for the estimation of error of measurement, along with the measures of reliability and representativeness were proposed (Momirović, 1974; Momirović and Dobrić, 1976; Zakrajšek, Momirović and Dobrić, 1977; Momirović, Dobrić and Gredelj, 1978; Momirović and Gredelj, 1980; Momirović, Pavičić and Hošek, 1984). Additionally, upper and lower bound of reliability (under the new general model) were derived (Momirović, 1974, 1975; Momirović, Pavičić and Hošek, 1984). That enabled objective definition and estimation of homogeneity independently from the reliability itself. (Momirović, 1974, 1977).

We'll try to illustrate some of these achievements, most of which were developed while K. Momirović has been affiliated to SRCE (Zagreb). Methods for determination of internal metric properties of measurement instruments had been continually in focus of his attention. Based on full assimilation of ideas of Guttman (1954) and Harris (1963) he generalized the classical test theory, the generalization being that the errors of measurement are permitted to exhibit correlation and nonconstant variability.

Momirović was constantly improving algorithms and implementations of programs for the analysis of metric characteristics of composite measurement instruments ("RTT" programs) from the initial SS program (MAPANAL) through the upgraded versions RTT7 (Statistical System, Momirović, 1980), RTT8 (GENSTAT version, Momirović and Prot 1986), RTT9/10 (SPSS macro version; Momirović and Knežević, 1996), to the most complex and general RTT12G SPSS implementation.

To briefly illustrate some of Momirović's original contributions to the analysis of metric properties of composite measurement instruments, let us define a set E as a set of n entities randomly selected from a homogeneous population P, and let T be a composite measurement instrument composed from m items measured on a continuous or on an ordinal scale. Let Z be a matrix of standardized (normalized, if necessary) results which describe set E over the set T. Then $\mathbf{R} = \mathbf{Z}^t\mathbf{Z}\mathbf{n}^{-1}$ and $\mathbf{U}^2 = (\text{diag}\ \mathbf{R}^{-1})^{-1}$ denote the correlation matrix and a diagonal matrix of estimated error variances, respectively. Error variables could be defined as antiimage variables (i.e., $\mathbf{E} = \mathbf{Z}\mathbf{R}^{-1}\mathbf{U}^2$), and true parts as image variables (i.e., $\mathbf{T} = \mathbf{Z}(\mathbf{I} - \mathbf{R}^{-1}\mathbf{U}^2$). The respective covariance matrices are:

$\mathbf{A} = \mathbf{E}^t\mathbf{E}\mathbf{n}^{-1} = \mathbf{U}^2\mathbf{R}^{-1}\mathbf{U}^2$, and

$\mathbf{G} = \mathbf{T}\mathbf{T}\mathbf{n}^{-1} = \mathbf{R} + \mathbf{U}^2\mathbf{R}^{-1}\mathbf{U}^2 - 2\mathbf{U}^2$.

Then the covariances between observed (**Z**) and true variables (**T**) are $\mathbf{P} = \mathbf{Z}\mathbf{T}\mathbf{n}^{-1} = \mathbf{R} - \mathbf{U}^2$, and covariances between observed (**Z**) and error variables (**E**) are $\mathbf{Z}^t\mathbf{E}\mathbf{n}^{-1} = \mathbf{U}^2$.

Let $\mathbf{M} = \mathbf{Z}\mathbf{U}^{-1}$, represent the observed variables transformed to the "universal" metric, where $\mathbf{H} = \mathbf{M}^t\mathbf{M}\mathbf{n}^{-1} = \mathbf{U}^{-1}\mathbf{R}\mathbf{U}^{-1}$ (see e.g. Harris (1962)).

Let **x**, **y**, **v** and **w** denote normalized eigenvectors and let $\lambda^2, \delta^2, \omega^2$ and η^2 denote eigenvalues of the matrices **R**, **G**, **P** and **H**, respectively.

Some examples of Momirović's original contributions regarding representativeness, reliability, homogeneity and convergence of metric indicators are presented in the following paragraphs.

REPRESENTATIVENESS: measures how the measurements are representative regardless of whether the synthetic composite measure is computed or not. Most of these measures were originally proposed by Kaiser (1970). Konstantin Momirovic proposed the following extensions: A measure of absolute lower bound of representativeness ψ_4 (Momirović, Dobrić and Gredelj, 1978), which is identical to absolute lower bound of reliability under Guttman's measurement model $\psi_4 = 1 - \eta^{-4}$, and ψ_5 (a measure proposed by Momirović and Hošek) defined as

$\psi_5 = ((\mathbf{s}^t(\mathbf{G} * \mathbf{G})\mathbf{s})(\mathbf{s}^t(\mathbf{R} * \mathbf{R})\mathbf{s})^{-1})^{1/2}$,

where s is a summation vector of order m.

RELIABILITY: Under the classical test theory model (CTT), the reliability of a test can be defined as $\alpha = \psi^2\sigma^{-2}$, where ψ^2 and σ^2 are variances of true part, and of total score, respectively. Alternatively $\beta = 1 - \varepsilon^2\sigma^{-2}$, where ε^2 is the error variance. Within CTT α and β are equivalent, but under the alternative model (by Momirović referred to as "Guttman's model") α and β are not equivalent. Momirović and his fellow researchers developed a series of reliability measures. Some of them, included in SPSS macro program "RTT12G" are as follows: absolute lower bound for component of standardized items $\mu_1 = 1 - \lambda^{-2}$; Lower bound of β as $\beta_1 = (1 - \lambda^{-2})^2$ and upper bound as $\beta_2 = 1 - \lambda^{-4}$ proposed by Momirović, Dobrić and Gredelj (1977); and $\beta_6 = 1 - (\mathbf{x}^t\mathbf{U}^2\mathbf{x})\ \lambda^{-2}$ proposed by Momirović (1996); Measures of reliability of component of items transformed into image form $\tau = \delta^2\lambda^{-2}$ Momirović (1975) and $\gamma = \omega^2\lambda^{-2}$ Momirović and Knežević (1991). In addition to Guttman-Nicewander $\lambda_6 = 1 - \eta^{-2}$, new measures of reliability (of the first component of standardized items rescaled to Harris universal metric) were proposed, i.e. lower bound $\rho_1 = (1 - \eta^{-2})^2$ as a completely new approach by Momirović and Dobrić (1977), and upper bound $\rho_2 = 1 - \eta^{-4}$ by Zakrajšek, Momirović and Dobrić (1977). A new extension of image transformation, mirror image analysis, and its application to reliability theory was examined by Momirović, Gredelj and Dobrić (1981).

HOMOGENEITY: In addition to the standard measure (i.e., the average of correlations among items), a series of new alternative measures were devised. Measure of relative variance of first principal component of items transformed into image form $h_2 = \delta^2\xi^{-2}$ Momirović (1977); measure defined by the number of components with non negative reliability was proposed by Momirović and Gredelj (1980) as $h_4 = 1 - (k - 1)(m - 1)^{-1}$ where $k = \text{num}\ (\lambda^2_p > 1)$ and λ^2_p, p = 1,...,m are eigenvalues of matrix **R**; measure $h_5 = 1 - (\theta^2 - \lambda^2)(m - \lambda^2)^{-1}$ (Knežević and Momirović (1995)), where θ^2 is the sum of k eigenvalues of matrix **R**, and another one defined as $h_6 = 1 - (\theta^2 - \lambda^2)(m - 1)^{-1}$; in addition, $h_7 = (\lambda^2 - 1)(\theta^2 - 1)^{-1}$ was proposed by Momirović and Knežević (1995).

CONVERGENCES OF INDICATORS: Momirović proposed one class of convergence measures of indicators which means that proportional conformity of item results to the first principal component. Let

$\mathbf{G} = \mathbf{R} + \mathbf{U}^2\mathbf{R}^{-1}\mathbf{U}^2 - 2\mathbf{U}^2$ and

$\mathbf{V} = (\text{diag}\mathbf{G}^{-1})^{-1/2}$

and let δ_1, δ_2 and δ_m be the first, second and mth eigenvalue of the matrix G. The following measures of convergences were proposed:

$\varphi_1 = 1 - \delta_1^{-1}$; $\varphi_2 = 1 - \delta_2\ \delta_1^{-1}$; $\varphi_3 = \delta_1 m^{-1}$;

$\varphi_4 = 1 - 2^{-1}(\delta_2 / \delta_m)\delta_1^{-1}$, $\varphi_5 = 1 - (\text{trace V})m^{-1}$

and a measure of convergence defined as relative informativity $\varphi = (1 - \mu_1)^{-1}m^{-1}$ where μ_1 is the absolute lower bound of the first principal component of items.

The new stage of development was achieved using neural network methodology. As an example RTT13HNN (Momirović, 2002) is an emulation of Hopfield neural network (Hopfield, 1982) for the estimation of sampling adequacy, reliability and homogeneity of composite measurement instruments. The basic procedure is the estimation of Guttman anti image and image variables (Guttman, 1953) by a simple modification of Hopfield network, and then the calculation of suitable modifications of Kaiser - Rice measure of sampling adequacy of items, denoted here as ψ_4 (Kaiser and Rice, 1974), Guttman sixth lower bound to reliability of result obtained by simple summation of item scores, usually referred to as λ_6 (Guttman, 1945), Momirović lower bound to reliability of result defined by the first principal component, usually referred to as β_6 (Momirović, 1996) and Momirović second measure of homogeneity h_2 (Momirović, 1977). Construction of Hopfield network for the estimation of anti image and image variables and technique of computation of measures ψ_4, λ_6, β_6 and h_2 can be easily understood from the symbolic code of the program itself (Momirović, 2002).

Taking into account the diversity of initial metrics of variables, i.e. nonstandardized and standardized real, and transformed into Guttman's and Harris' space, different criteria for extractions of latent dimensions, different parsimonious transformations, new explorative and confirmative models were recommended for estimation of validities of measurement instruments (Momirović, 1966, 1970, 1973; Bosnar and Prot, 1981; Prot and Momirović, 1984; Momirović, Erjavec and Radaković, 1988; Bosnar, 1989, Prot and Bosnar, 1989).

Multivariate Data Analysis and Statistics (new models, methods and algorithms for data analysis)

The field of data analysis, and specially the area of multivariate statistical methods, had been a subject of majority of methodological research. At a time, new methods and algorithms were proposed for component analysis (Momirović and Gredelj, 1980; Prot, Viskić-Štalec, Štalec, Bosnar, Momirović and Knap, 1984), taxonomic analysis (Momirović and Zakrajšek, 1973; Momirović, Szirovicza, Gredelj and Dobrić, 1980; Momirović, Hošek, Bosnar and Prot, 1984; Prot, Zenkin, Momirović, Bosnar and Knap, 1984; Prot, Viskić-Štalec, Štalec, Bosnar, Momirović and Knap, 1984; Momirović and Mildner, 1989), multidimensional scaling (Momirović, Bosnar, Štalec and Prot, 1983), canonical correlation (Momirović, Gredelj and Herak, 1980), multivariate regression (Momirović, Szirovicza, Dobrić and Gredelj, 1980) and discriminative analysis (Momirović, Dobrić and Szirovicza, 1979; Momirović, Szirovicza, Dobrić and Gredelj, 1980) analysis of nonnumerical (qualitative) data, which enabled applications of complex procedures in data analysis and hypotheses testing of data with weak metric properties. An algorithm of classical type had been implemented (Zlobec, Varga and Momirović, 1974). More advanced, multivariate approach, based on spectral decomposition of contingency tables was utilized (Bosnar and Pavičić, 1982; Bosnar and Hošek, 1983; Momirović, 1989). New complex integrative algorithms which support interpretation of realistic research data of so called nonquantitative data.

One of the classical problems, the problem of criteria for determination of number of important latent dimensions had been critically examined (Momirović, Kovačević, Ignjatović, Horga, Radovanović, Mejovšek, Štalec and Viskić-Štalec, 1972). Series of new criteria had been proposed and comparatively tested in real standardized metric (Štalec and Momirović, 1971), Guttman's nonstandardized and standardized space (Zakrajšek and Momirović, 1972; Momirović and Štalec, 1973; Momirović, Štalec and Zakrajšek, 1973) and Harris metric as well. Based on these experiences, a new general principle for determination of criterion in all metrics of analyzed variables had been developed (Momirović and Štalec, 1984). Principles of criteria construction for determination of number of important dimensions were generalized to the problem of analyses of relations of sets of variables (Dobrić, Momirović and Gredelj, 1987).

An algorithm for hierarchical component analysis in image space was developed (Prot and Bosnar, 1981; Dobrić and Momirović, 1984). Concurrent and comparative evaluation studies of component and factor analysis methods were provided (Momirović, Viskić-Štalec, Štalec, Mejovšek, Ignjatović, Radovanović, Horga and Kovačević, 1972; Viskić and Štalec, 1982; Viskić-Štalec 1987; Bosnar and Prot, 1994).

Canonical factor analysis model and component model in Harris' space have been studied and completely new algorithm for pseudocanonical component model has been developed (Bosnar, Prot, Momirović, Lužar and Dobrić, 1982). Estimation of factor score values had been studied as well (Radaković and Momirović, 1987). An algorithm for iterative multigroup method of factor analysis had been improved (Gredelj, Štalec and Momirović, 1983). On the basis of these experiences new different procedures which integrate explorative and confirmative approach in determination of latent spaces of sets of manifest variables were developed (Momirović, 1972; Momirović, Gredelj and Štalec, 1977; Szirovicza, Gredelj and Momirović, 1978; Štalec and Momirović, 1982; Bosnar, Prot, Štalec and Momirović, 1984; Cvitaš and Momirović, 1984; Viskić-Štalec, Štalec and Momirović, 1984; Knezović and Momirović, 1986; Momirović, Erjavec and Radaković, 1988).

Methods for identification of structural similarities or differences of matrices of covariances or crosscovariances were developed for the analyses of structural changes (Dobrić, Karaman and Momirović, 1983; Bosnar and Prot, 1984; Momirović, Prot, Dugić, Bosnar, Erjavec, Gredelj, Kern and Dobrić, 1987; Cvitaš and Momirović, 1985, 1987; Prot, Bosnar, Hošek and Momirović, 1984; Prot, Ivančević and Momirović, 1985; Prot and Bosnar, 1987).

Multivariate analysis of time series had been treated under the spectral decomposition of data matrices of individuals-INDIFF (Momirović and Karaman, 1982; Karaman and Momirović, 1984; Prot, Momirović and Bosnar, 1987), and

groups-COLDIFF (Momirović and Karaman, 1982; Pavičić, Karaman and Momirović, 1983; Bosnar, Momirović and Prot, 1987).

Significant results were achieved it the field of taxonomic analysis. The model of polar taxons has been treated from the point of view of different metrics of variables (Momirović, 1978; Momirović, Zakrajšek, Hošek and Stojanović, 1979; Momirović, 1981).

Integration of explorative and confirmative approach in determination of taxonomic dimensions enabled new methods for pattern recognition and multicriteria selection were developed, with or without linear constraints imposed (Prot and Bosnar, 1982; Momirović, Dobrić and Karaman, 1984; Prot, 1985, 1989; Momirović, 1989; Momirović and Mildner, 1989).

Canonical discriminative model had been studied from the formal point of view. Regarding the metrics of initial set of variables, a generalized discriminant procedure (Momirović, Gredelj and Herak, 1981), and a general program for multivariate analysis of variance were developed (Pavičić and Momirović, 1982). It had been found that Mahalanobis transformation of variables offers appropriate numeric and interpretative form for canonical discriminative analysis (Bosnar, Momirović and Prot, 1984).

Systematic application of generalized image transformation of sets of variables (Momirović, Štalec and Zakrajšek, 1973) resulted in definition of some of general measures of associations (Momirović and Dugić, 1986; Gredelj and Momirović, 1988). Symmetric and asymmetric measures of association of sets of variables were defined. Under the concept of generalized image transformation with suitable restrictions, it was possible to develop all of the methods for symmetric and asymmetric relations among sets of variables (Prot, Bosnar and Momirović, 1983, 1983; Bosnar, Prot and Momirović, 1985).

BICANAL method of canonical correlation analysis of images of variables, inspired by Tim and Carlson's (1976) bipartial canonical correlation analysis, has been successfully developed, implemented and applied (Gredelj, Momirović, Dobrić, Herak, Bosnar and Prot, 1982; Hošek, Bosnar, Prot and Momirović, 1984). Bi-partialisation of external sets of variables led to a new algorithms, i.e. bipartial canonical covariance analysis (Momirović, 2001).

Formal properties of relations among sets of variables were examined (Momirović, Štalec, Zakrajšek, 1973; Momirović, Dobrić, 1979; Bosnar, Prot, Momirović, 1985; Bosnar, Prot, 1988).

A class of robust methods for multivariate data analysis were proposed to enable processing of data that do not satisfy assumptions necessary for the application of classical data analysis methods. The advantages of the proposed methods are in their robustness both to outliers and to the artificial associations generated by the few pairs of variables from two different sets. Furthermore, this variables need neither be normally distributed nor their covariance matrices need be regular.

Canonical Covariance Analysis (QCR), Momirović, Dobrić and Karaman (1983). Relations between the canonical and quasicanonical correlation analysis can be found in Momirović, Bosnar and Prot (1984), Momirović and Dobrić, (1985), and Knežević and Momirović (1996). The influences of initial metric of variables on the results of applied algorithms of quasicanonical analysis of covariances were examined: Harris universal (Dobrić, Momirović and Gredelj, 1985), Guttman's partial image (Momirović, Dobrić and Gredelj, 1985), standardized image (Wolf, Radaković and Momirović, 1988), and between Guttman and Harris metric (Momirović, Dobrić and Gredelj, 1985).

Robust Redundancy Model. Under the generalized image transformation with suitable restrictions it was possible to develop different methods for symmetric and asymmetric methods of relations of sets of variables (Prot, Bosnar and Momirović, 1983, 1983; Bosnar, Prot and Momirović, 1985).

SRA model of regression analysis, Štalec and Momirović (1983). All that relations between SRA and LSR regression could be found in Dobrić, Štalec and Momirović (1984). The influences of different metrics and scaling of variables on the results of quasicanonical regression analysis had been also treated (Momirović, Dugić and Gredelj, 1987; Matečić and Momirović, 1988; Momirović, 1988),

SDA Model of robust discriminant analysis, Štalec and Momirović(1984). Furthermore, the properties of that model had been defined in Harris universal space (Milonja, Dobrić and Momirović, 1989), Hotelling space (Gredelj, Dobrić and Momirović, 1989), and Pearson space (Momirović, 1989).

The interrelations of results of canonical covariance analysis, multivariate redundancy analysis and regression analysis suggest a method of spectral analysis of relations of general images of variables named "nuclear analysis" (Hošek and Momirović 2001).

NUCLEAR ANALYSIS (Hošek and Momirović 2001) Nucleus of two sets of quantitative variables is defined as the cross covariance matrix of the variables mutually transformed to generalized image form (Hošek and Momirović, 2001). The singular values decomposition of nuclear matrix is named nuclear analysis. Because spectral analysis of any cross covariance matrix is actually canonical covariance analysis of two sets of variables, transformed to some selected metrics, it was possible to derive identification structures such as pattern, intercorrelations and structure matrices.

Beside the methods for robust analysis of hypothetical latent dimensions (Štalec and Momirović, 1982; Dobrić. Karaman, Momirović, 1983), and robust analysis of hypothetical taxonomic dimensions (Štalec, Bosnar, Prot, Momirović, 1982), the problem of relations between sets of variables had been successfully treated as well.

In order to clarify the interpretation of obtained results, relationships between robust methods and corresponding classical methods were established and examined. The formal relations between canonical correlation analysis and quasicanonical analysis of covariances were established (Hošek, Bosnar and Prot, 1984; Knežević and Momirović, 1996); quasicanonical analysis of covariances and principal component analysis (Gredelj, Momirović and Dobrić, 1986), least squares regression analysis and robust regression analysis (Dobrić, Štalec and Momirović, 1984). Diagnostic efficacy of robust discriminant analysis had been investigated (Momirović and Dobrić, 1988).

The taxonomic analysis of microsocial structures represented by binary graphs were solved by spectral decomposition of matrix of network of relations (Momirović, Hošek, Bosnar and Prot, 1984) and multidimensional scaling (Petrović and Momirović, 1972).

In Hotteling space (space of left eigenvectors of data matrices) general models were established where classical methods of data analyses could be treated as special cases (Momirović, Gredelj and Herak, 1978; Bosnar, Prot and Momirović, 1985: Momirović and Dobrić, 1988; Gredelj, Dobrić and Momirović, 1989).

Konstantin. Momirović continuously integrated new ideas related to acquisition, analysis and interpretations of results of data analysis procedures. In the field of development and applications of artifical neural networks new algorithms were developed for almost all relevant methods of data analysis. The nonlinear nature of results obtained by these new methods has significantly contributed to further data analysis conteptualisation beyond the classical general linear model based multivariate methods. Interesting results were obtained in taxonomic problems (Momirović, 2003; Popović and Momirović, 2003; Momirović, Hošek, Popović and Boli, 2003; Momirović, 2003; Momirović and Hošek, 2003; Knežević, Momirović, Radovanović and Radović, 2003; Bosnar, Prot, Momirović and Hošek, 2003; Prot, Bosnar, Hošek and Momirović 2003; Popović, and Momirović 2003).

Informatics/Applied Computer Science

(design and development of information systems, designing new software tools for information systems, and multivariate data analysis and management)

The experiences and research problems Momirović has been faced with, and solutions he proposed were related to the multivariate nature of problems, the size of problems and the availability of computer resources (lack or limited access to computer resources) at the time being.

He has been very active in promoting and implementing the ideas of establishment of modern, contemporary, computing centers where ever there has been any chance to initiate them. Computing center of Institute of Kinesiology and the University Computing Centre - SRCE illustrate that (Budin, Jurišić-Kette, Momirović, Peruško, Požar, Simović, Stefanini, Turk, 1974).

The importance of information systems in the fields of education and sports had been anticipated too. Several projects have been proposed: Information system of secondary education (Momirović, Aurer, Maćašović, Gredelj, Gospodnetić, Obelić, Hađina and Stipanović, 1979); Information system of physical culture (Momirović, Gredelj, Štalec, Gospodnetić Milonja, Pavičić, Semenov and Stipanović, 1979); and Information system of top level sport (Ambrožić, Ban, Gospodnetić, Momirović, Pavičić, Pedalo, Semenov and Štalec, 1983).

It has been realized very early on that collections of statistical and data analysis subroutines should be interrelated through general statistical language. So, the first version of SS (statistical system) appeared to be active on the base of close cooperation of Zakrajšek, Štalec and Momirović (1969). Initial versions of SS were developed and coded in FORTRAN IV for IBM 1130 at the Institute for Mathematics and Physics "Jozef Štefan" at the University of Ljubljana. By the year 1971 it was further developed and maintained at the Institute of Kinesiology at the College for Physical Education and at the University of Zagreb for IBM series 1130 and 370/165 of electronic computers.

Upgrading the computing facilities in Ljubljana (CDC Cyber) and in Zagreb (UNIVAC 1106) stimulated development of SS at Ljubljana and Zagreb. It went on for some time with cooperation and coordination. After 1974, further maintenance and development went on in Zagreb. SS Statistical system (Zakrajšek, Štalec and Momirović; 1974), the command (linear) programming language became ground floor for multivariate statistical data analysis explorations and education The basic kernel of SS was implemented in FORTRAN V language and systematically improved under the EXEC 8 operational system UNIVAC 1110 and UNIVAC1130 computers at the University Computing Centre - SRCE of the University of Zagreb.

In the period from 1976 to 1985 new algorithms were developed and numerous computer programs were written and implemented as ordinary scientific and educational tools in Zagreb methodological circle headed by SRCE. Most of these programs were realized in SS (Statistical System) programming environment (Figure 4). New developed algorithms Konstantin Momirović implemented along with his fellow researchers Marijan Gredelj, Vesna Lužar, Vesna Dobrić, Maja

Herak, Živan Karaman and Lajos Szirovicza from Universtiy Computing Centre - SRCE and Janez Štalec, Leo Pavičić, Ksenija Bosnar, Franjo Prot, and Nataša Viskić-Štalec from the Faculty of Physical Education.

At the time SS has been promoted and accepted as the key tool for multivariate statistical data analysis among potential users, members of the scientific community.

Supported by SRCE this multivariate data analysis program library SRCE*SS-MACRO had been used in various scientific and technical disciplines. Most frequently used macro programs could be classified as: analysis of non-numerical data (8 macro programs); metric (psychometrics, i.e. kinesiometrics) properties of measurements (5 macro programs); explorative and confirmative factor or component analysis (17 macro programs); taxonomic (cluster) analysis, pattern recognition and classification (8 macro programs); multidimensional scaling (11 macro programs); canonical correlation analysis, multivariate regression analysis, redundancy analysis and discriminative analysis (22 macro programs); stochastic process analysis and analysis of changes (7 macro programs).

Multivariate statistical analyzer (MSA) had been designed as a blue print of new version of Statistical system (SS), as a novel generation of specification language for multivariate data analysis and statistics with full set of nested logical and iteration program control structures (Momirović, Aurer, Maćašović, Gredelj, Gospodnetić, Obelić, Hađina and Stipanović, 1979; Momirović, Gredelj, Štalec, Gospodnetić Milonja, Pavičić, Semenov and Stipanović, 1979; Momirović and Štalec, 1983). Limited human resources and financial capacities stopped further development of SS Statistical System.

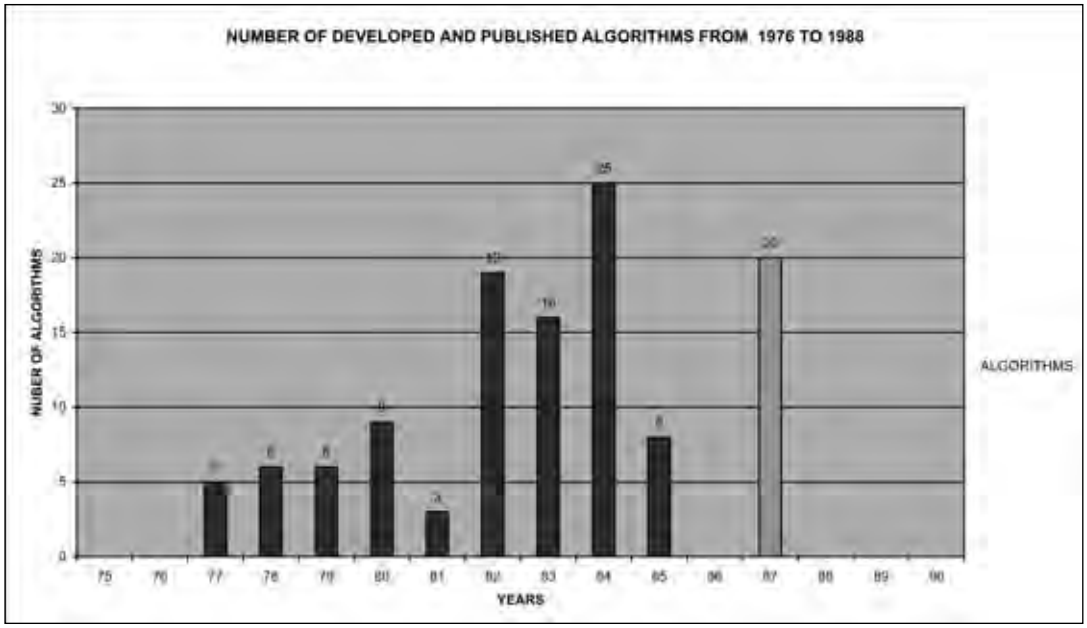


*Figure 3. The dynamics of creation, i.e. algorithm development for SRCE*SS-MACRO (1976-1985) and SRCE*GENS-MACRO library (1986-1990)*

In the period from 1986. to 1990. development and support of SS macro library was banned and further development was based on power and flexibility of GENSTAT system. Konstantin Momirović led a team of researchers (Marijan Gredelj, Vesna Lužar, Vesna Dobrić and Maja Herak, Ksenija Bosnar, Franjo Prot, Darko Dugić, Zlatko Knezović, Nataša Erjavec, Jovanka Radaković, Vesna Perišić, Josipa Kern) from the University Computing Centre - SRCE, Faculty of Physical Education and School of Public Health "Andrija Štampar" which established new public program library SRCE*GENS-MACRO on UNIVAC 1130 main frame computer (Figure 3). Most frequently used macro programs from SRCE*GENS-MACRO library could be classified into: analysis of non-numerical data (3 macro programs); metric (psychometrics, i.e. kinesiometrics) properties of measurements (2 macro programs); explorative and confirmative factor or component analysis (4 macro programs); taxonomic (cluster) analysis, pattern recognition, classification and discriminant analysis (5 macro programs); correlation analysis, canonical correlation analysis, multivariate regression analysis, redundancy analysis and discriminative analysis (26 macro programs); stochastic process analysis and analysis of changes (22 macro programs).

In the period from 1996 to 2004 Momirović devoted himself to design and development of a whole new macro library implemented in SPSS macro language as a library of macro programs "IKSI" at the Institute for Criminological and Sociological Research.

Algorithms and macro programs developed from 1996 to 2004 (Figure 4.) could be classified into 21 groups, as shown in Table 1.

In total there are 762 macro programs from which 703 are explicitly referred to as being designed, developed, and coded by Momirović himself (Table 1.). It is important to notice that 390 technical reports are referenced in these almost self documented macros. Technical reports are documenting methodological contributions.

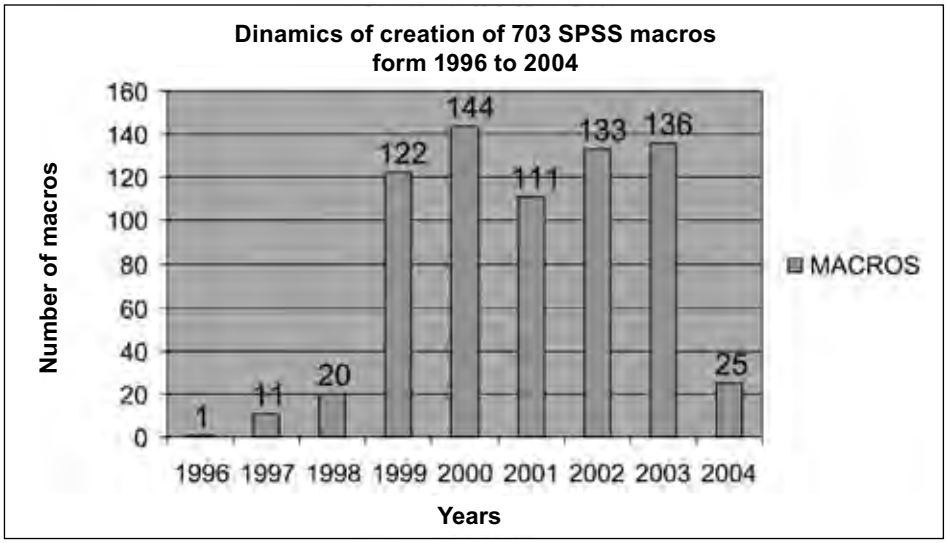


Figure 4. The dynamics of creation, i.e. algorithm development and SPSS macro coded programs (1996 - 2004).

The dynamics of creation of macro programs, i.e. algorithms between 1996 and 2004 demonstrate intensive and continuously high rate productivity for the last six years of his life.

Phenomenon of Konstantin Momirović's work on this macro library, along with 390 associate technical reports, as a part of his legacy in the field of multivariate statistics and data analysis is worth for further study.

Table 1. The distribution of SPSS macro programs coded by Momirović, classified in 21 program groups / areas of multivariate data analysis

PROGRAMS GROUP	No. of macro programs
(01) Analysis of metric characteristics of composite measurement instruments	46
(02) Component analysis	140
(03) Factor analysis	70
(04) Taxonomic analysis	51
(05) Metric multidimensional scaling	7
(06) Latent structure analysis	11
(07) Redundancy analysis	12
(08) Canonical correlation analysis	30
(09) Non-numerical data analysis	29
(10) Canonical covariance analysis	23
(11) Discriminant analysis	30
(12) Multivariate regression analysis	44
(13) Correlation analysis	22
(14) Analysis of qualitative changes	9
(15) Analysis of structural changes or structural differences	18
(16) Pattern recognition	9
(17) Emulation of neural networks	150
(18) Nuclear analysis	21
(19) Network analysis	4
(20) Descriptive and inferential statistical methods	21
(21) Auxiliary mathematical and statistical programs	24
T O T A L	771

Concluding remarks

Zagreb kinesiology circle have been developed around the contemporary science of human movement based on the methodological developments appropriate to the research problems imposed and resolved.

Konstantin Momirović, alias Stojan Hadžigalić, has been an active contributor to both theoretical and applied developments of multivariate data analysis from the early 1960s till his sudden death in 2004.

From the point of view of development of his ideas on multivariate data analysis, it is possible to recognize several phases. In the first, initialization phase, he worked on methodological topics as individual assimilating and developing contemporary ideas. His contribution to the design of SS Statistical System for multivariate data analysis prepared the ground floor the organized theoretical and applied team work. In the second phase, he influenced and became the originator and principal figure in the so called "Zagreb Methodological and Multivariate Data Analysis Circle at the University of Zagreb (Institute of Kinesiology at the Faculty of Physical Education and at the University Computing Centre - SRCE) where completely new ideas emerged. In the third phase he influenced and organized various productive groups of researchers around the Institute for Criminological and Sociological Research, and the Department of Psychology at the Faculty of Philosophy of University of Belgrade. That indicates that "circle" becomes an influential "school".

Methodological research and achievements after 1971 could be divided into the following three areas of data analysis:

1. Kinesiometrics (development of new theoretical and applied measurement models in the field of measurement theory)
2. Multivariate data analysis and statistics (new models, methods and algorithms for data analysis)
3. Informatics (a field of computer science related to the development of new software for information systems, data analysis and management)

Evolution of some ideas, algorithmic solutions and programs implementations are evident. The contributions and experiences are finally divided as they are grouped and incorporated in the SPSS macro language coded library of more then seven hundred macro programs. Further research is needed to enable better understanding of the complexities of his ideas implemented in macro programs, especially where artificial neural network approach to multivariate data analysis problems is integrated.

This rather short and illustrative overview is just a preliminary attempt to the deeper insight into phenomenon of Konstantin Momirović's work and his legacy in the field of multivariate statistics and data analysis as foundations of research methodology and methods in kinesiology.

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CORRELATION BETWEEN LATENT MORPHOLOGICAL AND SPECIFIC MOTOR SKILLS FACTORS OF 12 YEAR OLD WATER POLO PLAYERS

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Abstract

The purpose of this research is to determine the correlation between latent morphological and specific motor skills factors in the beginning of their career in water polo. Research sample consisted of total 92 water polo players aged 12 ± 0.5 years. The set of total 14 measurements for evaluation of morphological characteristics and 6 tests for specific motor skills evaluation were applied. Three morphological factors have been isolated and one factor was obtained in latent space of specific water polo motor skills. Obtained latent morphological factors affect, grouped, the latent expressing of situational motor skills. That means that the applied system of manifest morphological variables, when factorized, becomes a significant success predictor in water polo players' specific motor skills in the begging of their career.

Key words: *factor analysis, regression, morphology, specific motor skills, water polo*

Introduction

Morphological factors determine, to some point, the success in a sport activity. They are crucial for choosing the water polo tactics, as well as for the rank obtained at junior competitions (*Đurašković & al., 2002*). Success in sport games, and therefore in water polo as well, cannot be predicted by simple selection of predictive anthropological factors, because it is impossible to choose the criterion. Some longitudinal researches showed that the greatest influence on achieving success in water polo and entering the senior national team has the flair for the game (*Falk & al., 2004*). The flair for the game has never been presented by manifest tests before, so this research will present it by the set of specific motor skills test, that is, by basic motor skills latent space. The purpose of this research is to determine the correlation between latent morphological and specific motor skills factors in the beginning of their career in water polo.

Method

Research sample consisted of total 92 water polo players aged 12 ± 0.5 years, which have been training water polo for at least 2 years. The set of total 14 measurements for evaluation of morphological characteristics and 6 tests for specific motor skills evaluation were applied.

Determining the level of morphological characteristics was performed by standardized procedure (Eston & Reilly, 2001). The following measurements have been used: body height (AVIS), arm longitude (ADRU), Leg longitude (ADNO), hand longitude (ADSA), shoulder span (ASRA), pelvis span (ASKA), hip span (ASKU), upper arm scope of reached out arm (AONL), average chest scope (AOGR), abdomen size (AOTR), body weight (AMAS), upper arm skin wrinkles' thickness (AKNN), belly skin wrinkles' thickness (AKNT), back skin wrinkles' thickness (AKNL).

Ascertainment of the specific motor skills level was performed applying measuring instruments recommended by Volčanšek & Grčić-Zubčević (1985), Pivač & al. (1996) and Bratuša (2000): swimming 25 m water polo crawl (S25), swimming 50 m crawl (S50), swimming 100 m crawl (S100), swimming 4x5 m back crawl (S4x5), leading the ball 3x5 m (S3x5) and tossing the ball from the water (SBACL).

In order to determine the levels in the manifest space of water polo players examined characteristics, basic statistical parameters were applied but they won't be shown in this study due to lack of space.

In order to determine the morphological characteristics' space structure and specific motor skills space structure (for each space separately), following methods were applied: Hoteling's main components method, and calculated communalities (h^2), characteristic roots (Lambda), % of explanation of common variance, (%) and % of defining the total variability (Cum %).

For determining the correlation between the predictor set of variables (isolated latent morphological factors) and criterion variable (isolated latent specific motor skills factors).

Regression analysis was used and following coefficients were calculated: Pearson's correlation between every predictor and criterion variable (r), partial correlation (Part r), standardized partial regression coefficient of predictor variable toward the criterion variable (BETA), t-test of correlation significance between predictor and criterion variable (t), probability of correlation between predictor and criterion variable (p), multiple correlation coefficient between the system of predictor variables and criterion (R), criterion variable determination coefficient (R^2), and probability (significance level) of correlation between the system of predictor variables and the criterion variable (P).

Results and discussion

Performed factor analysis with rotation of main components of water polo players' latent morphological space explains about 80% percent of total variability (Cum %= 79.70) (Table No. 1) Three characteristic roots (factors) have been isolated. First characteristic root is 7.100 (λ= 7.10).and defines about 51% of common variance (Cum %= 50.7). Second characteristic root in water polo players is 2.87 (λ= 2.87) and independently defines about 21 % (Cum %= 20.519), and together with the first factor about 71% of common variance (Cum %= 71.24).

Third characteristic root in group of water polo players is 1.19 (λ= 1.19) and independently defines about 8 % (Cum %= 8.47). So after performed factorization of water polo players' morphological tests by applying the Hoteling method of main components that contains 14 manifest variables, 3 main components (factors) were obtained:

The first main presented component is *Growth and development factor.* It contains significant projections (correlation or saturation coefficients or the projections among the variables and factors) of all anthropometric variables. Those projections have the same sign which indicates that vectors of those variables make very narrow hyper cone around the first main component.

The second main component is mostly saturated with variables for estimation of *Adiposity* (AKNN, AKNT, AKNL) that have the positive *Longitudinal skeleton dimensionality* (AVIS, ADRU, ADSA, ADNO) negative sign of projection.

The third main component is defined by variables: average chest scope (AOGR), abdomen size (AOTR), that have negative, and shoulder span (ASRA) that has positive sign of projection and can be called *Abdomen sizes and shoulder spans.*

The structure of isolated factors obtained by applying Hoteleng's main components method is not clear because only 3 variables have clear projections onto the first main component (AMAS, ASKA and ASKU) because other variables have significant projections onto the second and then the third main variable.

Communalities of applied water polo players' morphological characteristics are medium high which means that measurements were performed with low number of errors.

The least valid results and the lowest contribution to the factor structure of morphological space has the variable with the lowest communality ASKA (h^2= .896). The most valid results and the highest contribution to the factor structure of morphological space have the variables with the highest communalities AMAS (h^2= .896), AOGR (h^2= .893) и AVIS (h^2= .891).

Table No. 1 -Water polo players' morphological characteristics tests factorization applying Hoteling's method of main components, their communalities, characteristic roots and explained parts of common variance

Variables	A1	A2	A3	h^2
AVIS	**.798**	**- .466**	- .193	.891
AMAS	**.925**	.190	- .065	.896
ADRU	**.634**	**- .619**	- .158	.811
ADSA	**.647**	**- .574**	.289	.832
ADNO	**.733**	**- .543**	- .035	.834
ASRA	**.611**	- .262	**.547**	.742
ASKA	**.664**	- .102	.161	.477
ASKU	**.752**	- .229	.153	.642
AOGR	**.702**	.165	**- .611**	.893
AOTR	**.728**	.233	**- .438**	.776
AONL	**.874**	.339	.011	.878
AKNN	**.591**	**.661**	.240	.844
AKNT	**.622**	**.669**	.086	.843
AKNL	**.589**	**.630**	.236	.800
Lambda	*7.10*	*2.87*	*1.19*	
%	*50.72*	*20.52*	*8.46*	
Cumul. %	***50.72***	***71.24***	***79.70***	

The first and only characteristic root in latent specific motor skills space is 3.83 (λ=3.83) and defines about 64% of common variance (%= 63.85). After performed factorization of water polo players' specific motor skills tests by applying the Hoteling method of main components (table No. 2) that contains 6 manifest variables, one main component was obtained: *General factor of situational motor skills* (SM1V). Projections of variables onto the main component are bipolar. The obtained result is the consequence of well selected and homogenised sample, as well as the selection of adequate tests in the battery.

Communalities of variables are medium high which means that measurements were performed with low number of errors.

The least valid results and the lowest contribution to the factor structure of specific motor skills space has the variable with the lowest communality S4X5 (h^2= .416). The most valid results and the highest contribution to the factor structure of specific motor skills space has the variable with the highest communality.

Table No. 2 -Water polo players' specific motor skills tests factorization applying Hoteling's method of main components, their communalities, characteristic roots and explained parts of common variance

Variiables	C1	h^2
S25	**.812**	.658
S50	**.912**	.831
S100	**.846**	.715
S4X5	**.645**	.416
S3X5	**.832**	.691
SBACL	**- .719**	.516
Lambda	*3.83*	
%	*63.85*	

Table No. 3 Results of Latent morphological space regression analysis (A1B, A2B, A3B) and the first factor of latent space in water polo players' specific motor skills (SM1V)

Variables	r	Part r	BETA	t(88)	P
A1V	- .259	- .276	- .259	- 2.693	**.008**
A2V	.348	.360	.348	3.623	**.000**
A3V	- .013	- .015	- .013	- .136	.892

R= .434 R^2= .188 **P= .000**

Correlation between the whole predictor system morphological characteristics' latent variables (A1V, A2V, A3V) and first factor of water polo players' situation motor skills latent space (SM1V) (Table No. 3), that is the multiple correlation coefficient is relatively high (R= .434). Common variability between the predictor system and criterion variable is about 19% (R^2= .188). This kind of correlation is relevant at the level of 99 % (p= .000). The remaining 81% in explaining the total latent space variability of water polo players' specific motor skills (SM1V) can be accredited to examinees' other skills and characteristics which were not handled in this research. By analyzing each variable individual influence, it can be concluded that the biggest and statistically relevant influence have the variables A2V (BETA= .348) and A1V (BETA= - .259), which is relevant at the level of 99 % (p= .000, p= .008).

Situational motor skills have been well expressed in water polo players with extremely higher values of morphological manifestations. Water polo players with extremely higher values of skeleton longitudinal dimensions and lower values of subcutaneous fat tissue are also successful in performing certain movements.

Conclusion

Research sample consisted of total 92 water polo players aged 12 ± 0.5 years which have been training water polo for at least 2 years. The set of total 14 measurements for evaluation of morphological characteristics and 6 tests for specific motor skills evaluation were applied.

The purpose of this research is to determine the correlation between latent morphological and specific motor skills factors in water polo players of the mentioned age.

Three morphological factors have been isolated: *the growth and development factor, the factor of adiposity and reverse skeleton longitudinal dimensionality, and Abdomen sizes and shoulder spans factor*, and one factor was obtained in latent space of specific water polo motor skills – *General factor of situational motor skills.*

Obtained latent morphological factors affect, grouped, the latent expressing of situational motor skills. That means that the applied system of 14 manifest morphological variables, when factorized, becomes a significant success predictor in water polo players' specific motor skills in the begging of their career. Individually, *The growth and development factor* and *The factor of adiposity and reverse skeleton longitudinal dimensionality* have a significant influence onto the specific water polo motor skills.

Young water polo players with high numeric values in all morphological admeasurements have a high-grade displaying of specific water polo movements, while water polo players with increased amount of subcutaneous fat tissue and lower skeleton longitudinal dimensions values have less qualitative displaying of specific motor skills. Therefore the selection of water polo players has to be guided by this fact. In order to generalize these results a research should be conducted at the sample of similar age, applying the same number, the same manifest tests and same data processing methods. In further researches we should seek for most optimal morphological measurements sample which would effectively predict the success in performing certain specific water polo movements and elements. Also, it is necessary to find an optimal set of specific water polo movements that would help to successfully select future water polo players.

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INDEX COPERNICUS AS MODERN FORM OF AN INTENSIFICATION OF SCIENTIFIC PROJECTS

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Abstract

Individual and group, single centre and multicentre, local and international, every – scientific projects can be supported and conducted by Web-based systems. This increases the number of taking up and conducting research projects. However real intensification guarantee systems that combine possibility of searching for co-researchers, evaluation of their usefulness and potential for scientific projects (according to defined criteria), conducting common scientific projects (at the simultaneous evaluation of their involvement and the contribution) and of selection of the appropriate place (way) presentation of results (conference, article). Index Copernicus is such a scientific system, which combines these functionalities, and by the *Virtual Research Groups* - internet platform, being his integral part - intensifies cooperation on the scientific projects.

Referring to the Science 2.0 [1] Index Copernicus is much more specified proposal for the science. The system base on algorithms permanently evaluates the scientific work of the researchers. Thus, every scientific project is subject of independent evaluation. The extended format of the review is supporting the objectivization of results and participation of individual persons in the research. The publication is not sole criteria of researcher or team evaluation but one of a few elements of achievements presentation.

Researches of motor competences from the scope of safe falling based on students (n = 811) from two colleges conducted on *Virtual Research Groups* confirmed advantages of this platform (free movement of data, simplicity of collecting and data analyses, access to empirical data from distant locations and in any time). Moreover, researchers developed new abilities, improved technique and increased number of scientific projects.

Key words: *index copernicus, scientific projects, virtual research groups, scientist networking, safe falling test*

Introduction

Researches are significant element stimulating development and progress. The value of Research and Development is undeniable. Influence on our life and environment - invaluable. The impact of Information and Communication Technologies (ICT) in education and general life implies new ways of creating knowledge, disseminating information, and educating people [2]. Focusing on life sciences, we get simple answer how Research and Development have changed our life. First decade of 21st century brought us flood of E-Technologies. Internet, mobile devices offer e-systems, which i.e. in healthcare enable to provide services of the health care from a distance without the need to leave the house. We could multiply examples influence on our life. However, our purpose was to find universal solution of the cooperation and intensification of scientific projects for researchers.

Methods

Industry, international research institutions, universities etc. can afford on the newest (personalized) e-systems. Unfortunately, single researchers use in their work basic applications like Excel, rarely Access, etc. For part of scientists, many available functions are too complicated, for other too limited or not enough to work simultaneously with other scientist in the same time. In spite of availability such, free tools like web-based word processor and spreadsheet Google Docs (BETA) - that let for the joint work on one project in the same time - still it is not complex and steady solution.

In search of universal solutions, which let on networking scientists and really intensifying scientific projects, we assumed for the base conception of the Science 2.0 [1]. The model would not be competent without multi-parametric methodology, which is transparent, recognized, and universal (confirmed by authorities).

Looking for solution networking scientists and intensifying scientific projects we made preliminary selection excluding all non-web-based applications, focusing only on web-based solutions. Next, we excluded the solutions that turn a social network like SciLink or MySpace, emphasizing on building the community (promotion), rather than development of scientific initiatives. Finally, we limited criteria of selection to multifunctional system solutions putting in practice idea “One stop shop” (we could also add “in Science” as an explication).

From various web-based systems one appears to increase scientific cooperation stimulating research activities, assuring high quality research (Evidence Based), by the scientific and cultural interaction (multilingual interface, real-time access to data) and permanent evaluation of scientific work.

Results

In result we obtained system that combines possibility of searching for co-researchers, evaluation of their usefulness and potential for scientific projects (according to defined criteria), conducting common scientific projects (at the simultaneous evaluation of their involvement and the contribution) and of selection of the appropriate place (way) presentation of results (conference, article).

Index Copernicus is such scientific system, which combines these functionalities, and by the *Virtual Research Groups* - internet platform, being its integral part - intensifying cooperation on the scientific projects.

We have practically tested this system creating ourselves from available tools *safe falling test. Virtual Research Groups* even though having the limited functionality allow for simple, intuitive, and fast creating the dedicated research home page with automatically calculated statistics, description of project, access to profiled information (literature, grants and patents) and possibility networking with scientists registered in Index Copernicus or inviting own.

An objective of test was acquiring the skill of safe falling, which is necessary for practicing flooring, tripping and throwing. Mastering the above reduces the danger of body injuries due to accidental falls and significantly increases the subject's physical fitness [3].

Safe falling test based on students (n = 811) from two colleges (The Jozef Pilsudski University of Physical Education in Warsaw, Poland and Pawel Wlodkowic University College in Plock, Poland), male and female, educated on full-time, extramural, and postgraduate studies.

Regardless of topic limitations, the base of analysis is not safe falling test itself but modern form of an increasing scientific project.

Virtual Research Groups let for simple collecting data and their analysis, access to empirical data from distant locations, with different internet speed and in any time (does not matter time zones). Every research initiative is based on the same procedures of creating and implementation, and final product – ready internet platform – has standardized form.

Discussion and conclusions

Carrying out research through the electronic platform of the scientific cooperation allows for documenting academic achievements, giving real evidence to the scientific work being subject evaluation in every moment both by other researchers involved in project, reviewers, grant funders, or investors. Scientists develop new abilities, improve technique, and increase number of scientific projects.

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SELF REPORTED AND MEASURED HEIGHT AND WEIGHT IN HIGH SCHOOL STUDENTS

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Abstract

The aim of this study was to determine the relationship of self reported and measured height and weight in Croatian adolescents of both genders. The samples of 215 male and 742 female high school students were asked to report their height and weight by questionnaire. Within ten days of completing the questionnaire, the students were measured by trained person during regular classes of physical education. Mean differences between self-reported and measured weight were -1.73 kg in female and -0.48 kg in male students (measured values were higher). Mean differences between self-reported and measured height were 0.019m in female and 0.014m in male students (self reported measures were higher). The t-tests show that female students misreport their height and weight in significantly larger extent than male students do. Correlations of self reported and measured weight and height in female students were 0.94 and 0.93, respectively. In male students, correlations of self reported and measured weight and height were 0.94 and 0.95, respectively. Body mass indexes (BMI) calculated with self reported and measured values correlated 0.90 and 0.92 for female and male students, respectively. The results indicate that self reported height and weight in Croatian adolescents are accurate enough to be used in correlational analyses. However, self reports are not so appropriate as measured results to calculate BMI in epidemiologic studies, giving lower proportions of male and female subjects with overweight and obesity.

Key words: *measured height, weight, school students*

Introduction

Height and weight are the most often used anthropometric measures. They add to the knowledge about trends in growth and development (McDowell, 2005.) and are commonly used in epidemiological studies of nutritional status because of their simplicity and low cost (Zuguo et al, 2002.). In large studies, values of height and weight are often collected by self report (Spencer et al, 2001.) by interviews, mail-questionnaires, or by telephone surveys.

There are different opinions about validity of self reported data. Weaver et al (1996.) state that not only weight and height, but also waist, hip, chest and bust circumferences obtained by mail-questionnaire in middle aged and old women are highly accurate and therefore appropriate for epidemiologic studies. Stewart (1982) states that self-reported weight and height are valid and reliable, even in groups of severely overweight subjects. Jeffery (1999) concluded that self-reported body weight is excellent approximation of actual weight regardless of education, occupation, health, or weight concern. On the other hand, some authors state that epidemiological studies should be based on measured anthropometric variables rather than declared (Shutz and Woringer, 2002), recommend avoiding of self reports (Hauck et al, 1995) and doubt validity of body mass index (BMI) obtained by telephone surveys (Paccaud, Wietlisbach and Rickenbach, 2001). Nyholm et al (2007) do not reject self reported weight and height, but recommend adjusted values, corrected regarding age and body size. Kuczmarski, Kuczmarski and Najjar (2001) state that adults aged 60 years and over have too inaccurate self-reported values to be of any use. Gillium ans Sempos (2005) found ethnic differences in reliability of self reported BMI independent of other socio-demographic variables, smoking or health status.

To obtain the better insight in the accuracy of self reported anthropometric measures in Croatian population, the aim of this study was to determine the relationship of self reported and measured height and weight in Croatian adolescents of both genders.

Methods

The sample of this study consists of 215 male and 742 female students aged 15 -19 years, from nature science high school in capital Zagreb. Total sample of 957 subjects represents almost all students from that school. Complete results of all measurements have 913 students.

The measurements were done during regular classes of physical education. First, students were asked their height and weight as the part of non-anonymous questionnaire regarding their health status and readiness to take physical education classes. After 7 – 10 days the same students were measured by physical education teacher qualified in anthropometric

measurement. Weight and standing height were measured by calibrated scale with height rod, from standard equipment in school medical office. Weight was measured to the nearest 0.1 kilogram (0.1kg) and height was measured to the nearest millimeter (0.001m). Students were barefoot, in light exercise clothes. The same person did all the measurements, and the same scale with height rod was used all the time.

The relationship of self reported and measured height and weight was determined by mean differences of two measures and by Pearson correlation coefficient. Body mass indexes (BMI) was calculated as BMI = weight / height^2 (kg/m^2).

Results and discussion

Mean differences between self-reported and measured weight and height show the same pattern in male and female students (Table 1). Measured values were higher for weigt, and self reported values were higher for height. The same results were obtained in Tienboon, Wahlqvist and Rutishauser (1992) in the study of the bias of self reported weight and height in adolescents and their parents. They found the same bias in both generations.

*Table 1. Mean differences (**M**) between self-reported and measured weight (**δ weight**) and height (**δ height**), standard deviations of differences (**SD**) in male and female students and in total sample*

	N	δ height M	δ height SD	δ weight M	δ weight SD
total	913	0.01807	0.02375	-1.44786	0.40734
males	207	0.01414	0.02341	-0.48164	0.43749
females	706	0.01922	0.02374	-1.73116	0.39392

The F- value (Table 2) and univariate t-tests with Bonferroni correction (Table 3) show that female students misreport their height and weight in significantly larger extent than male students do. The nature of gender differences in self-reported height and weight accuracy is still not clear. According to gender role, it could be expected that females underestimate their weight, and males overestimate their height. However, empirical results are not so simple. In the research of Spencer et al (2001) middle aged women were significantly more accurate than men, just opposite than in our adolescent sample.

*Table 2. The analysis of variance of differences between self-reported and measured weight and height in male and female group: Wilks' lambda (*Wilks' λ*), F-value, degrees of freedom (**df_1 and df_2**), statistical significance of F–value (**p**)*

	Wilks' λ	F - value	df_1	df_2	p
intercept	0.71794	178.7542	2	910	0.000000
gender	0.97644	10.9794	2	910	0.000019

In the Table 4, there are descriptive statistics of body mass index calculated from self-reported (**BMI**) and measured weight and height (**M-BMI**), as well as correlation of two measures in males and females. In male students, only maximal result of measured **M-BMI** is slightly higher than self reported BMI. In female sample, there are one point differences in mean values and minimal result in favor of M-BMI, and visible difference of more than 7 points in maximal result, in favor of M-BMI too. Prevalence of overweight or obesity, defined as BMI>=25kg/m^2, calculated from self reported and measured values in males are 16.6% and 17.2%, respectively (Figure 1). In females, the percent of overweight or obese assessed by two methods is 5.5% for self report, and 16.0% for measured height and weight (Figure 2). The results show considerable underestimation of the prevalence of overweight or obesity in female adolescents based on height and weight self-reported by questionnaire.

*Table 3. Univariate tests of differences between self-reported and measured weight (δ weight) and height (δ height) in male and female group: sum of squares (**SS**), F-value, degrees of freedom (**df_1 and df_2**), statistical significance of single F-value (**p**), p-value threshold for p<0.01 with Bonferroni correction (**p_B**)*

	SS	F - value	df_1	df_2	p	p_B
δ height	4142.4	7.3974	1	911	0.006656	0.005
δ weight	24991	15.29790	1	911	0.000099	0.005

*Table 4. Body mass index calculated from self-reported (**BMI**) and measured weight and height (**M-BMI**). The number of subjects with complete results (**N**), mean (**M**), standard deviation (**SD**), minimal and maximal result (**Min** and **Max**, respectively), correlation of **BMI** and **M-BMI** (r).*

	Male students				
	N	**M**	**Min**	**Max**	**SD**
BMI	210	22.28	16.82	34.33	3.32
M-BMI	212	22.83	16.70	36.63	3.90
r = 0.92					

	Female students				
	N	**M**	**Min**	**Max**	**SD**
BMI	724	20.60	14.53	32.65	2.62
M - BMI	724	21.75	15.59	40.08	3.51
r = 0.90					

The differences in self reported and measured height and weight could be the result of measurement error, wrong believes or misperception, but can also be the result of deliberate cheating. There is a possibility that the greatest differences are made intentionally, perhaps showing wished height, and particularly weight. Nevertheless, correlations of BMI and M-BMI are high in both samples, showing that ranks of BMI and M-BMI results do not differ to a great extent.

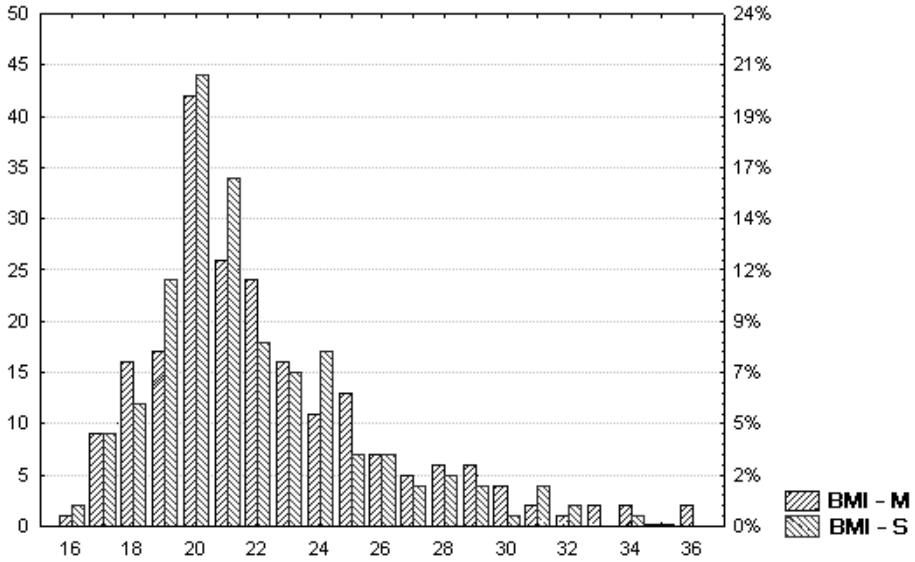

Figure 1. Distribution of measured (BMI – M) and self reported (BMI – S) values of body mass index in male students.

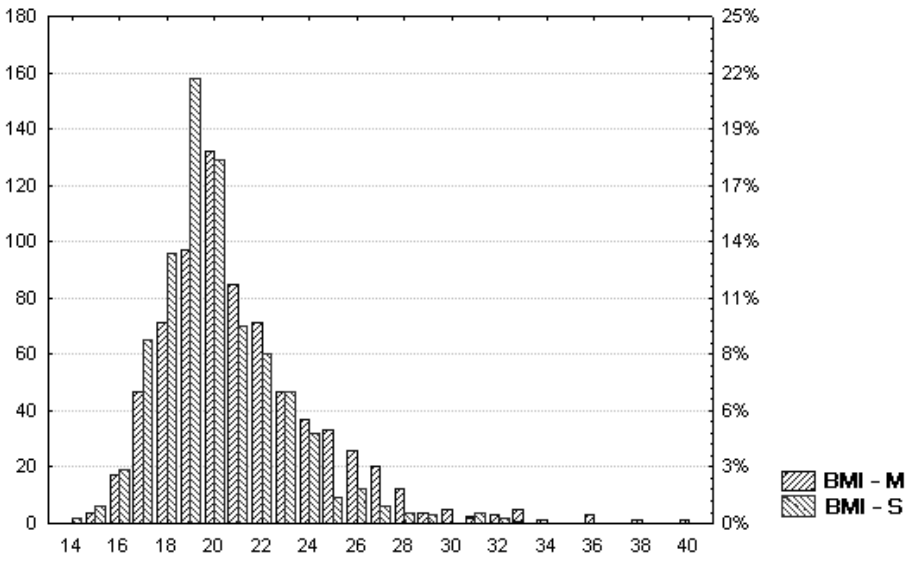

Figure 2. Distribution of measured (BMI – M) and self reported (BMI – S) values of body mass index in female students.

Conclusion

The results indicate that self reported height and weight in Croatian adolescents are accurate enough to be used in correlational analyses. However, self reports are not so appropriate as measured results to calculate BMI in epidemiologic studies, giving lower proportions of male and female subjects with overweight and obesity.

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THE PROPOSAL OF NEW GRADING SYSTEM OF GOALKEEPER'S EFFICIENCY IN HANDBALL

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Abstract

The goal of this research was to establish new system of grading the efficiency of goalkeepers based on their saves from the different positions of scoring goals. The data from 175 games from last four handball European championships for men were the bases for calculating coefficient of significance for each individual save. Special methodology based on calculating parameters gained from the final statistics was used for calculating coefficient. Each game was observed by official and trained statisticians of EHF, and six variables were observed for situational efficiency of goalkeepers: 6m save (O6M), 7m save (O7M), 9m save (O9M), wing save (OKR), fastbreak save (OKN) and breakthrough save (OPR). At the end, the results of goalkeeper's efficiency were compared combining previous methods with the proposed new method. This model of grading should contribute a lot in tactical preparation of goalkeepers for the game, and in more precisely differentiate the quality of each goalkeeper, and evaluate the total efficiency at the end of the game.

Key words: *handball, goalkeepers saves, coefficients of significance, European championships, situational parameters*

Introduction

Handball is a game in which continuous movement with and without changing direction together with fast and sharp dashes, high jumps, all kinds of landings and duels in contact with opponents is characteristic for player's activity. Since handball belongs to polystructural activities which are characteristic for their quick alteration of cyclic and acyclic movement, the analysis carried out just before, during and after the match demands a lot of time and effort. Following the game and conducting statistics makes it able to come to the indicator of situational efficiency of the course of the game. Every handball game gives us a lot of possibilities for observation many data suitable for interpretation. The research of parameters of situational efficiency in a handball game should enable forecasting and predicting the final result of a handball game.

Statistical observation of efficiency and of individual players and teams was introduced in handball later then in other sports. Available research of different aspects of players efficiency in handball can be divided in three groups (Vuleta et al., 2003). The first group of research are works that were on descriptive level analyzing frequencies, and how often different events happen, and the quality of performing different technical-tactical elements of scoring goals (Vuleta and Šimenc, 1989, Šimenc et al., 1996). Second important direction of research in handball is establishing differences between handball teams that are grouped according to different criteria (Brčić et al., 1997). Third direction in handball is connected with determining influences of different situational parameters on the final outcomes of matches (Rogulj, 2000; Srhoj et al., 2001; Vuleta et al. 2005; Gruić et al. 2005).

The main goal of this research is to determine new grading system of goalkeepers based on their saves from different positions. Until now, by observing handball games, there were mostly two simple accepted grading systems. The first system of evaluating regarded the total number of saves during the game (e.g. the goalkeeper finished the game with 12 saves). The second system also regarded the number of shots, so the final efficiency was shown in the percentage (e.g. goalkeeper had 9/36 or 25 % of saves). At the proposed grading system each of six different saves will have different coefficient of significance. As other situational parameters are not equally important for the final outcomes of match, with goalkeepers there should also be the difference between 7m penalty save and 9m save.

Methods

Sample of entities

Sample of entities makes 175 games from four last European championships (30 games from EC in Croatia, 50 games from EC in Sweden, 48 games from EC in Slovenia, 47 games from EC in Switzerland). All the games represent the official statistics of EHF, and the data was collected by qualified observers on each championship.

The sample of variables

The sample of variables includes six standard parameters of situational efficiency on which basis the goalkeepers were graded.

1. 6M SAVE - O6M

This variable includes all shots at the goal from 6m line that were made mostly by pivots, but also by the players who entered on the position as second pivot.

2. 7M SAVE - O7M

This variable includes saves from 7m, from penalty shot. At those shots the ball is thrown without obstruction from opponent players who are at the distance of at least 3m. This shot is performed by the players from different positions who are specialized, mostly two or three players in each team.

3. 9M SAVE - 9OM

The 9m saves are usually the easiest for the goalkeepers because the shots are made from the big distance, so the goalkeeper has more time to react, and the attackers have defence players in front of them who are trying to obstruct them more or less. The ball can be thrown from the position of the left, middle or right backcourt attackers. In this case synchronized action of goalkeeper and defence is very important because usually the goalkeeper covers one side and the players the other side of the goal.

4. WING SAVE - OKR

Shots from the wing position are made from left and right side of the field, from the area closed by base, side and 6m line. The attacker is trying to gain as bigger angle of entrance towards the goal as possible, so he would get in the good position for the shot, while defence player is trying to make that angle as smaller as possible, to make it easier for the goalkeeper to defend the goal.

5. BREAKTHROUGH SAVE - OPR

Breakthrough can be defined as dribbling of the defence player, with the aim of wining the space and acquiring as better position for shooting at the goal as possible. Passing through of players as consequence of good and fast passing of all players, usually when a team has one extra player, is also considered to be breakthrough. The shots are thrown from a close range, and penalty shot is given for most unrealized shots, because the attacker was in foul while he was throwing the ball.

6. FAST BREAK SAVE - OKN

Fast break is performed by one or more players, with no defender in zone that is not set, the shots are usually preformed by jump shot, from the distance of 4 to 5 m from the goal line. Save of these kind of shots is very difficult, and very often after a few saves for scoring goal the emotions and the motivation of the goalkeeper, but also the whole team is risen.

Methods of data processing

For grading the efficiency of goalkeepers in handball we use specially prepared methodology. It consisits of several steps:

1. In table 1 are results that show percentage of goalkeeper's saves from a certain point of shots. The percentage is calculated based on saves by all goalkeepers and on shots by all players, that are noted in all games in championship. These data are a part of an official EHF statistics, which follows every game.

Table 1. The final statisctics of variables of goalkeeper's saves from different positions from previous 4 EC

	BR.UT	O6M	OKR	O9M	O7M	OKN	OPR
CRO	30	22%	40%	45%	24%	19%	17%
SWE	50	30%	37%	46%	26%	19%	16%
SLO	48	22%	39%	46%	22%	21%	16%
SUI	47	20%	38%	44%	23%	20%	18%
x		23,5%	38,5%	45,3%	23,8%	19,8%	16,8%
1- x		0, 765	0, 615	0, 547	0, 762	0,802	0,832

2. Determening the arithmetic mean of each individual variable (table 1, row 6). As we can see the results in individual variables are very close and the dispersion is not too big. The only result that stands out a bit from the arithmetic mean is data 30% 6m saves on EC in Sweden.

3. Introducing constant 1 so we can substract arithmetic mean of each individual variable and by reverse scaling gain the coefficient of significance for each individual variable (table 1, row 7). In that way we get the highest values of coefficient at variable OPR= 0.832, while at variable O9M the coefficient is 0.547, which is understandable.

Eg. 1 – 0. 235 = 0. 765

4. The total efficiency of goalkeeper would be calculated in a way that the number of saves from each position is multyplied with its coefficient of significance. Formula would be the following:

E= nO9M*0.547 + nOKR*0.615 + nO7M*0.762 + nO6M*0.765 + nOKN*0.802 + nOPR*0.832

5. If we want to get the relative efficiency of each individual goalkeeper then the value (E) should be divided by the minutes in the game shown in hours (h= 60 min). The time (T) is shown in hours becuse one hanball game lasts for 60 minutes, or one hour.

E r = E/t(h)

Results and discussion

On the example of European championship in Croatia in 2000 which took part in Zagreb and Rijeka we will use the proposed model, and compare it with the way situational efficiency of goalkeepers was valued until now. The system of competition in this championship was that preliminary rounds were played in two groups with six teams, round robin system. Two best teams from each group were playing in the semi final, and others were played for 5.-12. place. In table 2 we have final statistics of 12 goalkeepers, one from each team (the one that played more minutes) after playing in groups.

The data shown in the table 2 give us the situational parameters of each analyzed goalkeeper: **UO**-total number of saves, **UU**- total number of games in which he played, %- percentage of successfulness, which is gained as a ratio of goalkeepers saves and shot, Min. (h) - brutto time spend in the game, that is shown in minutes, or hours, **Urel**- the average number of saves in one game that we get with the equation **UO/h**.

The first kind of grading that has been accepted in the official statistics for some time now regards the total of saves in one game **(UO)**. According to down mentioned statistics first place goes to the goalkeeper of Spain with 95 defences, second place to the goalkeeper of Russia with 47 defences, and the third place to the goalkeeper of Sweden with 45 defences. Croatian goalkeeper is at the eighth place with 31 defences. But the fact that is very often ignored and not taken into account is active time in the game. If one goalkeeper is at his team's goal during the whole game, then there is no need for calculating this equation. But almost always, a coach introduces the second goalkeeper, especially if it is a tournament or a championship in which the qualification round demands a goalkeeper who is in better shape.

In table 2 you can see there is not a goalkeeper who stays on the goal for 300 minutes in five games, on average four goalkeepers played more then three games, while the values of other goalkeepers are around 2,5, what means that both goalkeepers were participating in the game equally. H.G., the goalkeeper form national team of Iceland spent the most time in the game, 226 minutes, while Croatian goalkeeper L.V. spent the least time in the game, 147 minutes. If we calculate the average number of saves per game **Urel**, then we can see that that the situation in the order has quite changed. First place with 18 defences per game goes to the goalkeeper of Sweden S.T., second place goes to B.B., with 15, 94. The biggest

progress made the German goalkeeper H.J. who went from 7th to 4th place, with the average of 13, 67. Last two places go to the goalkeepers of Portugal and Ukraine, with the average number of defences per game under 8.

The second kind of grading the efficiency of goalkeepers, which is used quite often lately, is the percentage of saves (%), or the ratio between the defences and shots thrown. This method gives us more information then the first one, because it regards the relationship between defences, and the thrown shots, so time spent in the game is not so important. In this case, the order of goalkeepers is different. The first place goes to S.T. with 45 defences of 99 thrown shots, or 45.45 %, the second place goes to M.B., the goalkeeper of France with 42 defences of 99 thrown shots or 42.42 % while the third place goes to B.B., who holds the first place in the first method, with 40, 69 %. Croatian goalkeeper L.V. is in the high 5th place with 35, 63 %.

Table 2. Situational parameters of goalkeepers efficiency on EC 2000 in Croatia

GOALKEEPERS	Rep.	UO	UU	%	Min. (h)	Urel
B. B.	ESP	59	5	40.69	222(3,7)	15,94
L. A.	RUS	47	5	33.81	208(3,5)	13,42
S. T.	SWE	45	4	45.45	150(2,5)	18,00
M. B.	FRA	42	5	42.42	159(2,65)	15,84
H. G.	ISL	41	5	29.50	226(3,76)	10,90
A. S.	DEN	35	5	32.71	163(2,71)	12,91
H. J.	GER	35	4	37.23	154(2,56)	13,67
L. V.	CRO	31	4	35.63	147(2,45)	12,65
S. F.	NOR	30	5	34.88	159(2,65)	11,32
P. R.	SLO	28	5	27.72	173(2,88)	9,72
M. P.	POR	26	5	22.03	213(3,55)	7,32
B. Y.	UKR	20	4	25.97	155(2,58)	7,75

Table 3 gives us detailed analisys of each goalkeeper. We have the right number of saves according to every variable, or the position of shot. Goalkeeper B.B. has the highest number of saves from the distance of 9m (31), and from wings shots(16). In breakthrough save (OPR) none of the goelakeeper stand out, most of them have one or two saves. One of the reasons for such low number of saves is that the refreee after the goalkeepers save usually gives 7m penalty because of the contact between players. The most saves from fastbreak (OKN) has goalkeeper S.K., the total of seven. The goalkeeper who is the best at „figuring out" penalties is M.B. with seven saves, while goalkeepers S.T. and H.J. were the most efficient from the line of 6m, with 7 saves.

When we put all those saves in the equasion that we proposed, and multiply with its coefficients of significance raeched for each variable individually, we get the final calcualtion in apsolute (NM) and relative (NMrel) value. In the apsolute sum the best goalkeeper was B.B. with the coefficient of 36,16, while in relative sum two goalkeepers have higher values then him, S.T. with 11,83 and M.B. with 10,07

*Table 3. **Saves** of goalkeepers from different positions and coefficients of the new method (NM, NMrel)*

GOALKEEPERS	O7M	O6M	OKR	OPR	O9M	OKN	NM	NMrel
B. B.	2	6	16	2	31	2	36.16	9.77
L. A.	5	3	8	1	25	5	29.52	8.43
S. T.	4	7	8	1	18	7	29.58	11.83
M. B.	7	4	4	2	23	2	26.69	10.07
H. G.	3	6	10	2	15	5	26.88	7.14
A. S.	2	2	7	1	22	1	21.01	7.75
H. J.	1	7	4	0	20	3	21.91	8.55
L. V.	4	3	9	0	12	3	19.82	8.08
S. F.	2	2	3	1	22	0	17.75	6.69
P. R.	2	4	10	1	9	2	18.08	6.27
M. P.	3	2	5	0	13	3	16.4	4.61
B. Y.	0	3	3	2	12	0	12.35	4.78

Conclusion

Considering the former analysis of handball games and former ways of grading, the proposed model has some advantages. In the new model a lot of attention goes to differentiating goalkeepers saves from different positions of scoring goals, because the author of this work thinks that each of these saves has different difficulty and coefficient of significance. In this work the equation is given, on which basis the saves can be summed and given in absolute and relative value. Using this method should eliminate the dilemma at the end of the game and championship about what goalkeeper was more successful, or who is the best goalkeeper of the tournament. With this work different indicators of situational efficiency of goalkeepers were established, we compared different methods of grading, and established a new method in further research to be worked at and improved, as well as the all the situational space of play of goalkeepers in handball, which is not made just by saves, but also by other situational parameters (steals, technical faults, assists, exclusions....).

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MEASURING CHARACTERISTICS OF AGILITY ASSESSMENT TESTS

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Abstract

The main goal of this reasearch is to create and validate an agility assessment measuring instrument, that is, determinig metric charactersitics of the newly created measuring instrument, frontal, lateral and backward movement. The reasearch was conducted on a sample of twenty-seven basketball players, aged twenty to twenty-five. The test proved to be precise while determining their physical agility abilities, responsible for them being able to quickly change their direction of movement – an essential feature of basketball. The game consists of moving your body quickly and efficiently, conditioned by sudden stops and changes of their direction of movement.

Key words: *basketball, testing, physical ability, change of direction of movement, result*

Introduction

Most half-structural and comlex sports contain, within their structure, a sudden change of direction in movement. These specifics movements, measured with precise tests of physical ability, can be a good indicator of the athletes abilities in complex and half-structural sports. They can also provide feedback about the athlete's current state of readiness. For this research I decided to create a test which would estimate the first factor of agility (agility in carrying out various excercises of sudden change in the direction of movement in small spaces). That is why a new agility test was constructed, of frontal, lateral and backward movement, which can be an accurate indicator of specific physical condition of basketball players.

Methods

The subjects used for this research were randomly chosen from a group of basketball players. The sample consisted of twenty-seven basketball players, aged twenty to twenty-five, who still compete, practice and train for the national basketball league. The measuring was carried out in four intervals, during the players' morning practice at the gym, from 10 am to 12 pm. The MAGKRIŽ test was measured 3 times, and each measuring represented a fragment of the measuring instrument, and each fragment was measured on a different day. The programme Statistica 5.0 was used to process the data. The programme's modules were also used to calculate the basic statistical parametres – the arithmetic middle, standard deviation, minimum, maximum and skewness. The distribution of the variables was tested with the Kolmogorov-Smirnovljev test. The RTT programme was used to determine metric characteristics. In order to determine the validity of the measuring instrument, factor analysis, a matrix of intercorrelation and the Sperman-Brownov coefficient were used.

Variables

Along with the newly constructed measuring instrument, the subjects were tested with other standardized tests, which help while determining the metric characteristics of the MAGKRIŽ test. The sample of variables consist of: MAGKUS – side steps, MAGNN - running backwards and forwards, MAGKUSN - moving by stepping to the side, backwards, to the side, backwards.

MAGKRIŽ test

The athletes task is to, upon hearing the start signal, frontally move forward (1), after which he moves to the right by stepping sideways (2) to a marked point, followed by returning to the middle of the cross by stepping sideways (3), then frontally moving forward (4) also to a marked point, after which he returns backwards (5) to the middle of the cross and starts moving left by stepping sideways (6) and returning (7) to the middle of the cross, finally followed by the last task of moving backwards (8). Each movement is 4 metres long, and the goal is to complete each movement as quickly as possible. The result is timed in seconds.

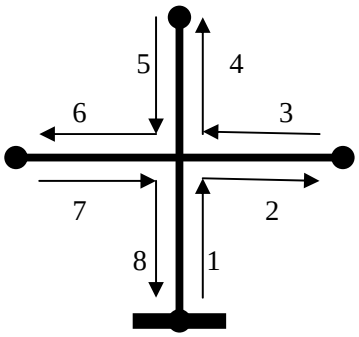

Figure1. Layout of the MAGKRIZ test

Results

Table 1. Descriptive statistics of MAGKRIZ test

	Valid N	Mean	Minimun	Maximum	Range	Std.Dev	Skewness	Kurtosis
MAGKRIZ_1	27	9.92	8.90	11.15	2.25	0.65	0.22	-0,98
MAGKRIZ_2	27	9.47	8.02	10.77	2.75	0.76	-0.11	-0.72
MAGKRIZ_3	27	9.22	7.92	10.59	2.67	0.80	-0.11	-0.95

Legend: MAGKRIZ1-first measurement, MAGKRIZ2-second measurement, MAGKRIZ3-third measurement

Table 2. Results of Kolmogor-Smirnov test

K-S	d=,05814

The Kolmogor-Smirnov test of normality distribution showed that the monitored actions do not vary from the usual, so it can be said that the measuring instrument satisfies the demand of sensitivity, that is has the ability to differentiate entities according to their measured abilities.

Reliability

Table 3. Matrix of intercorrelation of MAGKRIZ test

	MAGKRIZ_1	MAGKRIZ_2	MAGKRIZ_3	
MAGKRIZ_1	1,00	0,89	0,88	
MAGKRIZ_2	0,89	1,00	0,94	
MAGKRIZ_3	0,88	0,94	1,00	**Σr**
Σr	2,77	2,83	2,82	8,43

Legend: MAGKRIZ1-first measurement, MAGKRIZ2-second measurement, MAGKRIZ3-third measurement

SB reliability coefficient

$$\alpha_{SB} = \frac{m}{m-1}\left(1-\frac{m}{\sum\sum r}\right) = \frac{3}{3-1}\left(1-\frac{3}{8,43}\right) = 0,9661921$$

Based on the matrix of correlation of fragments, the metric characterstics of the MAGKRIZ test (table 4.) were determined with the help of a classic model of measuring with an RTT algorithm.

*Table 4. Metric charactersitics of the newly created measuring instrument (**MAGKRIZ**)*

RTT	0.965457
Alpha	0.965507
Alpha1	0.414313
Alpha2	0.87303
Lamda6	0.956953
Rho1	0.915759
Rho2	0.998147
Tau	0.913329
MSA	0.995857
AVR	0.903068
Hom1	0.984822

Table 5. Metrix of correlation for the MAGKRIZ, MAGKUSN, MAGKUS and MAGNN test

	MAGKIZ	**MAGKUSN**	**KUS**	**MAGNN**
MAGKRIZ	1.00	**0.47**	**0.39**	**0.53**
MAGKUSN	**0.47**	1.00	**0.36**	0.21
MAGKUS	**0.39**	**0.36**	1.00	**0.39**
MAGNN	**0.53**	0.21	**0.39**	1.00

Table 6. Guttman-Keiser criteria of MAGKRIZ test

Extraction: Principal components				
	Eigenval	% total Variance	Cumul. Eigenval	Cumul. %
1	2,405112	60,12779	2,405112	60,12779

Table 7. Scale of the factor validity for the MAGKRIZ, MAGKUSN, MAGKUS and MAGNN test

	Factor 1
MAGKRIZ	0.830690
MAGKUSN	0.677354
MAGKUS	0.714250
MAGNN	0.727160
Expl.Var	2.187769
Prp.Totl	0.546942

Discussion

The basic descriptive fragment parametres of the new test, as well as the fragment average, are shown in table 1. The average skewness value in the MAGKRIZ test fragments speak about the irrelevant deviation from the normal distribution. The value of the kurtosis also speaks about the irrelevant deviation from the normal distribution. The normality of distribution test showed that the measuring instrument can differentiate entities according to their measured abilities. It is clear, based on the given data of fragment intercorrelation, that all fragments are in high correlation. Table 4. shows that the values of the RTT, the Kaiser Cafrey Alphe and Lambde6 test are high. It is only visible in the Lambde6 test results that the values are somewhat lower than in the RTT and Alpha tests. However, it is nevertheless very high and it can be said that the MAGKRIZ test is realiable. An important main component was revealed by using the Guttman-Keiseroav criteria ($\lambda \geq 1$) (Table 6). The main component can be interpreted as a latent dimension – agility. The scale of the factor validity shown in table 7. proves that the newly constructed test is in high correlation with the first major component which represents a good factor validity of the test. I therefore conclude that the newly created MAGKRIZ test measures agility.

Conclusion

I decided, for the purposes of this reasearch, to create a new test which would measure agility (agility in conducting various changes of directions in movement in confided spaces). Therefore, a new agility test was constructed, consisting of frontal, lateral and backward movement (MAGKRIZ). Based on the obtained results we can conclude that the MAGKRIZ test is reliable, stable, homogeneous, sensitive and factor-accurate, and that it can measure physical agility abilities. Not only can this newly constructed test be a good indicator when measuring agility, it can also function as a way for coaches to get feedback about the physical abilities of athletes.

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QUANTITATIVE AND QUALITATIVE TRANSFORMATION OF MORPHOLOGICAL ATTRIBUTES AND MOTOR ABILITIES IN ADDITIONAL CLASSES

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Abstract

The subjects of this research are morphological characteristics and motor abilities of Techical High Scool students from Zenica, aged 14-16 years, who are included in additional classes (afterschool activities) and are members of Leaque of Scouts organisation in Bosnia and Herzegovina, in order to establish the levels of motorical characteristics and their mutual linkage, a result of precisely defined schedule of action. The goal has consisted in the tendency to ascertain the transformations of morphological characteristics and motor abilities of the students, using a method of paralel data analysis of the experimental group samples in relation to the monitored group, and also to ascertain which of the given models of class conducting offers the most efficient results of transformation in morphological sense and in the area of motor abilities.

Key words: *transformation, additional program, afterschool activities*

Introduction

The century we live in has started with the revolution of computer science, characterized by quick and large data flow (which is a positive thing for information transfer), by high industrial level of technical progress and automation, but the result we received has had as a consequence a reduced physical activity and reduced health care. Anthropology is the foundation for almost all research done in kinesiology, specially the segment concerning structure defining and development of some of its integral space, as well as their mutual relations. Human organism, since its birth until its end, throughout all the years of existing and living, is influenced by many inner and outer factors which are jointly or in coherence with the factors of genetics determining all biological features. Every human being with all its complexity is a unique natural experiment, and it is completely clear and logical that all of us are amongst ourselves different. Modeling of the education unit as the fourth segment of theme planning has as its basic term to supply and secure the proper courses of action, with special emphasis on utility, more so when observing the results of initial state. Better and quicker enforcement of the transformational process, especially the creation of a well-devised plan and program in composing the educational units, understands and secures a more versatile influence of physical training on student's organism. (Malacko and sar.1997.). Complex contents of physical and health education can only be successfully accomplished if we see in advance, or precisely, plan in advance what to do in a longer time period and how to do it. This means that we need to predict, as is expected from us after all, in advance how and in what way during a scheduled time period to accomplish the realization of educational work with students. The basic starting point in planning represents the defining of goals and tasks which will be realized in the course of a predicted time period. (Talović i sar. 2003.).

The goal

In this research the testing of concrete goal was done-ascertaining the transformations of morphological characteristics and motor abilities of Technical High School students in Zenica who are included in additional classes (afterschool activities), with specially defined action schedule, as well as the relation of two anthropological systems, the first anthropological system-assembly of morphological variables and the second anthropological system-assembly of motor variables.

Method of work

Sample of examinees: the research includes 260 examinees, students of Technical High School in Zenica, male gender, age between 14 and 16 years, unselectioned and divided into two numerically equal groups, experimental and monitored, all citizens and residents of Bosnia and Herzegovina, clinically and emotionally healthy, without expressed morphological or locomotor defects.

Monitored group operated according to the plan and program designed for high schools, for two school hours weekly. Experimental group operated according to existing plan and program for high schools, for the usual two school hours

weekly, and additionally for two more hours weekly (one times two school hours), also according to scheduled program of school sections (athletics, handball, basketball, volleyball, football), during the preparatory part of additional classes and specially selected body-shaping exercises, under the supervision of professor of physical and health education.

Experimental group carried out its classes in accordance to The Plan and Program of specific sport branch (athletics, handball, basketball, volleyball, and football) and was additionally "burdened" by a set of exercises for body preservation and for proper body posture, that were divided into three groups, 18 exercises per class, with frequency of 10 repetitions. Experimental group also had a one-day excursion once a month to Smetovi excursion site, excursion that included about 16 kilometers of walking (departure and return).

Method of data analysis

The effects of quantitative changes were analyzed in accordance with standard DIFFG and SSDIF multi-versioned changes in two states.. (Bonacin 2004). To these analyses factor structures were added in order to use the preservation of examinees' latent dimensions under the influence of transformational treatment. Structural changes were analyzed according to advanced LSDIF model, according to KARZANOWSKI'S model and SCHONEMAN'S model of multi-versioned structural changes in two states (Bonacin, 2004). The analyses of variance were added to these analyses in order to compare the changes on certain applied variables under the influence of transformational system.

Results

Motor abilities greatly develop under the influence of those anthropological factors which determine the subject's position in the subsystem. Favorable position in these subsystems has a very strong influence on the development of complex motor abilities, while only those motor abilities, which demand weak intervention of cortical processes, become independent from subject's status features and can be developed in great measure under the influence of their own activity. The choice of examinees sample, is without a doubt a fundamental problem of every research worker in kinesiology researches. First of all, attention should be directed at development processes which can have very different effects in structure analyses of different anthropological spaces. When one is ascertaining the latent structure of any subspace with the possibility to maximize the generalization of obtained results, the research is conducted with the entities which are in approximate, stationary phase of analyzed development of dimensions. If a certain group of entities, which are in their stationary phase of development, are encompassed only by one criteria, that does not represent a specific problem which would justify the research worker. An objective difficulty represents the population definition from which a representative sample of entities needs to be drawn out for a research that treats two or more anthropological spaces in with the stationary phases of development are in different age categories needs to be drawn out.

Factor structures as the global changes

The factor structure of analyzed space, the Promax structure in initial surveying, is always one of the key things for treatment effects' understanding, because provoked changes also reflect on the position and the structure of latent dimensions. Latent dimensions in this project were acquired as main components, and were rotated in varimax and primax position. As can be seen from table 1, five latent dimensions were isolated in initial surveying, the ones that are easy to identify. The first one dominantly represents bone growth longwise namely the longitude of the skeleton. The second latent dimension describes solely skin folds, namely fat tissue. The third latent dimension describes frequency and explosiveness namely excitability (stimulation). The fourth latent dimension represents a complex composite of coordination precision and flexibility. The fifth one is also an unusual combination of flexibility, frequency and precision. On the basis of factor correlation it can be seen that even among latent dimensions the connections are very weak, with barely a few being significant, and those are relatively low themselves. This means that morphological-motor structure in its initial surveying was relatively divergent and incoherent. The reasons for this could be found in former way of work which the examinees underwent, that probably favored the an isolated, disintegral development of certain abilities or characteristics, or even certain action types, which were extracted out of content's general context and which were overly differentiated. Evident changes occurred in the final survey, changes that can be recognized at two levels. The first level relates to latent dimension's configuration, so now the first factor can be recognized as fat tissue, which is identical to the second factor's situation in initial surveying and there is no special global changes there. There are also no specificities regarding the other factor, namely the longitudinal bone growth which represented the first factor in the first survey. Finally, there is volume as the fifth factor. It can be concluded that there are only three morphological dimensions in this case. However, the final survey, in table 2, brought a considerably more qualified and simpler structure in which two types of motor steerage are recognized. One type is described by the third factor and contains an almost complete motor set of variables. In this model coordination is obviously dominant, but other projections are visible as well. It is also visible that explosiveness holds an important contribution to this dimension, so it can be said that this is in most part a controlled energy. The remained latent dimension (fourth) also describes steerage by movement, all from the position of information canals' fluidity (frequencies) and the engagement of muscle units, so it can be claimed that stimulation

of locomotor structures is the case here. The relations between the described factors are now much more expressed than before, in initial survey, which means that important reconstruction of latent dimensions has occurred in such a way, that after the treatment the dimensions were integrated into unique assembly, which would generally create more efficient movements and also help in realization of kinesiology or sport. All the relations are more or less the same class size and they reflect a stable and homogenous latent space which wasn't the case in initial survey and that is the second important level on which the changes can be noticed. Since the case in point is a total asset of 260 entities, it can be stated that in a whole sample a significant, recognizable and welcomed results were achieved. This also means that both treatments were efficient, because if a different situation were obtained, then this research would hardly make sense, because it wouldn't be able to withstand the first check, the case where both effect are cumulatively positive. After all, we are talking about the same population and entities which will co-exist in real common conditions in the future day. Differential usage with separate samples in quantitative and structural sense will show which treatment is eventually better and in what way. The results in table 3, DIFFG analysis of quantitative changes, show the amount of change on the first main component of treatment differences. As it can be seen, the changes are statisticly important. To these changes on the first component the most contributive are frequency, coordination and explosiveness. This means that the character of importance in latent dimensions has changed, especially some basic latent dimensions from which all other manifestations depend on, but her content as well. Some important changes have occurred, most probably caused by combination of growth and development, at the same time bolstered by physical and health education classes, but also by some other sport activities. According to indicators in table 4, SSDIF analysis of quantitative changes, the quantitative global changes are undoubtedly significant and they are stretching across the entire spectrum of analyzed samples and examinees. The number of variables which contribute to those quantitative changes is bigger, but contributions of certain variables to discriminative function are rather small. This means that the global effects were provoked indeed, but rather mellow ones, the ones without dramatic changes and all the variables positively participate in them (fat tissue has a negative mark, which signifies reduction. The results in table 5 show that the changes occurred in five global directions. First and the most important direction describes the complete motor space, which is extremely useful information, because it addresses the fact that system work brings about the full optimization of the movement's steering composite. What is interesting is the fact that this is the only direction in which the motor changes developed. All the rest of the changes, described with the remaining four promax factors of differences, are morphological. It can be seen that morphological mechanisms acted in four directions: change (reduction) of fat tissue, longitude, total body weight and volume. It is obvious that the optimization of energy disposal has occurred, even by incorporating resources into biological-morphological composite, which is important information as well, because the subjects are high school students, whose biological manifestations are still forming. The described effects show that system work can accomplish many useful effects which are then left to students as a capital for their further developmental phases in life. Separate analyses have yet to show which treatment will show better effects and in what measure.

Analyses of global structural (qualitative) changes

It is well-known that structural (qualitative) changes describe the differences originated as a consequence of the influence the processes had over the entity's features, because of which relations between variables are manifested in a different way by comparison with the initial state. LSDIF analysis, is testing the hypothesis that in two different spots some process has influenced the changes of relations or in this case, the correlation of variables. As it can be seen, such difference undoubtedly exists, because the trace function (which has a hi-quadrant distribution) is immensely high (6505.56), so the probability is also doubtless (0.0000). So, significant structural changes have occurred under the influence of the treatment. The changes in accordance to Krzanowsky' model, show that the similarities of two conditions are very small and that qualitative effects can be registered over the entire set of variables. Therefore, many effects have occurred under the influence of this treatment, but the structural remain the most important, because they are responsible for different configuration of correlations, that is, the relations of variables.

As it seems, the biggest changes happened to variables for fat tissue estimate, which isn't a surprise since any serious treatment is directly reflected on fat masses reduction. This is also the case with variables for frequency estimate. Maybe in this case it can be stated that frequency, as ability, is better adjusted and integrated into general morphological-motor composite and thus greatly contributes to the movement's efficiency, before any dramatic shift occurs in the frequency itself. Finally, bigger structural changes are visible in the same way with explosiveness. However, it should be noted that a whole row of variables is significantly caught.

Analyses of differential effects treatment

According to the results, it is obvious that the quantitative changes have been accomplished over the entire set of variables, but those changes have small intensity and they move in range from 0.17 to 0.35. this position tells us that quantitative shifts in the experimental group are not especially expressed, at least not in the sense of individual variables. However, the test of significance of Mahalabis' distance shows that these effects are statisticly important, and individual

projections of variables onto the discriminative function are getting distinguishable a 95%, which favorably speaks to the fact that the transformational process caused multiple and equable, mild quantitative changes to the experimental group. Like the experimental group, the monitored group also notes significant multi-versioned quantitative changes. These changes, of course, are globally weaker in intensity, but individual variables have shown stronger intensity. This is especially the case for a larger number of morphological variables which define longitude, mass and body volume. This fact alone points to the conclusion the monitored program extracted the weaker effects, because in the structure of quantitative shifts those parameters that can register in growth anyway are dominant, in spite of the influence of the special transformational process. This fact is confirmed by the position of fat folds, which possesses considerably lower intensity and are almost insignificant in the structure of quantitative changes. The reasons for this should be looked for in lesser total volume of action and intensity in the classes of physical and health education, in comparasing to the experimental group which has had an extra engagement. Enhanced effect on frequency, flexibility and explosiveness can be recognized as well, with which the positive effect of school classes are encompassed.

Generally, according to the results, the positive influence of physical and health education classes cannot be opposed, regardless the fact that the effects were weak in the experimental group. They are still significant and they spread throughout a fine portion of variables chosen to track effects. Maybe one part of the answer to this question lays in the fact that during the week the monitored group's examinees were engaged in sport activities (games, football, basketball, walking, cycling, swimming, etc...), so they partly compensated the expected bigger difference in relation to the experimental group. It seems that it is not possible to unilaterally declare the action done regular classes of physical education less efficient, just like it is not possible to declare a model of action with the experimental group more efficient. Still, for final conclusions, a lot more detailed analysis of plan and program's structure should be done, and very precise and controlled treatments should be undertaken, and evaluate their global and differential differences in the space of quantitative achievement should be done in a very high methodological level.

The remaining changes /structural changes/

Experimental group

On the foundation of table 11's result, it is easy to conclude how the structural changes occurred trough literally all the variables, so the similarities after two surveys are minor. So, it is for sure that the changes and effects should be observed in the sense of the change in the structure dimensions, which the experimental program induced. This situation is confirmed also by LSDIF analyses. As it can be seen, truly significant and serious structural changes have occurred.

Monitored group

The indicators of structural changes in monitored group, clearly identify also an entire set of variables as potentially important in understanding the structural changes so the similarities after two surveys are minor. Therefore, the changes and effects in monitored group need to be observed strictly in the sense of changes in the structure of dimensions, whicht the experimental program induced. This situation is confirmed by LSDIF analysis. As it can be seen, truly significant and serious structural changes have occurred.

Conclusion

The monitored group, by an analysis of differential treatment's effects, notes multi-versioned quantitative changes although they are globally weaker in intensity, but certain variables have shown bigger intensity. This is especially true for the large number of morphological variables which define longitude, mass and body volume. This refers to the conclusion that the monitored program resulted in weaker effects, because in the structure of quantitative shifts those parameters that can register in growth anyway are dominant, regardless of the programs influence. This fact is confirmed by the position of fat folds, which possesses considerably lower intensity and are almost insignificant in the structure of quantitative changes. The reasons for this should be looked in lesser total volume of action and intensity in the classes of physical and health education, in comparasment to the experimental group which has had an extra engagement. The positive influence of physical and health education classes cannot be opposed, regardless the fact that the effects were weak. They are still significant and they spread throughout a fine portion of variables chosen to track effects. **DIFFG** analysis of quantitative changes shows statisticly important change on the first main component of treatment differences. To these changes the most contributive are frequency, coordination and explosiveness. The character of importance in latent dimensions has changed, especially some basic latent dimensions from which all other manifestations depend on, but her content as well. The gained changes were most probably caused by combination of growth and development bolstered by physical and health education classes, but also by some other sport activities. The results of **SSDIF** analysis of quantitative changes have confirmed that the global changes are undoubtedly significant and that they spread over the entire spectrum of analyzed samples and examinees. Since the number of variables that contribute to quantitative changes are larger, and the number of variables that contribute to discriminative function are very small, we can rightly claim

that global effect were induced, in which almost all the variables participate. The quantitative changes occurred in five global directions. First and the most important direction describes the complete motor space and this useful information addresses the fact that system work brings about the full optimization of the movement's steering composite. All the rest of the changes, described with the remaining four promax factors of differences, are morphological, and here we can see that morphological mechanisms acted in four directions: reduction of fat tissue, longitude of skeleton, total body weight and volume. It is obvious that the optimization of the energy disposal has occurred and also the embedding of resources into biological-morphological composite. This is important information, because the subjects are high school students, whose biological manifestations are still forming, and the described effects show that system work can accomplish many useful effects which are then left to students as a capital for their further developmental phases in life. Separate analyses have yet to show which treatment will show better effects and in what measure. Both groups of students included in their exercise program a certain part of common program, non-differentiated in the moments of school break, when they weren't under the supervision of scholastic or experimental treatment and it worked in the sense of effect equalizing. The indicator of individual shifts in experimental and monitored group clearly shows that the experimental program was aspiring to cause a more intensive change because the coefficient of translation and the coefficient of dilatation as well are stronger in intensity. It can basicly be concluded that the monitored program was bolstering growth and development of examinees in a way that they mainly kept the same continuous mechanism of achieving effects, without deeper encroachment in the essence of transformations. The experimental group achieved more obvious and more visible positive effects. We can conclude that the enforced transformational treatment has optimized the steerage of locomotor system's parts, whereat most probably a product of adequate force and bio-chemical optimization was very well adjusted. This characteristics is confirmed by the results of previous analyses, so it can be justly assumed that extra classes of physical education had not a small role in establishment of optimal trajectories of movement in realistic conditions, and more efficient steering or surveillance and control of movement's realization, which is the most useful in terms of learning new exercises, which is what the examinees of experimental group were subjected to. The experimental group achieved more obvious and more visible positive effects. We can conclude that the enforced transformational treatment has optimized the morphological-motor structures for realization of movement, and the movement in the survey is much more optimal and with much more disposal of energetic and other resources. In this conclusion the most important effects of transformational treatment can be seen and this is the first and the most important characteristic of this treatment. We can conclude that the enforced transformational treatment has optimized the steerage of locomotor system's parts, whereat most probably a product of adequate force and bio-chemical optimization was very well adjusted. This characteristics has been confirmed by the results of previous analyses, so it can be justly assumed that extra classes of physical education had not a small role in establishment of optimal trajectories of movement in realistic conditions, and more efficient steering or surveillance and control of movement's realization, which is the most useful in terms of learning new exercises, which is what the examinees of experimental group were subjected to.

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CONSTRUCTION AND VALIDATION OF COORDINATION TEST BOSKO

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Abstract

The goal of this research was to construct and validate metric characteristics of a coordination test called BOSKO which was recently constructed. Examinee sample included 30 female pupils attending elementary school, with the average age of 13. The test named BOSKO was constructed with the purpose to evaluate a part of coordination, specifically agility in changing movement direction in small space with obstacles. BOSKO consists of side jumps, jumps and landings with the rotation of 90°. In order to establish its methric characteristics it was compared to three other tests which are commonly used in judo trainig process. The results obtained on the selected sample point out that this new constructed test of coordination (BOSKO) is sufficiently sensitive, reliable and valid, therefore, according to these results, it can be used for evaluation of target latent dimension in judo as well as in other sport fields.

Key words: *coordination, agility, measurement characteristics, female pupilsIntroduction*

Introduction

Coordination is a complex motor ability essential in several types of sport, especially for the performance technique which is one of the important elements for success. Judo is one of the sports where coordination is of great importance in achieving top results. One of the ways of defining coordination is the ability of movement of the whole body or some parts of locomotor system, and it considers speed and precise execution of the complex motor tasks, as well as fast motor problem solving (Milanović, 2007). It is well known that the group of coordination abilities forms very early, especially the ability of rhythmic coordination, agilities, rhythm and motor reactions. It is never too early to start working on the development of coordination abilities, considering the fact that coordination contributes to better motor learning at later stages of sport preparedness (Milanović & al.,2003). Establishing validity and reliability of the measuring instruments for the evaluation of complex latent structure of coordination (Metikoš & al.,1972) it is significant in improving the training field in judo as well as in other sports.

Therefore, the new test named BOSKO was constructed with the purpose to estimate a part of factor structure of coordination - agility (the agility in changing movement direction in the small space with obstacles). BOSKO consists of side jumps and landings with the body rotation of 90°. The construction of this test was primarily made for the use in measuring and evaluating coordination in judo.

Methods

Measuring was carried out by identical procedure in three time intervals (16. March, 8. June and 21. September 2007.), on *the sample of 30 female pupils*, with the average age of 13 (mostly between 12-14). All examinees were attending elementary school "Braće Radić" Novi Zagreb.

The sample of variables consisted of four measurement instruments whose hypothetical measuring subject was the factor of coordination (body coordination, speed of execution complex motor tasks, agility, reorganization of motor stereotype). Three of them are commonly used in testings in judo: *Side rolling to the left and right (MKOOBK) ,Turns forward – back (MKOONN) and Jumps over the hoop forward (MKOOPO).* Those tests were used to compare the results to the results of the new constructed test *Side jumps and landings (BOSKO).*

The examinees were performing each test according to instructions which were interpreted as follows.

Side rolling to the left and right (MKOOBK)

Total time of work per one group of examinees is 1 min, with one time measurer and his assistant. The necessary equipment consists of 1 stopwatch and the place of execution which is indoor or outdoor area with dimensions 2x3m per examinee. Task description: the starting position: examinees are lying on their back, with stretched legs and arms up; task performance: the examinee performs accurately as much cycles as he can starting at the "now" sign until the

period of 20 sec expires. The performance consists of the following series of movements: starting at the initial position, rolling sideways to the left (360°), touching the left foot with the right hand, returning to the initial position, then rolling sideways to the right (360°), touching the right foot with the left hand, returning to the initial position. All these movements represent one cycle. Without stopping, at the end of one cycle, the examinee continues repeating the second, third, etc. The task is finished after the expiration of 20 sec, and the result of this test is the number of properly completed and finished cycles during 20 sec.

Turns forward – back (MKOONN)

Total time of work per one group of examinees is 1 min, with one time measurer and one assistant. The needed equipment consists of 1 stopwatch and the place of execution which is indoor or outdoor area with dimensions 2x4m per examinee. The starting position: from the straddle standing position with arms supported forward, behind the start line. Description of task: starting at the initial position and moving forward – then turning of 360° - returning back – turning of 360° (MKOONN). Task performance: the examinee starts at the "now" sign and accurately performs as much cycles as he can until the period of 20 sec expires. The performance consists of the following series of movements: 1. starting at the initial position and moving forward, crossing of target line (at the distance of 2 m), making the turn of 360° without the repositioning the body, 2. moving backwards, crossing the start line and making the turn of 360°. After the end of the first cycle, examinee continues with the second, third. etc. The task is finished after the expiration 20 sec, and the result is the number of properly completed and finished cycles during 20 secs.

Jumps over the hoop forward (MKOOPO)

Total time of work per one group of examinees is 1 min., with one time measurer and one assistant. The necessary equipment consists of 1 stopwatch, hoops and the place of execution which is indoor or outdoor area with dimensions 1x1m per examinee. Description of task: the initial position: the examinee is holding the hoop in her hands, she steps forward through the hoop with her right leg and starts skipping through the hoop on the start sign. The task is finished after the expiration of 20 sec., and the result is the number of correctly performed skips during 20 sec.

The new constructed test: *Side jumps and landings (BOSKO)*

Total time of work per one group of examinees takes 30 sec, with one time measurer and one assistant. The necessary equipment consists of 1 stopwatch and 1 Swedish bench. The place of execution is indoor or outdoor area with dimensions 5x2m per examinee. Description of task: the initial position: standing sideways with both feet distanced 10cm from the bench. On the start sign the examinee makes the side jump on the bench, rotates clockwise in the air (to the right) for 90°,makes the landing, and after the landing she is in the starting position beside the bench, prepared for the next jump, then she rotates to the right again for 90° and lands behind the bench. The performance of this task lasts for 30 sec. It considers constant rotation to the right, because this test measures the level of coordination, but also partially the balance of the body depending on possible obstacles in the space. The level of coordination is possible to express through the number of jumps and landings, and to represent it in the spreadsheet view with grades. The described task is finished after the expiration of 30 SEC, and the final result is the number of properly completed series of jumps and landings (numbered as one) during 30 secs. Monopode jumps and landings with premature rotations of the trunk are not allowed, therefore these kinds of movement are not numbered.

The order of performing each test was defined, and the examinees were devided into three groups with each consisting of 10 examinees. Every examinee, after finishing his attempt, had to wait his group to finish and then prerformed specific task again (in order to reduce the effect of fatigue to minimum level).

Each examinee in the sample was measured *three times in each time interval in all described tests.*

The basic central and dispersive parameters were calculated for all variables and the normality of distribution of the obtained values was tested by the Kolmogov-Smirnov test. The measurement characteristics of the selected instrument for coordination evaluation were tested with Momirović's RTT program, which was written in The Statistic Basic program language, and implemented into the statistical package of the Statistic for Windows version 5.0 by Dizdar (1999). The matrice of intercorrelations was calculated for all test items, which determined the first characteristic roots and valid variances of the item system, using SPSS statistical package version 11.5.

Results

Table 1. Matrices of intercorrelations - BOSKO test

	Bosko1	Bosko2	Bosko3
Bosko1	1		
Bosko2	0,79	1	
Bosko3	0,82	0,88	1

Table 2. Squares of the multiple correlation coefficients

	Multiple R2
MKOOBK	0,622578
MKOONN	0,748743
MKOOPO	0,718974
MKBOSKO	0,731418

Table 3. Factor analysis of coordination tests

	H1
MKOOBK	-0,864621
MKOONN	-0,915989
MKOOPO	-0,914735
MKBOSKO	-0,9044
Expl.Var	3,241285
Prp.Totl	0,810321

The validity factor of the Bosko test was determined according to the correlations of test items with the first principal component (reskalated on the antiimage metrics, which is also coefficient of inter validity) showed in table 3.

According to the values of the correlation matrices between items, under the classic model of measurement, the following measures of reliability were calculated: ALPHA (0,936) ,calculation based on the first eigenvalue of correlation matrice (Kaiser and Caffrey, 1965); Cronbach's generability index (=0,912).

Based on the covariances matrices and transformed into the image and Harris's metrics, and under Guttman's model, the average correlation between the items was calculated and it can serve as a measure of homogeneity (AVR= 0,83).

Discussion and conclusions

In this research the main purpose was to establish the metric characteristics of the new constructed test for evaluating coordination named BOSKO. In order to define them, the three existing tests for evaluating coordination were used (MKOOBK, MKOONN, MKOOPO).

The obtained results show that the new constructed test has satisfactory sensitivity because the results of all measurements, for selected examinee sample, weren't significantly statistically different from the normal distribution. In other words, the new constructed test discriminates, in a good way, the examinees' results included in this research. Based on high intercorrelations between repeated measurements (Table 1.), one could say that the results obtained in repeated measurements were well connected and that they are measuring the same thing.

The established analysis of latent space of applied measuring instruments has determined that all selected instruments explained the high number of 81% of total variances of the measured dimension. The factor analysis of the BOSKO test highly correlates with the first principal component (Table 3.), so it can be concluded that the BOSKO test is factor valid because it measures the same dimension as the other used tests in this experiment. The BOSKO test also correlates better with the first principal component than the MKOOBK test. Furthermore, the measurement characteristics of the BOSKO test reliability based on calculated coefficients show satisfactory level of reliability.

This experiment was taken on the sample of 30 female pupils of elementary school. It is possible to conclude that the BOSKO test shows good metrical characteristics in this examinee sample, therefore its future use is recommended. The test is also very practical to use because of its simple equipment demands. Based on its good metrical characteristics it should be used in judo testings because it is well known fact that coordination, together with the strength (especially muscle contractions of dynamic type, and less static strengths), has large influence on the success in judo struggle.

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NOTATION ANALYSIS IN SOCCER - DIFFERENCES BETWEEN TWO WORLD CUPS CONCERNING THE FIELD AREAS AND ACTIONS DURING ATTACK

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Abstract

The aim of the study was to establish differences between the teams at two World Cups by using a computerized system to gather and analyse data on field areas and attacks. There were a total of 2030 entities (attacks) that consisted of 3226 actions in different sub-areas of the field (during World Cup '98, World Cup '02 and World Cup '06). The results show that there are quantitatively bigger changes in actions which occurred in the observed field areas during World Cup '02 compared to the previous cup. This change, which was expected, can be attributed to more complex and sophisticated forms of a training process that improves each year. It is also the reason for these differences. By analysing the discriminative function, it can be seen that the biggest differences occur with the variables: passing of the ball to a team-mate (ds_d) and dribbling the ball over long distances (vldr_d).

Key words: *analysis, football, field areas, actions during attack, teams*

Introduction

The analysis of the play of individual players, or the whole team, as well as the play of the players from the opposing team, or the teams that could be possible rivals, is becoming the central problem of the modern football. All coaches and other football experts are concerned with the question of how to 'guess' the play of the opposing team in order to choose the right tactics for their teams and to ensure the winning. Beside decoding the opponent, there is always a question how to play and how to outsmart the opponent in order to win. These demands exist at all levels of competition in football, especially at big competitions, i.e. World Cups. Game analyses are therefore used by experts to dissect the opponent's play, and to improve the play of their own team. This scientific approach towards football might seem too complicated for some average spectator who has a more romantic approach towards football. Game analyses based on the use of modern and highly sophisticated technical and electronic devices that enable scientific observation of all relevant factors in football were published. It is important to mention Bishovets et al. (1993) who deal with computer analysis of technical and tactical moves of the football players during the games at the Olympic Games and World Cup. The sample of variables was comprised of number of attacks, areas of the field during the attack, number of passes, number of shots at goal and the positions. The authors conclude that these data should be a basis for the preparation of players. Jinshan and co-authors (1993) analyse scoring of goals at the 14th World Cup. These authors set up, for the purpose of game analysis, three sub-areas of the field. With regard to these areas and situations during the game, they establish evaluation of the situation for scoring a goal depending on the type of action and sub-areas of the field.

Argilaga and co-authors (2003) point out in their paper on match and player analysis in football by computer coding and analytic possibilities that in the team sports there is a certain complexity of the interaction (substitutes, lacks that will enable regulation of interruptions, throws, ball losses, ball recoveries, passes, duration of attack, etc.). The authors suggest an instrument that combines a structure of field formats with system of categories in order to achieve a systematized game analysis. The approaches of the instrument are: time of the play, lateral spaces, area of ball reception, player and pass area.

Methods

The sample of variables

Variables actions during attack used in this paper are a part of the model for acquisition and analysis of data that were also used in papers by Miljković, Jerković & Šimenc (2002), Miljković & Barišić (2002) and Miljković, Jerković & Hmjelovjec (2005).

A set of 12 variables:

(1)	RBTM	receiving the ball from a team-mate
(2)	TNADA	total number of actions during one attack
(3)	PBLP25	passing the ball to a team-mate (a long pass – more than 25 m)
(4)	PBSP5-6	passing the ball to a team-mate (a short 5-6 m pass)
(5)	PBMLP25	passing the ball to a team-mate (a medium-long pass up to 25 m)
(6)	GPB	gaining the possession of the ball (by taking it away from the opponent, by interception, or gaining possession due to the incorrect pass by an opponent)
(7)	RP25	receiving and passing the ball to a team-mate (over 25 m)
(8)	RP5-6	receiving and passing the ball to a team-mate(a short 5-6 m pass)
(9)	RP25	receiving and passing the ball to a team-mate (a medium-long pass up to 25 m)
(10)	DB25	dribbling the ball over long distances (over 25 m)
(11)	D5-6	dribbling the ball over short distances (5-6 m)
(12)	D25	dribbling the ball over medium long distances (up to 25 m)

The sample of entities

The sample of entities was taken from the football games played at the 1998 FIFA World Cup in France, the 2002 FIFA World Cup in Japan and South Korea and the 2006 FIFA World Cup in Deutschland. In each Word Cup there were analyzed games played in the quarter -final, semi-final and final. The sample of entities is represented by attacks executed by the teams monitored. At least two contacts with the ball by players from the team now in possession of the ball are necessary for commencement of an attack. The total number of attacks was 2030 (N=2030). The first part of the sample of entities is from the World Cup in France (WORLD CUP ’98; N=808), and the second part is from the World Cup held in Japan and South Korea (WORLD CUP ’02; N=1221). Each attack, as an entity, can be identified by the summation of actions executed during its duration from the moment at which a team gains possession of the ball until the moment at which the team loses possession of the ball. The term ACTION represents the basic unit of attack. It represents the activity of the player from the moment he gets the ball until he passes the ball to another player from his team or towards the goal, i.e. until this action is interrupted by the player from the other team or by the referee.

Data processing methods

Mean (AS) and Standard Deviation (SD) were calculated for each group (Cup) and for each field. The differences between these two World Cups (WORLD CUP ‘98; WORLD CUP ’02) were established by the analysis of variance.

Results

From the given data (Table 1) it can be seen that the total number of actions has increased, as well as for certain field areas (zones) in favour of the World Cup ’02. Table 2 shows that a total number of actions for Back field area has increased for the following variables: akc_ps, brakc, ds_d, ds_k, n_pp_d, n_vldr_d, n_vldr_k (for World Cup ’02).

Table 2. Back field area

	Mean 98	Mean 02	Mean 06	F	Sig.
akc_ps	*2.725*	***3.356***	*4.435*	*11.560*	***.001***
brakc	*10.014*	***11.399***	*12.345*	*7.433*	***.011***
ds_d	*.634*	***.889***	*1.645*	*22.844*	***.000***
ds_k	*.545*	***.679***	*0.945*	*5.265*	***.039***
ds_s	2.137	2.268	2.356	.866	.382
n_doposj	.393	.427	.564	1.484	.277
n_pp_d	*.140*	***.193***	*.231*	*4.907*	***.048***
n_pp_k	.451	.446	.476	.018	.929
n_pp_s	1.024	.947	1.234	1.172	.301
n_vldr_d	*.087*	***.151***	*.235*	*8.422*	***.007***
n_vldr_k	*.880*	***1.070***	*1.876*	*6.443*	***.020***
n_vldr_s	.805	.782	.987	.208	.710

There is also a slight increase for the variables ds_s (2.268), n_doposj (.472), while the variables n_pp_k (.451), n_pp_s (1.024), n_vldr_s (805) were higher for Wold Cup ’98. Discriminative function shows that variables: ds_d (.580), akc_ps (.404), n_vldr_d (.338) should be used to display differences. The analysis of results for the Midfield area (Table 3) shows that there is an increase of actions in favour of World Cup ’02.

Table 3. Midfield area

Mean 98	Mean 02	Mean 06	F	Sig.
3.377	***3.738***	*4.213*	*5.090*	***.026***
11.738	*12.375*	*13.432*	*2..440*	*.164*
.589	***.842***	*1.023*	*25.418*	***.000***
.775	.837	1.023	.983	.322
2.555	2.496	2.543	.224	.636
.326	***.389***	*.413*	*5.259*	***.022***
.102	***.154***	*.231*	*5.798*	***.016***
.534	.482	.465	1.302	.254
1.117	1.006	1.023	2.787	.095
.081	***.168***	*.234*	*16.728*	***.000***
1.117	1.171	1.235	.539	.463
.925	.852	1.023	1.717	.190

There is a significant increase for the following variables: akc_ps (3.738), ds_d (.842), n_doposj (.389), n_pp_d (.154), n_vldr_d (.168). There is also a slight increase for: brakc, ds_k, n_vldr_k. The following variables: ds_s, n_pp_k, n_pp_s, n_vldr_s are in favour of the World Cup ’98.

Discriminative function shows that the biggest differences are for the variable ds_d (.534), and then n_vldr_d (.433) and then the variable n_pp_d (.255). In the Front field (Table 4) there are some differences in favour of the World Cup ’02 and only for 3 variables: ds_d (1.049), n_pp_d (.160) and n_vldr_d (.220).

Table 4. Front field area

Mean 98	Mean 02	Mean 06	F	Sig.
4.179	4.424		1.119	.290
14.295	14.635		.266	.606
.686	***1.049***		*22.993*	***.000***
1.000	.964		.160	.689
3.016	2.883		.558	.455
.346	.399		2.026	.155
.064	***.160***		*11.578*	***.001***
.631	.537		2.074	.150
1.212	1.098		1.446	.230
.087	***.220***		*18.070*	***.000***
1.410	1.407		.001	.977
1.247	*1.055*		*5.611*	***.018***

There is a slight increase for the variables: akc_ps, brakc, n_doposj. There is a significant increase for the variable n_vldr_s (1.247) in favour of World Cup ’98, while the variables: ds_k, ds_s, n_pp_k, n_pp_s i n_vldr_k show only a slight increase.

Discussion

A general conclusion is that there is an increase in all the variables in favour of the World Cup ’02, and the reason for these positive changes is a good training process that improves each year. By observing certain sub-areas of the field

and frequency of individual actions, it can be concluded that the acquired results show what is characteristic for certain field area. The results for the front field (World Cup '02) show that there were some tactical changes in favour of greater control of the ball and the play in the back field area with the emphasis on the so called 'safe' play and goal defence. In the midfield area there is an increase for the majority of observed variables in favour of World Cup '02. This proves that most of the actions concerning the attack are concentrated in the midfield area. All these activities are possible because of the better fitness condition of the players. The results for the front field show that there is a slight increase in the total number of actions in favour of World Cup '02. This is because of the characteristic type of play during the attack in the front field. The possibilities of improving the activities in that area are very limited because the destruction of the play by the opponent is great. It will be interesting to analyse the play in that area (in the future), although some drastic changes are not to be expected. Discriminative function shows that the following variables: ds_d (.549), n_vldr_d (.487) and n_pp_d (.390) indicate these changes, while for the variable n_vldr_s there is a change in the direction (-.271).

Conclusion

This paper deals with the analysis of differences between the teams at two World Cups concerning the field areas and actions during attack, by using the computerised system for gathering and analysis of data. 2030 entities (attacks) were analysed, i.e. 3226 actions that occurred during these attacks at two World Cups (1998 and 2002).

By using the analysis of variance, canonical discriminative analysis and by discriminative function it can be concluded that there is an increase in the total number of actions in all field areas in favour of the World Cup '02 which was expected. The differences in the back field area are because of the tactical ideas in the play during defence with the main goal to control the ball and so called 'safe play'. Discriminative function shows that the biggest differences are for the variable: passing the ball to a team-mate (a long pass) (ds_d) and dribbling the ball over long distances (vldr_d).

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EFECTS OF SCHEDULED ACTION ON TRANSFORMATION OF QUALITATIVE AND QUANTITATIVE LEVEL OF HANDBALL MOTOR ABILITIES FOR HANDBALL PLAYERS AGED 11-14 YEARS

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Abstract

On the example of 82 handball players, which have been in scholastic process for at least a year, have aged 11-14 years, a scheduled transformational procedure in duration of three months has been conducted.

The basic feature of this program were situational methods of action.

The structural-qualitative changes of motor abilities in the structure of relations are significant. Two latent mechanisms of specific motions have been isolated, containing altogether as much as 73% of joint variability. In this way it can be concluded that a great part of specific tests' variability is quite well encompassed and the criteria picked is Gutman Keiser.

These two factors clearly describe the essence of handball:

F1-the movement and conquest of the field,

F2-reachment of the mark (goal).

Quantitative differences between the initial and final status, as it could have been expected on the basis of previous results, out of 5 variables, 3 latent dimensions (factors) were received, all three of equable intensity (from 21 till 27%). According to GK criteria, as much as 71% of joint variability was retained.

Leading the ball around stalks (meaning the conquest of the field with a ball) and kicking it against the wall (meaning adjunction) define the **first factor of differences** with total expulsion of the rest of the variables. At first glance it seems that this is a special type of integral success in handball because these two dimensions are enough to describe a typical efficient handball player, who does not score goals, but operates within the field.

The second latent dimension (factor) of differences is described as throwing the ball at the mark and running inside a triangle with defensive position. This dimension describes the second type of successful handball player, the one in charge of scoring goals. The type of player with enhanced scoring abilities.

Finally, **the third factor of differences** is defined by throwing the ball in inaction at the distance. Something like this represents long passes, a kick from the wing or the pass from the goal keeper, and that is the third type of successful handball player, the type which contains strength and great precision of transferring and passing of the ball. In every case it seems that the treatment worked in such a way that it displayed favoritism in forming types of handball players, which can be seen from effects in the area of motor abilities.

For this purpose, the criteria and goals of action in different ages of youth should be more precisely ascertained, as well as in handball clubs and handball academies so that a handball player can be identified and modeled from the very beginning, from pioneer to top-quality handball player. This would only ease the work of handball coaches in forming top-quality handball player, which is, I hope, is the goal of all who deal with handball. Programming of action in different youth ages with the result's projection in senior age is a continuous problem of kinesiology.

Key words: *transformation, motor abilities, handball players*

Introduction

In today's degree of kinesiology's discoveries and sports technology usage, it is obvious that for the first-rate handball result one prepares for ten, fifteen years, sometimes more. Mature handball players achieve their maximum in chronological age of 22-25, sometimes even older. We can conclude from that the period of sport preparation of top-quality handball player is marked with long period of exercises, with disposition of many resources, material demands and knowledge whose carriers are specialists of certain activities and disciplines. This immense arrangement has as it's goal primarily the all-round development of the future handball player and his steering towards the highest sport achievements. Since

the projection of activity in the future is the case here, at the beginning of such work, global parameters and rules on which successful transformational process are scheduled, should be at least familiar.

Motor abilities are one of the basic factors who determine the success of a handball player. Every situation which has occurred during the game, primarily needs to be adequately realized trough motor skills, and this realization is provided trough the locomotor system by the player's strength, endurance, precision, speed, coordination, balance and agility. The player's activity is based on general motor abilities, which provide knowledge from specific situational technical-tactical elements relevant for success in handball. Based on former research (Pavlin, Šimenc, Delija, 1982), it can be assumed that there are five instantaneous latent dimensions: precision of aiming at the non-moving mark, handling of the ball, speed of movements with the ball, speed of movements without the ball and the power of ball ejection.

The first dimension, the precision of aiming at the non-moving target is extremely important because it is responsible for the situational precision in aiming at the given mark inside the handball goal, which matches the precision in the terms of the game.

The second dimension, the skill of ball handling, represents the ability of good player's manipulation of the ball in non-moving and moving position. The ability of ball handling should be considered a basic precondition for achieving desirable success in handball. High level of preparation in ball handling allows others, more tactical characteristics of the player, to be successfully used.

The third dimension, speed of player's movements with the ball, covers the area of player's movement with the ball in offence. Considering the fact the field is conquered more quickly and safely in offence by passing the ball, the task of leading the ball during the game is reduced, except in situations when leading the ball is allowed for tactical reasons, and that happens in individual counter attack, in counter attack with an extra player, in breach between two guards, and in some offence combinations.

The fourth dimension, the speed of player's movements without the ball, mainly covers the area which is distinctive for the game in defense, while it is less represented in offence. In offence, it signifies the conquering of the field, detection and running, while in defense, it signifies running across the field in order to prevent a counter attack, and also different forms of guarding and distracting the opponent players.

The fifth dimension, the power of ball ejection, is responsible for situational explosive strength of ball ejection. Throwing the ball in the form of passing it and kicking it is one of the most often used elements of handball technique.

Contemporary approach for the basic and specific anthropological features of a handball player and of handball's specific demands, seeks scientific foundation for analyses and understandings, and this foundation can only be created by enforcing a scientific research program. Creating a player is a lasting, demanding and complex task, or better said, it is a process which demands the fulfillment of many conditions contributing to that process. For these reasons, in the pyramid of overlooking, evaluating and controlling the effects of sport preparation, the work with younger categories must be primary and qualitative, as transformational processes of such could have a projection in the future.

THE SUBJECT of this project are the transformational processes of qualitative-quantitative changes in handball players' motor abilities aged 11-14 years

THE PROBLEM in this project is the need to determine qualitative and quantitative changes in motor skills under the influence of handball scheduled training

THE GOAL of this project is determination of qualitative and quantitative changes in players' motor skills under the influence of scheduled action

Method of the project

With this project, a longitudinal approach of reasearch, the tracking of motor skills has been done during a period of three months

The sample of examinees: This research included 82 handball players aged 11-14 years. The players are members of handball teams "Ilidza" from Ilidza, "Olimpik from Sarajevo, "Vogošća" from Vogošća and "Goražde" from Goražde. The handball players were subjected to medical examination and all are healthy, without acute locomotor or morphologic defects.

The sample of variables: Variables for motor skills evaluation

For evaluation of motor skills the tests that were utilized were previously used on young handball players in Russia, Italy, Slovenia, Germany, Croatia, etc.

The sample of these tests includes five hypothetical latent factors which are responsible for situational efficiency in handball:

1. **The speed of movement with the ball**, TEST-SMVLS, leading the ball in slalom
2. **Precision**, TEST-SMGLC, throwing the ball at a mark

3. **The power of ball ejection**, TEST-SMŠLD, kicking the ball from non-moving position
4. **The speed of movement without the ball**, TEST-SMTTOS, running inside the triangle with basic defense stand
5. **Handling of the ball**, TEST SMŠZ20, kicking against the wall for 20 seconds.

The method of data analysis: in order to ascertain the qualitative-structural differences in motor abilities, the most competent methods were used: the **CRAMER** model, **QDIFF1** and the **KRZANOWSKI** model. For the purpose of ascertaining the qualitative differences the Gutman-Kaiser method was used.

In order to ascertain the quantitative difference between initial and final state of the samples tested, the most competent methods for such identification will be used: the **DIFFG model of changes**, the **SSDIF model of differences**, the Criteria for discriminative intensity of applied variables will be the **Hoteling's t-test**.

Results and discussion

The structural-qualitative changes of motor skills in the structure of relations are significant. Two latent mechanisms of specific motions have been isolated, containing altogether as much as 73% of joint variability. In this was it can be concluded that a great part of variability of motor abilities tests' is very well encompassed, which can clearly be seen in table number 1, where the criteria Gutman Keiser was used.

Table 1. Specific values remain unchanged according to CK criteria

N	L	P	P CUM
1	**2.47**	**0.49**	**0.49**
2	**1.16**	**0.23**	**0.73**

Table 2. The assembly and corelation of sidelong rotated factors

	F1	F2
1VLS	**0.90**	0.09
1GLC	-0.18	**0.73**
1SLD	**-0.77**	0.21
1TOS	**0.90**	0.05
1SOZ20	0.13	**0.87**
	F1	F2
F1	1.00	-0.24
F2		1.00

From table number 2 The assembly and corelation of sidelong rotated factors, it can clearly be seen that the **first** latent dimension describes the complex movement with the ball in slalom (SVLS) and kicking the ball against the wall (STOZ).

It seems that there are **two** seperate machanisms of movement regulation, with the first being responsible for movement in the field, and the second for the missile ejection.

These two factors clearly desribe the essence of handball:

F1: the movement and conquest of the field

The precision of aiming at non-moving target is extremely important because it is responsible for situational precision in throwing the ball at a mark, which matches the precision ih game conditions.

The skill of handling the ball represents the player's fine ability to manipulate the ball in non-moving position and in movement. The ability of ball handling should be considered a basic precondition for achieving desirable success in handball. . High level of preparation in ball handling allows others, more tactical characteristics of the player, to be successfully used.

The speed of player's movement with the ball covers the area of player's movement with the ball in offence. Considering the fact the field is conquered more quickly and safely in offence by passing the ball, the task of leading the ball during the game is reduced, except in situations when leading the ball is allowed for tactical reasons, and that happens in individual counter attack, in counter attack with an extra player, in breach between two guards, and in some offence combinations.

F2-reachment of the mark (goal)

The speed of player's movements without the ball, mainly covers the area which is distinctive for the game in defense, while it is less represented in offence. In offence, it signifies the conquering of the field, detection and running, while in defense, it signifies running across the field in order to prevent a counter attack, and also different forms of guarding and distracting the opponent players.

The power of ball ejection, is responsible for situational explosive strength of ball ejection. Throwing the ball in the form of passing it and kicking it is one of the most often used elements of handball technique. Since the handball terrain has relatively small dimensions, the power of ball ejection can be used only when counter attacks of long balls are o being organized, and sometimes, in quick ball slinging from one wing to another within the goal keepers area.

This kind of result is positive and confirms previously stated facts. This can clearly be seen from table number 3, where GK criteria was used.

Table 3. Retained specific values according to CK criteria

N	L	P	P CUM
1	2.80	0.56	0.56

Table 4. The structure of factors

	F1
2VLS	-0.76
2GLC	0.60
2SLD	0.87
2TOS	-0.82
2SOZ20	0.67

Table 5. The analysis results

Var.	D
SVLS	0.98
SGLC	0.92
SSLD	-0.91
STOS	0.87
SSOZ20	0.90

The gained factor is integral and equable, with projection that tesifiest that all used variables equaly participate in the final mechanisms of specific handball motions.

This kind of result is exepcted and welcomed and only confirms that scheduled handball treatman realised in this project had an effect.

In table number 5, which represents change analisys done according to the Krzanowsky model, it can clearly be seen that the structural changes were caused by all the variables, with just slightly expressed intensity of change in defensive stand runnung within a triangle.

Certanly, this kind of result testifies that restructuring of dimensions and all the variables along the entire sample of entities has occured.

Quantitative differences between initial and final state, as it could have been expected on basis of previous results, out of 5 variables as much as 3 latent dimensions were recieved, all three of equable intensity (from 21 till 27%). According to the GK criteria, table number 6 contains as much as 71 % of join variability, which is an immense amount.

Sidelong rotated dimensions of specific space differences, as seen in table 7, show a clear complexity. Three factors according to GK criteria can be isolated:

1. **The First Factor** consists of SMVLS variables - Leading the ball around stalks (meaning the conquest of the field with a ball) and kicking it against the wall (meaning adjunction) define the first factor of differences with total expulsion of the rest of the variables. This is a special type of integral success in handball because two dimensions are enough to describe a typical efficient handball player, who does not score goals, but operates within the field. Contemporary handball seeks model of a player who will independently solve the most complex situations during a game in the best possible way. The player who possesses these characteristics which determine the first factor, will successfully be able to operate on individual tactical plan.

2. **The Second Factor** of differences is described with SMGLS variables (shooting the ball at the mark) and SMTOS (running inside a triangle with defensive position). This dimension describes the second type of successful handball player, the one in charge of scoring goals. Creating a handball player with enhanced scoring abilities is very important in handball, because the lacking of such a player enables the entire game. This is why all coaches who work with young categories have as their main goal a creation of an enhanced scoring abilities player. The schedule realized in this project has in it's content enough elements which develop this precious player's ability, and that's why this factor is separated.

3. **The Third Factor** id described with SM SLD (throwing the ball in inaction at the distance) and SMTOS (running within the triangle). Something like this represents long passes, a kick from the wing or the pass from the goal keeper, and that is the third type of successful handball player who contains strength and hand precision.

Table 6. Retained specific values according to CK criteria

N	L	P	P CUM
1	1.37	0.27	0.27
2	1.16	0.23	0.51
3	1.03	0.21	0.71

Table 7. The assembly of sidelong rotated factors

	F1	F2	F3
SVLS	**0.74**	0.16	0.22
SGLC	-0.01	**0.80**	-0.22
SSLD	-0.01	-0.05	**0.95**
STOS	0.01	**0.72**	0.16
SSOZ20	**0.86**	-0.13	-0.18
	F1	F2	F3
F1	1.00	0.06	0.07
F2		1.00	0.08
F3			1.00

The creation of successful handball player is the main goal of work with younger players and so in this research three models of handball players have been differentiated. Work done with this age had was basicly a situatinal model of action, which represents the the action done in actual match.

Table number 8 represents the results of SSDIF anlysis. Multi-versioned quantitative changes are certanly provoked, no matter in what measure it was initialy the treatment's intention. All specific variables are equable in their contribution to effect's decriptions, which can be seen from the R function. (from 0.30 till 0.47).

Uni-versioned differences also show equable character of changes, which can be seen from table number 9. Variable SSOZ is isolated slightly, which tells us how important in handball is throwing the ball at a mark, even as an educational mean which causes the changes, not purely in the sense of sport acomplishments. This is the bigest locally provoked homogenisation of enities, although other variables are directed in that way as well.

Table 8. The results of SSDIF Analysis (multi-versioned differences)

	A	D	S	R
SVLS	-1.69	-0.86	-0.88	-0.30
SGLC	3.13	0.47	0.94	0.32
SLD	2.82	0.44	0.91	0.31
STOS	-1.20	-1.46	-1.21	-0.41
SSOZ20	2.94	0.94	1.40	0.47

MU	8.66
H T	710.16
F	135.02
DF1	5
DF2	77
P	0.0000

Table 9. Uni-versioned differences

	FA	XA1	XA2	TL	SD1	SD2	DT
SVLS	0.00	21.75	20.06	0.92	3.93	3.60	0.92
SGLC	0.00	27.63	30.77	1.11	5.26	4.83	0.92
SLD	0.00	24.09	26.90	1.12	6.93	6.74	0.97
STOS	0.00	16.71	15.51	0.93	2.37	2.03	0.86
SSOZ20	0.00	12.39	15.33	1.24	3.46	2.94	0.85
DF1	1.00						
DF2	81.00						

Conclusion

The structural-qualitative changes of motor abilities in the structure of relations are significant. Two latent mechanisms of specific motions have been isolated, containing altogether as much as 73% of joint variability. In this way it can be concluded that a great part of specific tests' variability is quite well encompassed and the criteria picked is Gutman Keiser.

These two factors clearly describe the essence of handball:

F1-the movement and conquest of the field,

F2-reachment of the mark (goal).

Scheduled handball program three months in duration has caused significant changes in the motor abilities' structure. Quantitative differences between the initial and final status, as it could have been expected on the basis of previous results, out of 5 variables, 3 latent dimensions (factors) were received, all three of equable intensity (from 21 till 27%). According to GK criteria, as much as 71% of joint variability was retained.

Leading the ball around stalks (meaning the conquest of the field with a ball) and kicking it against the wall (meaning adjunction) define the **first factor of differences** with total expulsion of the rest of the variables. At first glance it seems that this is a special type of integral success in handball because these two dimensions are enough to describe a typical efficient handball player, who does not score goals, but operates within the field.

The second latent dimension (factor) of differences is described as throwing the ball at the mark and running inside a triangle with defensive position. This dimension describes the second type of successful handball player, the one in charge of scoring goals. The type of player with enhanced scoring abilities.

Finally, the **third factor of differences** is defined by throwing the ball in inaction at the distance. Something like this represents long passes, a kick from the wing or the pass from the goal keeper, and that is the third type of successful handball player, the type which contains strength and great precision of transferring and passing of the ball.

In every case it seems that the treatment worked in such a way that it displayed favoritism in forming types of handball players, which can be seen from effects in the area of motor abilities.

For this purpose, the criteria and goals of action in different ages of youth should be more precisely ascertained, as well as in handball clubs and handball academies so that a handball player can be identified and modeled from the very beginning, from pioneer to top-quality handball player. This would only ease the work of handball coaches in forming top-quality handball player, which is, I hope, is the goal of all who deal with handball.

Programming of action in different youth ages with the result's projection in senior age is a continuous problem of kinesiology.

After everything presented above, a coclusion can be formed:

Handball program, three months in duration, has affected the positive transformations of motor abilities.

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UNIVERSITIES AND SCHOOLS. AN INTEGRATED MODEL OF RESEARCH ON SPORT AND MOTOR IN EDUCATION FIELD

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Abstract

The aim of this study is to test an integrated model of research on motor and sport activities preparing a specific protocol between university and school based on the paradigm of Social Cognition, applying the methodology of the action research and using laboratory as teaching.

The proposed search model applies to the educational processes and is designed to enhance body, movement and sport in the educational relationship both in the formative processes of teachers and in the formative processes of students.

In the proposed integrated model motor and sport activities are a search field on which to investigate that meets the specific needs of the appreciation of the possible interaction between body and psyche and between nature and the environment.

Key words: *ethno-methodology, social cognition, didactic laboratory, action-research, meta-cognition*

Introduction

One of the possible interpretation of the function of the social sciences, among them we include the sciences of education, is in the postulate "I can not understand a cultural object without reference to the human activity that produced it" (A. Schutz, 1987).

In this perspective has been started an exploratory path of phenomenology and its relations with the ethno-methodology, and "has been reconsidered in a very personal way by Garfinkel which deepened the theme, at that time underdeveloped, of the reflexivity of common sense, ie the ability of agents to make themselves account of their practices before any other scientific practice" (F. Heran, 1987). Garfinkel thanks to the ethno-methodology approach developed reflections on the social origins of knowledge of Schutz, for which the interpretation is the connotation that governs the meaning of research focusing attention on the relationship between researcher and its subject of study, setting up the interpreter role of the researcher.

This search model has as its object of study the "ethno-methods", the procedures, the knowledges that members of a group use to communicate and interact daily.

Similarly, in a research group whose members belong to different institutions, the need to interact in a constructive way in order to implement the various phases of search requires a share of the project which must answer to a social-constructivist perspective, where the interest is to understand how social relations and the relationship with the Other (individual or group) involved in the process of construction of knowledge (Social Cognition). This is one of the fundamental reasons that drove our research group to experiment an integrated model in which university researchers and school teachers lead different (but joint) actions and aimed at a single goal.

Scientific paradigm

Motor and sport activities shape up as an heuristic tool of the experimental proposal and help to investigate the effectiveness of educational act; the scientific principle that inspires the method is based on the didactic value of meta-cognitive approach, applied both by university researchers in the educational path of teachers and by the teachers in the educational processes of students.

It is fundamental that the future primary school teachers acquire the importance of the meta-cognition methods, as well as in learning deficit (where can resolve in a positive way some problematic situations) than in any other learning/teaching process (where meta-cognition can serve as a vehicle for excellence).

"The modern pedagogy is increasingly convinced that the child should be aware of his thought processes and it is essential that the theorist of pedagogy and teacher help him in order to become more "meta-cognitive", to be aware not

only of matter that he is studying, but also of his own approach to action and thought. Acquiring skills and accumulate knowledge is not enough. The student can be helped to achieve full mastery reflecting on his way of dealing with the work and how to intervene in order to improve its approach. One way to help the student is provide a good theory of the mind or a theory of mental functioning" (Bruner 1997). Therefore through this experimental proposal it is useful to investigate the value of motor and sport activities as meta-cognitive methodology studying formative protocols for teachers (in input) and reflecting, through the action-research (Kemmis & Mc Taggart, 1982), on the value of innovative methods shared (researchers and teachers on duty) and their awareness of the teaching skills acquired during the educational practice in their classes.

In Italy Universities through both the Interuniversity Specialization School for Teaching and the education/update courses held at schools, respectively, qualify the teachers in order to work at school and those already on duty for teaching of physical education in secondary schools (junior high school and secondary school). For the primary school there is a degree course in Primary Education Sciences that provide for specific studies and experiences related to the methods and didactic of motor and sport activities; through the degree course in Primary Education Sciences University recognizes the educational value of motor and sports activities that become branch of learning, teacher training and laboratory (Sibilio, 2002). In particular the didactic laboratory is a model of research, expresses its application value thanks to a mix of scientific theories related to multiple interrelated disciplines (pedagogy, psychology, neuroscience, biology). The scientific plurality that supports the laboratory, as well as an attempt to reproduce approach to reality, representing a potential tool of interaction between man and environment, between humanities and exact sciences. Starting from the principle that "the human perception not simply reproduces the external reality, but reconstructs it" (Bartlett, 1932; Koffka, 1935), the integrated experimental model school-university is inspired by the Social Cognition, that is a scientific paradigm bear out in the field of cognitive psychology that deals with the study of the processes through which people acquire piece of information from the environment, code them, store them in memory and recover from it, looks at how the social context affects cognitive performance. Social Cognition, assigning a meaning to the input collected from the environment, try to establish the relationship between each new incoming information and the network of knowledge we already have; the organization of social knowledge therefore is based on cognitive patterns and structures that organize the information about an object of knowledge (Shank and Abelson, 1977);

If we consider that till now has not yet reached a full understanding of the application value of this theoretical paradigm and the supporting function of the corporeity to this approach (J. Lindblom & T. Ziemke, 2005), we justify the experimental hypothesis proposed.

Too often, in our opinion, the theoretical study based on the epistemology of motor and sport sciences don't favor the meeting between theory and practice, making didactically contextual the theoretical paradigms; the risk that result from this is to consolidate an abstractly value "concrete" of motor-sports experience, a training profile not able to encode the educational value of the movement.

Aims

The aim of this research is to demonstrate the effectiveness of inter-institutional system and formative network "University, School and Municipality" implementing an integrated model based on the Social Cognition that uses motor sports experience. The protocol provides for a phase of shared analysis and reflection on principles and methods of motor and sports science in educational field justifying, first of all, the educational role of the body and the movement for the formation and development of the person and stating the purpose, methods and aims in the various experimental activities proposed in the school.

The aims of the project, therefore, are:

- to place the school as centre of excellence related to the scientific nationally and internationally community through the collaboration with Universities in order to make the best use of skills, experts interventions, professionalism and in order to incorporate proposals and any further initiatives encouraged by institutions involved on the formative usage of motor and sport activities;
- to coordinate competences and functions of the most important Institutional and Educational Agencies operating in the national territory for the development of motor and sports activities, even with the prospect of change of Italian school system;
- to enhance the teaching of motor and sport activities as aspect of education, in collaboration with all other scientific-disciplinary circles, and to recognize the crucial role as way to access to knowledge in the schedule of schools of all levels.
- to build a centre for scientific research and related documentation, for a lifelong formation in motor and sports analyzing the educational-psychology, biological, methodological, technical and sociological implications.

The research protocol

The research protocol provides tasks for each institution as follows:

- Universities will be responsible for scientific coordination of research, preparing scientific tools, protocols and procedures and supervising the preparation of reports;
- School must make activate, manage and control motor and sport activities in the morning and in the afternoon, coordinating the organizational and educational level of scientific research on issues related to implementation;
- Municipality feature to support the project by contributing to the improvement of educational services and favoring the construction of a research centre for scientific monitoring of motor and sport activities in the national territory.

The organizational structure of the project

The first testing of this protocol provides for an agreement between the fourth Didactic Circle of Giugliano (Naples-Italy), the Department of Science of Education of the University of Salerno (Italy) and the Municipality of Giugliano in Campania, home city of school and a scientific collaboration in the analysis of the results with the University Kore of Enna (Italy).

The project invests three macro-areas, as a scientific research fields:

1. The first, educational area, is aimed at building knowledge through the body, movement and play sports. The educational action will be address to the bodily, cognitive and relational experiences, with the aim of interpreting the subjective potential referring to the environment considered as an enhancement of acoustic-noise, visual-gestural, chemical and emotional, physical or tactile or else expression. Then it will put into practice work on cultures of the body as: verbal or gestural languages; psycho-cognitive principles and communication; pedagogy of body and movement.
2. The second, playful and recreational area, provide for activities aimed to reach physical wellbeing, formation and socialization of the person. The organization of games within the rules are respected and are used the roles, is an essential starting point and an interdisciplinary basis for the consolidation of character and citizenship. In addition, the fun- recreational time proposed shall promote the need for affirmation of the body, the acquisition of a sense of identity through exploration, appropriating the capacity of a "know-how changeable" and its reorganization should make plastic the motion. Therefore it is necessary to explore new functional strategies in order to a remodeling the new situation by performing specific experiences related to interculture and inclusive education: different visions of the body; gestures: universal and cultural aspects; gesture and non-verbal communication in sports games; game-sport: group dynamics. Currently, the sport has lost much of its educational role and the project aims to establish and represent a tool to restore the original role that pertain to the sport in the development of the person and his inclusion in society.

The key points of the research will be: an awareness of sport as an open and fair contest; an awareness of sport as way to channel needs, affirmation, socialization, healthy competition; refusal of sport as a moment of violence and oppression.

Conclusions

Our integrated model of research represents a new way to investigate the value of motor and sports activities, activating a cultural connection between the school and the university, where the reliability of scientific research is powered by a wealth of scientific paradigms in the same wavelength as a school experimental that does emerge in the "situation" the effectiveness of the theoretical model and is a constant feedback for teaching and a verification tool.

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RESEARCH OF SWIMMERS' COORDINATION

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Abstract

The aim of our research was to bring new knowledge about the level and relationships between coordination abilities on land and swimming skills of swimmers with different performance level. The results showed similarity of relationships. The group of 9-11 years old swimmers showed similar relationships between dependent variables (swimming performance) and special swimming tests as well as the group of 12-14 years old swimmers, whilst the number and size of statistic relationships was not as high as in the other group. The same result was found in both groups in the test of space orientation on land with all the dependent variables. It seems that coordination abilities especially space orientation is for swimmers significant and its level is important for swimming performance.

Key words: *coordination abilities on land, swimming skills, 9 – 14 years old swimmers, sport swimming*

Introduction

The water environment creates a lot of specific impulses not only on somatic, physiologic but also on sensomotoric system, whilst all these impulses work as a compact unit. Swimming as itself has relatively simple kinematic structure of movement, which is highly determined by the character of water environment (pressure, buoyancy, resistance, density). The process of sensomotoric adaptation to this special environment and the learning of swimming skills are affected by sensomotoric perception, what is the basic condition to develop coordination abilities. With respect to this not enough examined area, the aim of our research in a grant called "Study of human motor behaviour in water environment "which is solved at the Department of Swimming at the Faculty of Physical Education and Sport, is to find relationships between the motor behaviour on land and the in water and to modernize motor test for evaluation of swimming skills.

At the beginning of swimming courses you learn basic swimming skills (floating, breathing, buoyancy, diving, orientation in water). The first aim of swimming course is to get the feeling you are safe in water (Macejková, 2007). The basic swimming skills are the first step to learn swimming technique. The professionals agree that all the particular skills are in swimming locomotion performed as one skill called swimming. The balance, orientation and rhythm are performed in swimming skills as well as in technique of swimming strokes. However, the relationship with coordination on land is not exactly known or stated. It is important to say that we do not speak only of motor performance but also of the quality of sensomotoric perception which is known as "feeling for water". Didactics and evaluation of swimming skills have always played a great role (Jursík, 1977; Blaser and co. 1984; Čechovská, 2002).

In the recent years there has been a lot written about coordination abilities of school population but all of that has been aimed at coordination on land (Hirtz, Měkota, Starosta, Šimonek). However, the relationships between the coordination on land and in water have still not been completely revealed. The reason is impossibility of comparing the influence of external environment and the fact that there are not validated tests for coordination in water.

The development of condition and coordination abilities at the beginning of sport training is highly related to the sensitive period of school attendance. Although there are more opinions about the sensitive periods for coordination abilities, mostly we speak of intensive phase of development between 7 and 12 years (Hirtz, 1985; Starosta-Hirtz, 1989; Belej -Junger,2006 and others).

The perfect technique of the best sportsmen reaches the top which is very difficult to be developed without perfect specific coordination skills (Ljach, 1988).

According to Jursík (1977) and Arold (1979) in the first phase of swimming the level of balance, rhythm and space orientation affect the quality, accuracy and pace of learning the basic swimming skills.

Turek (1998) had a research where at the base of input and output diagnostics of special swimming performance of various age and performance groups (n=627, probands), he tried to hypothetically determine the quality of proprioception which could be called "feeling for water". Its level is, according to author, conditioned by inborn dispositions and level of coordination abilities.

Stejskal (1995) after discussion with Hungarian swimming coaches, came to a conclusion that there should be paid higher attention to development of rhythm abilities. Stejskal (1996) thinks that swimming beginners need coordination

abilities which are strongly related to docility of a swimmer. He points out that the rhythm and pace have a common physiological base with creating swimming movements.

Benčuriková (2001) was looking for the relationships between the level of swimming capability, somatometric indices and selected indices of general motor performance in a group of girls n=393 aged 14-15. Multiple correlation analysis showed that the biggest partial rate in explaining the variance of changes in swimming capability have the physical height, aerobic endurance and coordination abilities (obstacle track). The rate of determination was higher in the test 50m freestyle. In the test 100m freestyle the order of determination factors was physical height and coordination abilities.

Coordination abilities are very difficult to be diagnosed. The reason is that they are built of partial abilities which together make one unit. The reliability of tests (Mekota, 2000) is between 0,3-0,5 whilst the balance tests and tests of accuracy are the least reliable. The author points out that it is necessary to monitor whether the score is a demonstration of genetic, biological abilities or upbringing. Therefore it is important to carefully interpret the found results (especially the found effects).

The aim of the research was to bring knowledge about the relationships between the level of coordination abilities on land and swimming skills of swimmers with various level of performance.

Methods

There were two groups of swimmers involved in the research. One group was made of 47 swimmers aged 9-11 years (28 girls, 19 boys), which were attending an intermediate swimming course. It was their second year of regular swimming 3 times a week. The second group was made of 34 swimmers aged 12-14 years (18 girls and 16 boys). The swimmers were attending a sport swimming training and it was their fourth year. They trained regularly 7 times a week. One third of the second group participated and won medals at the Slovak Swimming Championship in the concrete age category.

Tests of coordination on land and tests of swimming skills were the independent variables. We tested on land (Šimonek, 1998; Měkota-Blahuš, 1983):

(plam) – one foot stand on land, eyes closed,

(svih) – rope skipping,

(lopty)– run to base,

(ten) –throw with tennis ball on accuracy from sitting position.

Swimming skills:

(Sss) – floating with push off of the pool side, with open eyes,

(Sbz) - floating with push off of the pool side, with eyes closed,

(Vrt) – propeller with eyes closed,

(Jump) – jump over noodle in water height to the breast, time limit 15s.

The dependent variables were:

(SV0) – time of the obstacle track,

(SV1) – guess of time for 50m freestyle at 70% of max,

(SV2) – time of 50m freestyle,

(SV3) – time of 50m backstroke.

The obstacle track was made of stands to evaluate basic swimming skills:

St. 1 water entry – jump, legs in front, run to the second stand,

St. 2 breathing – 3x inspiration, expiration in circles,

St. 3 orientation under water – diving for 3 pucks,

St. 4 push-off of the pool side – floating max 5m,

St. 5 swimming 12,5m (width of the pool).

For evaluation of the relationships we used the Spearman correlation coefficient, to evaluate the differences in groups we used non-parametric t-test for independent selections. We did not take into account intersexual differences.

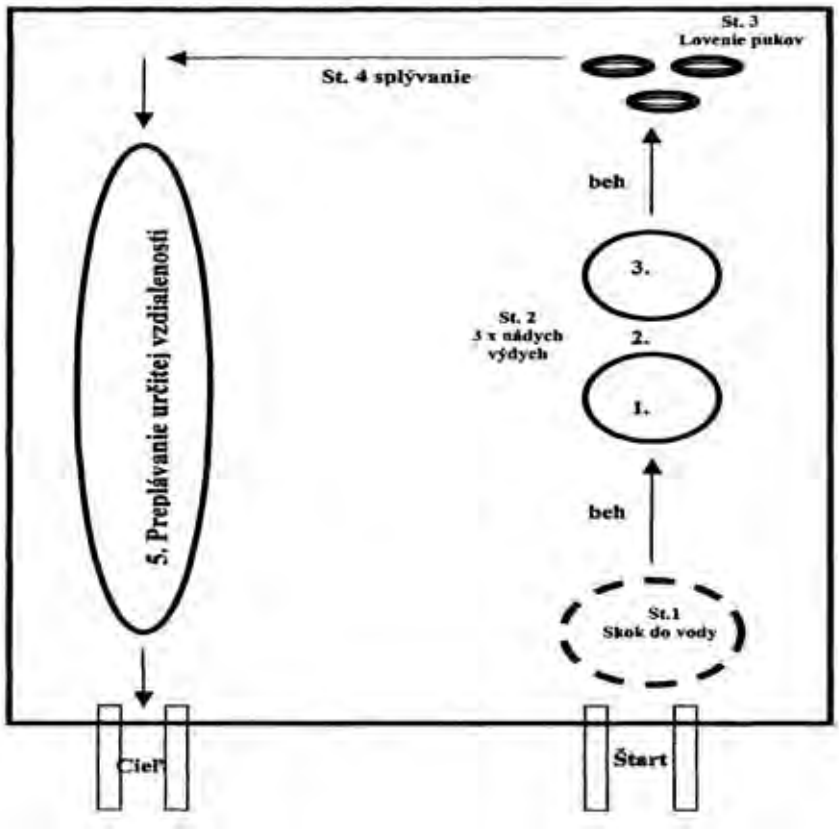

Fig. 1 Obstacle track in water (Macejková, 2007)

Results

Empiric findings validate that the swimming skills and swimming technique are determined by the length of swimming training. High statistic significance of differences between the groups of swimmers showed that the older swimmers reach better performance level (tab 1,2,3). We found great differences between the groups in the test of static balance and in the test of space orientation for the benefit of better swimmers.

The level of swimming skills was significantly higher in the group of older swimmers in the tests jump over the noodle, propeller, floating with eyes closed. In the group of 9-11 years old swimmers there were found relationships between the tests of coordination on land and the level of static balance and space orientation (run to base r=0,550) with all the dependent variables (tab.4). Bigger number of correlation relationships was found between the tests on land and swimming skills of younger swimmers. Especially space orientation seems to be important coordination ability in swimming locomotion. In the group of older swimmers this ability seems to be very important in maximum performance of 50m freestyle and 50m backstroke. A dependent variable, kinaesthetic-differentiation ability, guess of 70% intensity of maximum in 50m freestyle, we consider this as not appropriate for this age group. The relationships between swimming skills showed high correlations, which shows a similarity of motor tests whilst most of them are performed in floating position.

On the basis of our results it is possible to say that space orientation is significant coordination ability of swimmers. We think that its high level is a result of swimming training and also play an important role in swimming locomotion.

Table 1. Statistic character of variables (swimmers 9-11 y. n = 47)

	Plam.(s)	Švih.(s)	Lopty(s)	Ten.(m)	Sss(m)	Sss(s)	Sbz(m)	Sbz(s)	Vrt.(m)	Vrt.(s)	Skok.(n)
aritm.pr.	19,65	1,681	8,672	0,515	5,178	8,326	4,993	8,354	2,860	4,616	12,26
smer.od.	11,30	2,071	0,831	0,185	1,118	2,051	1,274	1,993	1,611	2,592	2,471
median	15,75	1,10	8,56	0,45	5,25	7,95	4,90	8,12	3,15	5,00	12,00
min.	4,25	0,00	7,16	0,25	3,25	4,45	3,05	3,90	0,00	0,00	6,00
max.	57,70	11,00	10,30	0,95	7,95	14,00	8,35	13,70	5,30	8,35	18,00
var.rozp.	53,45	11,00	3,14	0,70	4,70	9,55	5,30	9,80	5,30	8,35	12,00
počet	47	38	47	47	47	47	47	47	47	47	47

Table 2. Statistic character of variables (swimmers 12-14 y. n = 34)

	Plam.(s)	Švih.(s)	Lopty(s)	Ten.(m)	Sss(m)	Sss(s)	Sbz(m)	Sbz(s)	Vrt.(m)	Vrt.(s)	Skok.(n)
aritm.pr.	44,46	1,322	7,622	0,525	6,459	9,811	6,343	9,615	4,744	6,641	17,26
smer.od.	38,67	1,073	0,842	0,212	1,231	3,017	1,263	2,632	1,025	1,638	2,756
median	31,55	1,00	7,66	0,53	6,18	9,25	6,25	9,33	4,68	6,68	17,00
min.	10,46	0,00	6,00	0,10	4,10	5,43	4,40	5,90	2,70	3,30	13,00
max.	159,0	4,1	9,1	1,1	8,9	21,5	9,6	20,3	7,2	9,4	23,0
var.rozp.	148,5	4,1	3,1	1,0	4,8	16,0	5,2	14,4	4,5	6,1	10,0
počet	34	33	34	34	34	34	34	34	34	34	34

Table 3. The differences between groups in the level of coordination abilities

Test	4,167**	0,894	5,580**	0,228	4,876**	2,638*	4,723**	2,456*	5,993**	4,010**	8,578**
	p < 0,01		p < 0,01		p < 0,01	p < 0,05	p < 0,01	p < 0,05	p < 0,01	p < 0,01	p < 0,01

Legend: Plam.: static balance – one foot stand on land , eyes closed, Švih.: rhythm, rope skipping, Lopty: space orientation – run to base, Ten.: kinesthetic –differentation ability – throw on accuracy from sitting position, Sss (m): floating wih eyes open (length), Sss (s): floating with eyes open (time), Sbz (s): floating with eyes closed (length), Sbz (m): floating with eyes closed (time), Vrt. (m): propeler with eyes closed (length), Vrt. (s): propeler with eyes closed (time), Skok.: swimming motor test – jump over noodle in water height to the breast, time limit 15s.

Table 4. Correlation relationships between coordination abilities and swimming skills (swimmers 9-11 y. n = 47)

	Plam.(s)	Švih.(s)	Lopty(s)	Ten.(m)	Sss(m)	Sss(s)	Sbz(m)	Sbz(s)	Vrt.(m)	Vrt.(s)	Skok.(n)	SV1	SV2	SV3
Plam.(s)	1													
Švih.(s)	-0,060	1												
Lopty(s)	-0,208	0,100	1											
Ten.(m)	-0,133	-0,117	-0,009	1										
Sss(m)	**0,308***	-0,016	**-0,462****	-0,191	1									
Sss(s)	0,223	0,147	-0,230	-0,172	**0,712****	1								
Sbz(m)	0,154	-0,002	**-0,526****	-0,241	**0,875****	**0,547****	1							
Sbz(s)	0,062	0,102	**-0,391****	**-0,339***	**0,679****	**0,700****	**0,776****	1						
Vrt.(m)	0,253	**-0,471****	**-0,381****	-0,019	**0,529****	**0,296***	**0,541****	**0,361***	1					
Vrt.(s)	0,205	**-0,495****	-0,255	0,014	**0,395****	**0,316***	**0,390****	**0,320***	**0,897****	1				
Skok.(n)	0,235	-0,017	**-0,377****	-0,217	**0,540****	0,274	**0,547****	**0,414****	**0,409****	0,279	1			
SV1	**-0,335***	0,043	**0,550****	0,278	**-0,564****	-0,135	**-0,610****	**-0,352***	**-0,634***	-0,207	**-0,631****	1		
SV2	-0,250	0,195	**0,473****	-0,041	**-0,509****	-0,211	**-0,546****	**-0,322***	**-0,313***	-0,185	**-0,566****	**0,632****	1	
SV3	-0,279	0,246	**0,382****	0,001	**-0,475****	-0,243	**-0,502****	-0,278	**-0,378****	-0,267	**-0,561****	**0,547****	**0,926****	1

Poznámka: ** p < 0,01 (rk = 0,372); * p < 0,05 (rk = 0,287)

Legend: Plam.: static balance – one foot stand on land , eyes closed, Švih.: rhythm, rope skipping, Lopty: space orientation – run to base, Ten.: kinesthetic –differentation ability – throw on accuracy from sitting position, Sss (m): floating wih eyes open (length), Sss (s): floating with eyes open (time), Sbz (s): floating with eyes closed (length), Sbz (m): floating with eyes closed (time), Vrt. (m): propeler with eyes closed (length), Vrt. (s): propeler with eyes closed (time), Skok.: swimming motor test – jump over noodle in water height to the breast, time limit 15s., SV1: guess of time for 50m freestyle at 70% of max, SV2: 50m freestyle, SV3: 50m backstroke.

Table 5. Correlation relationships between coordination abilities and swimming skills (swimmers 12 – 14 y. n = 34)

	Plam.(s)	Švih.(s)	Lopty(s)	Ten.(m)	Sss(m)	Sss(s)	Sbz(m)	Sbz(s)	Vrt.(m)	Vrt.(s)	Skok.(n)	SV1	SV2	SV3
Plam.(s)	1													
Švih.(s)	-0,172	1												
Lopty(s)	0,005	0,313	1											
Ten.(m)	**-0,375***	-0,012	-0,077	1										
Sss(m)	-0,338	-0,008	-0,019	0,044	1									
Sss(s)	-0,269	0,014	0,215	-0,056	**0,771****	1								
Sbz(m)	**-0,354***	0,023	-0,129	0,155	**0,876****	**0,687****	1							
Sbz(s)	-0,280	-0,020	0,003	0,005	**0,727****	**0,911****	**0,789****	1						
Vrt.(m)	-0,300	-0,123	**-0,366***	0,275	**0,721****	**0,349***	**0,725****	**0,422***	1					
Vrt.(s)	-0,298	-0,185	-0,237	0,151	**0,745****	**0,551****	**0,694****	**0,544****	**0,864****	1				
Skok.(n)	0,013	-0,086	**-0,368***	-0,253	-0,249	-0,237	-0,220	-0,100	-0,074	-0,152	1			
SV1	0,165	**0,370***	**0,544****	-0,131	-0,173	0,035	-0,222	-0,103	-0,170	-0,098	-0,349	1		
SV2	0,261	0,195	**0,543****	-0,075	**-0,426***	-0,122	**-0,457****	-0,274	**-0,563****	**-0,452****	-0,287	**0,455***	1	
SV3	0,171	0,278	**0,531****	0,025	**-0,433***	-0,061	**-0,436***	-0,225	**-0,611****	**-0,447****	-0,296	**0,403***	**0,909****	1

Legend: Plam.: static balance – one foot stand on land , eyes closed, Švih.: rhythm, rope skipping, Lopty: space orientation – run to base, Ten.: kinesthetic –differentation ability – throw on accuracy from sitting position, Sss (m): floating wih eyes open (length), Sss (s): floating with eyes open (time), Sbz (s): floating with eyes closed (length), Sbz (m): floating with eyes closed (time), Vrt. (m): propeler with eyes closed (length), Vrt. (s): propeler with eyes closed (time), Skok.: swimming motor test – jump over noodle in water height to the breast, time limit 15s., SV1: guess of time for 50m freestyle at 70% of max, SV2: 50m freestyle, SV3: 50m backstroke.

Conclusion

In our research we monitored the level of coordination skills on land (4 tests) and in water (7 tests) of swimmers in the age of 9-14 years (n=34). To evaluate coordination skills in water – except the test floating- we suggested new motor tests for evaluation of coordination in water (jump over noodle, propeller - turn of 360° in floating position). The dependent variable was a sport performance in disciplines 50 m freestyle, 50 m backstroke and a speed guess (70% of best performance). We found statistically significant relationships between the level of space orientation evaluated by test on land and all dependent variables in water.

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FROM "PHYSICAL FITNESS" THROUGH "MOTOR COMPETENCE" TO THE "POSSIBILITY OF ACTION"

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Abstract

Conscious physical activity of person is a topic of study many detailed scientific disciplines. The purpose of this study is a general review model for possibility of action. Model based on praxeology criteria and concerns external actions (requiring muscle work). Defined motives underlie each physical work includes mental elements (internal operations). Based on many experiments we have ascertained that near 10% persons (among athletes and no athletes) were maximum motivated to make all motor tasks that required precision of action (e.g. to hit the basket from distance with a fixed number of balls). Tasks put into practice before, after warm up and after multiple, intensive physical exercises. The results of recommended tests: physical fitness, motor competence etc. do not take into consideration motivation factor. Forecasting based on success in suitable activity (e.g. during sport fight) is burdened high error. Model of estimate for possibility of action of person takes into consideration: a) flexible feasibility measurement (motor simulation of the elements in suitable activity and level of motivation for this activity), b) estimation of situational feasibility, c) decision if subject has full possibility of action, d) correction of the level "a" & "b".

Key words: *flexible feasibility – situational feasibility – complete possibility of action*

MEASURING CHARACTERISTICS OF THE TEST QUESTIONNAIRE FOR THE EVALUATION OF SPORTS THEORETICAL KNOWLEDGE AFTER THREE YEARS OF EDUCATION

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Abstract

The article reviews measuring characteristics of the test questionnaire, which was used for the evaluation of sports theoretical knowledge of pupils of both genders after three years of compulsory education. The sample of measured subjects is characteristic for Slovenia and includes 209 girls and 221 boys. The questionnaire consists of 21 closed-type test questions that incorporate all the main areas from the Years 1-3 primary school curriculum. The results indicate that the questionnaire has suitable measuring characteristics. The questions included in the questionnaire characterize it as an easy questionnaire. The questionnaire well differentiates the level of acquired knowledge and is adequate for both genders.

Key words: *physical education, evaluation, theoretical knowledge, questionnaire, measuring characteristics*

Introduction

A number of authors (Zorman, 1974; Jurman, 1989; Sagadin, 1993; Bucik 2000; Cencič, 2000; Marentič Požarnik, 2000, in Majerič, 2004) have been discussing the implication of validity, reliability, objectivity and sensitivity when analysing the measuring characteristics in the evaluation of knowledge. Test questionnaires are used frequently in the evaluation of knowledge; difficulty and discrimination of questionnaires and their adequacy according to gender are being analysed.

Several Slovenian authors (Hribar, 2002; Hribar, Dežman and Pocrnjič, 2002; Katavič, 2002; Kovač, 2002; Peček, 2002; RIC, 2003, 2004; Štemberger, 2003; all in Majerič, 2004; Majerič, Strel and Kovač, 2008) have been examining the efficiency of teaching in physical education; for different age groups they have analysed the level of acquired theoretical knowledge. Authors used objective type test questionnaires whilst analysing *difficulty* and *discrimination* of questionnaires.

Difficulty of test questions is assessed with the difficulty index (TI), which displays the percentage ratio of pupils that have solved the question correctly (RIC, 2000). Zorman (1974) states that a difficulty of test questions should have a percentage ratio between 50 and 80% (TI = 0,50–0,80), whereas multiple-choice questions should have the optimum difficulty and a percentage ratio of 60% (TI = 0,60); therefore, the difficulty index of the whole test questionnaire should be between 0,5 and 0,6. Analyses of the final examination of academic subjects (RIC, 2000) stipulate that the difficulty of test questions for the evaluation of theoretical knowledge is defined with the following percentage of pupils, who can solve it: very difficult less than 20%, difficult less than 30%, easier less than 70% and easy between 90-100%.

Differentiation of test questions is assessed with the differentiation index, which reveals if pupils differ according to the level of acquired knowledge (Zorman, 1974; RIC; 2000). Test questions are well chosen if they differentiate pupils with more knowledge from those with less knowledge. The former pupils should be able to answer the questions better in comparison with the latter pupils. Several authors (Hribar, 2002; Hribar, Dežman and Pocrnjič, 2002; Peček, 2002; all in Majerič, 2004; Majerič, Strel and Kovač, 2008) have used Ebel's differentiation classification (in Zorman, 1974; RIC, 2000) in order to evaluate the differentiation of test questionnaires for examining the theoretical knowledge. Ebel's classification regards as very good questions those with the differentiation index 0,49 or more; good are questions with the index between 0,30 and 0,39, whereas for school purposes questions with the index between 0,20 and 0,29 are still considered satisfactory. Questions with the differentiation index of less than 0,20 as inadequate questions are considered.

The purpose of the present article is to find out if the questionnaire, used for the examination of theoretical knowledge of a given sample of Slovenian pupils of both genders who finished three years of compulsory education, has suitable measuring characteristics.

Review of some comparable data

Only a few studies on the examination of measuring characteristics of test questionnaires about physical education have been carried out in Slovenia. Their review is presented in continuation.

First, the RIC reports state that between the years 2002 and 2004, at the external examination of physical education at the end of compulsory education, the total difficulty indexes of questionnaires applied were between 0,64 and 0,72 and the differentiation indexes were between 0,22 and 0,42 (Kovač, 2002; RIC, 2003; 2004; all in Majerič, 2004). External education at the end of nine-year compulsory education has changed since 2004: the Minister of education and sport decides on the last of the academic subjects; in the last four years physical education has not yet been selected.

Second, Štemberger (2003, in Majerič, 2004) analysed the theoretical knowledge at the end of first three years of primary school with the use of a questionnaire with a difficulty index of 0,55.

Third, Peček (2002, in Majerič, 2004) analysed the difficulty and differentiation of a test questionnaire for examination of the theoretical knowledge of basketball in the Year 5 of primary school. Difficulty index of individual topic clusters (rules, technique, tactics) was between 0,61 and 0,67, whereas the differentiation index was between 0,34 and 0,55.

Fourth, Hribar (2002, in Majerič, 2004) analysed the difficulty and differentiation of a test questionnaire for examination of the theoretical knowledge of football in the Year 5 of primary school. The average difficulty index was 0,63 and the average differentiation index was 0,29.

Fifth, Katavič (2002, in Majerič, 2004) analysed the difficulty of a test questionnaire for the evaluation of theoretical knowledge of volleyball in Year 5 of primary school. Difficulty index of individual questions from different topic clusters (rules, technique, tactics) was between 0,35 and 0,65.

Finally, Majerič, Strel and Kovač (2008) studied the characteristics of a test questionnaire for the evaluation of sports theoretical knowledge of pupils of both genders after six years of compulsory education. The average difficulty index of boys was 0,71 and of girls 0,70. The differentiation index for the whole questionnaire was 0,50 for boys and 0,21 for girls.

Methodology

The sample of measured subjects included 209 girls and 221 boys from 11 primary schools. All the subjects have finished three years of education and the parents have given written consent for their inclusion in the study. The sample is characteristic for Slovenia, as it was stratified across the regions. Data were collected within the framework of study by Strel et al. (2003), the set protocol fro data collection was used in September and October 2003.

Sample of chosen variables is represented by 21 test questions for the evaluation of theoretical knowledge (Kovač and Majerič, 2003). Questions were closed-type (4 multiple choice answers) and they incorporated all the main areas from the physical education curriculum (Kovač and Novak, 1998). Simple descriptive statistics parameters were calculated for all the variables with the use of SPSS for Windows statistical package.

Analysis of test questions was due to its simplicity and reliability carried out as per Zorman (1974) and RIC (2000), in order to determine the difficulty and discrimination of the test questionnaire. Pupils were first classified from the lowest to the highest number of points achieved. Afterwards, pupils were divided according to the number of points into three approximately equal size groups: better, medium and worse group (see Table 1). The calculation of difficulty and differentiation index has been done separately for boys and girls.

Table 1. Frequency and percentage of correct answers and groups selection

ŠPO	Boys					Girls				
	f	%	SK	SK (f)	SK (%)	f	%	SK	SK (f)	SK (%)
5	1	0,48	1 - worse	60	28,71	0	0,00	1 - worse	61	27,60
6	1	0,48				1	0,45			
7	1	0,48				1	0,45			
8	0	0,00				2	0,90			
9	2	0,96				3	1,36			
10	3	1,44				2	0,90			
11	6	2,87				5	2,26			
12	6	2,87				1	0,45			
13	8	3,83				4	1,81			
14	12	5,74				21	9,50			
15	20	9,57				21	9,50			
16	33	15,79	2 - medium	68	32,54	41	18,55	2 - medium	79	35,75
17	35	16,75				38	17,19			
18	33	15,79	3 - better	81	38,76	25	11,31	3 - better	81	36,65
19	31	14,83				28	12,67			
20	16	7,66				23	10,41			
21	1	0,48				5	2,26			
Total	209	100,00		209	100,00	221	100,00		221	100,00

ŠPO – number of correct answers; f – frequency, % – percentage; SK – groups;

Difficulty index was established by calculating the percentage of measured subjects that have solved a certain question correctly. The following formula was used (Zorman, 1974; RIC, 2000):

Difficulty = P/S x 100.

(P – number of pupils who solved the question correctly; S – total number of pupils who were given the question).

Differentiation index was calculated by first establishing how many measured subjects from the better groups and how many from the worse group have solved a given question correctly; then, the number of correct answers of worse groups was subtracted from the number of correct answer of better group and finally divided with the half the number of boys or girls, included in the analysis. The following formula was used (Zorman, 1974, RIC, 2000):

Differentiation = $P_b - P_s / ½ S$.

(P_b – number of pupils from better group who answered the question correctly; P_s – number of pupils from worse group who answered the question correctly; S – total number of pupils who were given the question).

Results

Table 2. Difficulty index for questions and topic clusters

ŠV	VS	Girls				Boys			
		PO (f)	PO (%)	ITV	ITS	PO (f)	PO (%)	ITV	ITS
11	1	22	10,53	0,11	0,11	21	9,50	0,10	0,10
1	2	141	67,46	0,67	0,81	174	78,73	0,79	0,88
2	2	199	95,22	0,95		213	96,38	0,96	
16	3	175	83,73	0,84	0,38	178	80,54	0,81	0,84
18	3	191	91,39	0,91		189	85,52	0,86	
6	4	79	37,80	0,38	0,68	125	56,56	0,57	0,75
7	4	203	97,13	0,97		205	92,76	0,93	
3	5	196	93,78	0,94	0,90	205	92,76	0,93	0,88
4	5	179	85,65	0,86		183	82,81	0,83	
5	6	189	90,43	0,90	0,93	190	85,97	0,86	0,90
15	6	198	94,74	0,95		205	92,76	0,93	
8	7a	200	95,69	0,96	0,77	210	95,02	0,95	0,81
9	7a	133	63,64	0,64		162	73,30	0,73	
10	7a	146	69,86	0,70		164	74,21	0,74	
12	7b	176	84,21	0,84	0,81	195	88,24	0,88	0,80
13a	7b	197	94,26	0,94		199	90,05	0,90	
13b	7b	192	91,87	0,92		193	87,33	0,87	
13c	7b	143	68,42	0,68		145	65,61	0,66	
13d	7b	144	68,90	0,69		147	66,52	0,67	
14	7c	155	74,16	0,74	0,77	179	81,00	0,81	0,79
17	7c	165	78,95	0,79		171	77,38	0,77	
Total all questions			77,99	0,78			78,71	0,79	

ŠV: number of question; VS – content groups; f – frequency, % – percentage; PO – correct answers; ITV – difficulty index for questions; ITS – difficulty index for content groups

Key to the tables 2 and 3:

Groups:	
General knowledge	1. general sports terminology
	2. physical characteristics and motor abilities
	3. sport and safety
	4. sports behaviour
	5. the rules of sports exercising and effect on human body
	6. sport and health
Knowledge of individual sport disciplines	7. a) track and fields, gymnastics, dance
	b) basketball, handball, football, volleyball
	c) walking, swimming, skiing

Table 2 reveals that the difficulty index of the whole questionnaire did not differ between genders, as the value was 0,78 in girls and 0,79 in boys.

Table 3 reveals that the differentiation index of the whole questionnaire did not differ significantly according to gender, as the value was 0,34 in girls and 0,32 in boys.

Table 3. Differentiation index for individual questions and topic clusters

ŠV	VS	Girls		Boys	
		IDV	IDS	IDV	IDS
11	1	0,08	0,08	0,07	0,07
1	2	0,38	0,33	0,32	0,27
2	2	0,27		0,22	
16	3	0,38	0,36	0,41	0,38
18	3	0,33		0,35	
6	4	0,21	0,22	0,33	0,30
7	4	0,23		0,27	
3	5	0,29	0,31	0,27	0,30
4	5	0,33		0,32	
5	6	0,34	0,32	0,31	0,31
15	6	0,30		0,30	
8	7a	0,25	0,37	0,22	0,32
9	7a	0,48		0,36	
10	7a	0,38		0,37	
12	7b	0,36	0,41	0,32	0,38
13a	7b	0,31		0,33	
13b	7b	0,34		0,35	
13c	7b	0,51		0,46	
13d	7b	0,52		0,44	
14	7c	0,47	0,44	0,33	0,36
17	7c	0,40		0,38	
Total all questions		0,34		0,32	

ŠV: number of question; VS –content groups; f – frequency, % – percentage; PO – correct answers; IDV – differentiation index for questions; IDS – differentiation index for content groups

Discussion and conclusions

The results indicate that the questionnaire used is an easy questionnaire (according to Zorman, 1974, RIC, 2000), as the difficulty index was 0,79 for boys and 0,78 for girls. Therefore, in future the questionnaire should include also more difficult questions or a different type of questions should be used (open answers). A comparison of genders does not reveal significant differences from the difficulty aspect, indicating that pupils have acquired knowledge in the physical education lessons, as in general boys know more about sport than girls (RIC, 2004). Analysis of the differentiation of the questionnaire indicates that the questionnaire consists of good test questions. There are no significant differences between genders, as the differentiation index for girls was 0,34 and for boys 0,32. The consistency of questions is good, as the better groups of boys and girls showed higher level of acquired knowledge in all tests, therefore, questions have well differentiated measured subjects with more knowledge from those with less knowledge. A comparison of differentiation index with similar studies (Hribar, 2002; Hribar, Dežman and Pocrnjič, 2002; Peček, 2002; RIC 2003, 2004; all in Majerič, 2004; Majerič, Strel and Kovač, 2008) showed that the differentiation index was between 0,20 and 0,55. Similar to difficulty, data cannot be directly compared or generalised due to the different structure of question and different samples. In conclusion, it can be said that the questionnaire has suitable measuring characteristics according to the methodology used and that it is suitable for the evaluation of knowledge after three years of education.

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ASSESSING ESP IN KINESIOLOGY STUDENTS

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Abstract

A random sample of 62 fourth-year students – 37 men and 25 women – with the Faculty of Kinesiology University of Zagreb (Croatia) participated in this analysis. The aim was to identify any possible differences between genders on the one hand, and students belonging to one of the three specialization groups (*Sport, Physical Fitness Training/Physical Conditioning and Kinesiological Recreation*) on the other. *Gender* and *specialization group* were used as two categorical predictors for the multivariate two-factor analysis of variance which showed no significant differences either between genders or between the three specialization groups as regards their *written test mark in the subject English language in the third year of the kinesiology study*, the *final examination mark in the subject English language in the third year of the kinesiology study, the sum of 28 dictation items test scores* and *the sum of 28 translation items test scores* that served as dependent variables. The presented results make it possible to conclude that all the tasks both at the examination in the third year of the kinesiology study (written and oral examination) and at the dictation and translation tests given to the students in the fourth year of the kinesiology study were well structured and well balanced.

Key words: *vocabulary, dictation, translation, written test, oral examination*

Introduction

Assessing vocabulary is one among the several foci in language testing (see, e.g., Read, 2000; Nation, 2001). In testing language for specific purposes (LSP) attention is paid to gaining an insight into the contextualized communicative language ability of learners. In learners of English as a foreign language, particularly *English for Specific Purposes* (ESP), assessing vocabulary produces valuable results that can be further used to outline the vocabulary size necessary for a certain group of target learners. According to Douglas (2000, p. 2), there are two aspects that distinguish LSP from more general purpose language testing: *authenticity of task* and the *interaction between language knowledge and specific purpose content knowledge*. The former relates to the fact that test and non-test tasks should be linked, and the latter to the fact that background knowledge is an integral part of the concept of specific purpose language ability (Douglas, 2000, p. 2). The tests can yield results that can reflect various aspects necessary both for the teacher and for the learner.

Two very important facts are to be considered here. The first one relates to the ways in which new vocabulary is learned. There are researchers who argue that intentional learning results in better vocabulary acquisition (for example, Hulstijn, 1992), but there are also researchers such as Smidt and Hegelheimer (2004) who say that it has been agreed that most vocabulary is acquired incidentally. The second important fact relates to the cognitive language learning approach. According to Chamot and O'Malley (1996), cognitive learning theory considers learners to be active participants in the teaching-learning interaction. To research into this topic the *Cognitive Academic Language Learning Approach (CALLA)* was designed which represents a valuable model in foreign language teaching practice because it fosters the achievement of English language learning students by integrating content-area instruction with language development (Chamot & O'Malley, 1996).

Methods

The aim of this study was to identify any possible differences between genders on the one hand, and students belonging to one of the three elective applied kinesiology specialization groups on the other – *gender* and *specialization group* being two categorical predictors - as regards their *written test mark in the subject English language in the third year of the kinesiology study*, the *final examination mark in the subject English language in the third year of the kinesiology study, the sum of 28 dictation items test scores* and *the sum of 28 translation items test scores* – the two tests given to the fourth-year students - that were used as dependent variables.

A random sample of 62 fourth-year students – 37 men and 25 women – with the Faculty of Kinesiology University of Zagreb (Croatia) participated in this study. The students were aged 21–27 years (average age: 22.73 years). All 62 students enrolled in the optional subject *English language* in the fourth year of the kinesiology study at the Faculty of Kinesiology University of Zagreb upon passing the examination in the obligatory subject *English language* in the third year of the kinesiology study. The dictation and the translation tests were given to the students before the end of the eighth semester

(the second out of the two semesters in the fourth year of the kinesiology study). Twenty (n=20; 32.26%) students chose *Sport* (various sports were chosen such as sailing, swimming, football, judo, artistic gymnastics or team handball) as their specialization in the fourth year of the kinesiology study, thirty-two (n=32; 51.61%) chose *Physical Fitness Training* or *Physical Conditioning* and ten (n=10; 16.13%) chose *Kinesiological Recreation* (Table 1).

Table 1. Number of male and female students per specialization group. (Legend: PhCon = Physical Conditioning; PhFT = Physical Fitness Training; KinRec = Kinesiological Recreation)

SPECIALIZATION	MALE	FEMALE
Sport	11	9
PhCon & PhFT	19	13
KinRec	7	3
TOTAL	37	25

The students were asked to do two tests. The terms selected for both tests were the terms that are, according to the curriculum, taught in the fourth year of the kinesiology study. First, they were asked to write down on dictation 28 technical kinesiological terms in English. Each term was read to the students only once. The students had been told in advance that the items once read would not be read again, and therefore, their full attention was sought for. Upon writing the dictation test, the translation test (English into Croatian) was given to the students, which consisted of the same 28 items dictated to the students previously. The translation test was given immediately after the dictation test in order to prevent the students from looking up the terms either in the dictionaries or in their textbooks on the one hand, and on the other, to prevent them from discussing the terms with their colleagues. The students were also asked to write down the mark that they got on the written test as the first part of the examination as well as the final mark (written mark + the mark at the oral examination) in the subject *English language* in the third year of the kinesiology study. The multivariate two-factor analysis of variance was used to calculate the differences between genders and the three specialization groups of students.

Results

The frequency distribution histograms show that neither the distribution of the sums of 28 item scores on the dictation test (Figure 1) nor the distribution of the sums of 28 item scores on the translation test (Figure 2) can be proved to deviate from the normal distribution.

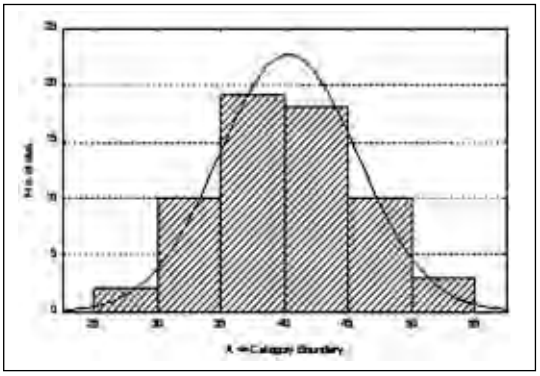

Figure 1. Distribution of the sums of 28 dictation items scores. The line denotes the expected normal distribution.

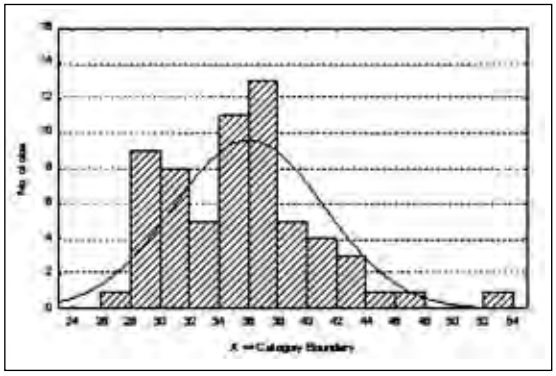

Figure 2. Distribution of the sums of 28 translation items scores. The line denotes the expected normal distribution.

Sixteen correlations of dictation and translation test mirror items were at or below .20, i.e. they were insignificant, and the remaining twelve variables showed low correlations. Arithmetic means and standard deviations for the variables *written test mark in the subject English language in the third year of the kinesiology study*, the *final examination mark in the subject English language in the third year of the kinesiology study, the sum of 28 dictation items test scores* and *the sum of 28 translation items test scores* showed no significant differences between the groups of each categorical predictor - *gender* (Table 2a) and the selected *specialization* (Table 2b), whereas the Table 3 shows significant correlations between the variables *written test mark in the subject English language in the third year of the kinesiology study* (.44) and *the sum of 28 dictation items test scores* on the one hand, and the variables *the sum of 28 dictation items test scores* and *the sum of 28 translation items test scores* on the other (.56).

Table 2a. Arithmetic means (AM) and standard deviations (SD) of results by gender achieved by 62 students on the written test in the subject English language in the third year of the kinesiology study (WTST3Y), the final examination mark in the subject English language in the third year of the kinesiology study (TEX3Y), the sum of 28 dictation items test scores (SUM28D) and the sum of 28 translation items test scores (SUM28T).

Group	N	*WTST3Y* **AM**	*WTST3Y* **SD**	*TEX3Y* **AM**	*TEX3Y* **SD**	*SUM28D* **AM**	*SUM28D* **SD**	*SUM28T* **AM**	*SUM28T* **SD**
Total	62	2.71	0.82	4.50	0.80	40.29	5.47	36.02	5.15
Gender (male)	37	2.65	0.82	4.43	0.90	40.95	5.31	36.27	5.82
Gender (female)	25	2.80	0.82	4.60	0.64	39.32	5.65	35.64	4.06

Table 2b. Arithmetic means (AM) and standard deviations (SD) of results by specialization group achieved by 62 students on the written test in the subject English language in the third year of the kinesiology study (WTST3Y), the final examination mark in the subject English language in the third year of the kinesiology study (TEX3Y), the sum of 28 dictation items test scores (SUM28D) and the sum of 28 translation items test scores (SUM28T).

Group	N	*WTST3Y* **AM**	*WTST3Y* **SD**	*TEX3Y* **AM**	*TEX3Y* **SD**	*SUM28D* **AM**	*SUM28D* **SD**	*SUM28T* **AM**	*SUM28T* **SD**
Total	62	2.71	0.82	4.50	0.80	40.29	5.47	36.02	5.15
Spec. (Sport)	20	2.45	0.69	4.20	1.06	40.10	4.79	34.65	3.25
Spec. (PhCon& PhFT)	32	2.87	0.91	4.69	0.59	40.72	6.06	37.47	6.03
Spec. (KinRec)	10	2.70	0.67	4.50	0.71	39.30	5.08	34.10	4.10

Legend: Spec. = ***specialization***; PhCon = Physical Conditioning; PhFT = Physical Fitness Training; KinRec = Kinesiological Recreation.

The differences between the distributions of marks on the written test (Figure 3) and of the final marks at the examination in the subject English language in the third year of the kinesiology study (Figure 4) can be explained by the fact that writing is almost always, and thus also in this case, more difficult for the learners of English as a foreign language.

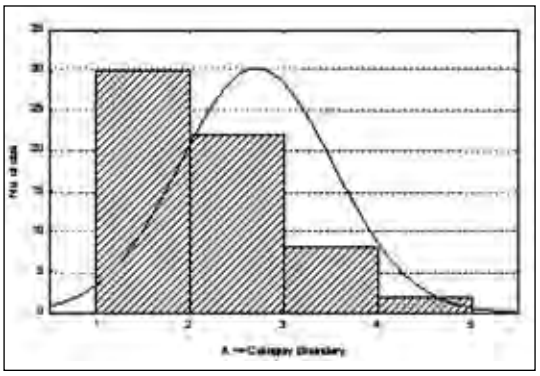

Figure 3. The distribution of marks on the written test of the examination in the subject English language in the third year of the kinesiology study.

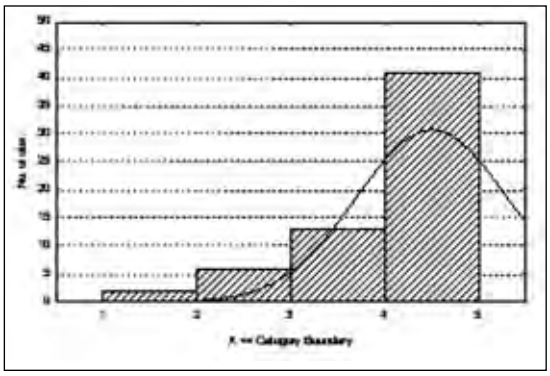

Figure 4. The distribution of final marks at the examination in the subject English language in the third year of the kinesiology study.

The multivariate analyses of variance showed no significant differences between genders or the three specialization groups as regards the written test and the final examination marks in the subject *English language* in the third year of the kinesiology study, and as regards the two test forms written by the fourth-year students.

Table 3. Correlation matrix of four dependent variables - written test mark in the subject English language in the third year of the kinesiology study (WTST3Y), the final examination mark in the subject English language in the third year of the kinesiology study (TEX3Y), the sum of 28 dictation items test scores (SUM28D) and the sum of 28 translation items test scores (SUM28T).

VARIABLES	WTST3Y	TEX3Y	SUM28D	SUM28T
WTST3Y	**1.00**	0.37	0.44	0.38
TEX3Y	0.37	**1.00**	0.31	0.28
SUM28D	0.44	0.31	**1.00**	0.56
SUM28T	0.38	0.28	0.56	**1.00**

Discussion and conclusion

Chamot and O'Malley's discussion (1996) on cognitive learning and on integrating content-area instruction with language development substantiates the results of this research. First, there is the fact that kinesiology students start learning – in terms of the teaching subject and its curriculum as a part of the overall university study of kinesiology - the technical English of kinesiology in the third year of the kinesiology study, and can go on learning it in the optional subject offered in the fourth year. Prior to the third year of their kinesiology study most probably the only way in which they acquired technical English (as a foreign language) of kinesiology was to acquire certain technical terms incidentally. Secondly, a cognitive approach is almost exclusively utilized at tertiary education level.

The differences in the distribution of marks on the written test in the subject *English language* in the third year of the kinesiology study (Figure 3) and of the final marks at the examination (Figure 4) are the result of two facts: *a.* the final mark at the examination is the combination of the mark on the written test and at the oral examination; *b.* the performance of foreign language learners is usually poorer on the written test than at the oral examination because the former requires more accuracy in grammar in general and the latter allows for more freedom in linguistic expression regardless of proficiency in grammar.

The correlations between the 28 mirror items on each test were either insignificant or low due to the fact that writing and translating belong to different cognitive processes. The arithmetic means of the sums of scores for the dictation and translation tests were 40.29 and 36.02, respectively, and the *t*-test for dependent samples of differences between the means of the sums of scores on the two tests proved to be significant (*t*-value=6.75; df=61; p=.00). Several correlations between different items from each test were significant – the highest one was between the items *fatty acid* and *insomnia* (.55) – the significant correlation was obtained due to the fact that less than a half of the subjects spelled and translated the terms correctly, but that those who did spell them correctly also translated them correctly. As for the dictation test, the students achieved the best results on writing the item *body fat* (AM = 1.87) and *magnitude* (AM = 1.82), whereas the best results on the translation test were achieved on the items *arrow* (AM = 1.79) and *clay pigeon shooting* (AM = 1.66). The high arithmetic means of the mentioned items from the dictation test are probably due to the fact that body image is very important for the population of kinesiology students, and the terms *body fat* and *magnitude* are frequently mentioned in this context. The high arithmetic means obtained for the items *arrow* and *clay pigeon shooting* may be explained by the fact that the word *arrow* is rather frequent in general language. The term *clay pigeon shooting* consists of three words out of which the last one – *shooting* – is well known in kinesiological technical vocabulary (e.g., players *shoot* the ball at the basket in basketball, etc.), but it is also the word that is among the two thousand most frequent words in English (*Longman Dictionary of Contemporary English* (2006., 1517), whereas the words *clay* and *pigeon* are also the words that are frequently used in general language (the word *pigeon* belongs to the three thousand most frequent words in English - *Longman Dictionary of Contemporary English* (2006., 1237), so that their combination is not difficult to understand.

The significant correlation (.44) between the variables *written test mark in the subject English language in the third year of the kinesiology study* and *the sum of 28 dictation items test scores* is logical, because the tasks on the written test in the third year require a reasonable level of spelling competence. The significant correlation (.56) between the variables *the sum of 28 dictation items test scores* and *the sum of 28 translation items test scores* shows that the meaning of the term is connected with its orthographic picture as retained in the mental lexicon of students.

The fact that no significant differences were found either between genders or the three specialization groups in the two test forms (Table 4) can be explained in two ways. Firstly, there is the fact that there were no significant differences between genders, which can be further explained by saying that the profile of women who enrol in this Faculty is not different from the profile of men who decided to study kinesiology. Interestingly, it may be said that the women who study at this Faculty entered the traditionally *male* profession in *which bodily* strength corresponds to the macho image of men. Consequently, since the female students were rather proportionately distributed across all three specialization groups (Table 3), it is only logical that no significant differences in scores on both tests were found between the three groups.

Secondly, such results confirm that the tests were well structured and that they did not favour any group – either by gender or by specialization – in any way.

The presented results make it possible to conclude that all tasks both at the examination in the third year of the kinesiology study (written and oral examination) and at the dictation and translation tests used in this analysis were well structured and well balanced.

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THE 5-YEAR FOLLOW-UP STUDY OF BODY MASS INDEX IN CORRELATION TO SKELETAL MUSCLE BELLY STIFFNESS AND LATERAL SYMMETRY

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Abstract

The epidemic of childhood obesity is progressing worldwide, especially in children. Great concern has to be made as it is likely that excess weight in childhood adversely affects health in adulthood. Five year follow-up study was done in Republic of Slovenia measuring body mass index and tensiomyographic response of erector spinae muscle on both lateral sides. A total of 108 children (55 boys) were assessed six times from age of 8 to 13 years. Findings show that children with higher BMI consistently have lower mechanical amplitude of tensiomyographic response, hence higher muscle belly stiffness. Lateral symmetry was not impaired consistently with increased BMI, whereas at higher age (13 years) also lateral symmetry was significantly impaired. In conclusion we could confirm that obesity could triggers serious health related problems in lower back muscles.

Key word: *body mass index, tensiomyography, skeletal muscle, erector spinae, mechanomyograpy*

Introduction

The epidemic of childhood obesity is progressing worldwide, especially in younger ages. Some countries are already meeting a percentage over 20% at age of 6 to 11 years. Thus, many children are at risk for weight related orthopaedic problems, social stigmatization, and endocrine abnormalities. The epidemic of childhood obesity is of great concern because, in addition to these concurrent effects of obesity, it is likely that excess weight in childhood will adversely affect health in adulthood.

Skeletal muscle adaptation is a common event after training and therefore also after lifestyle specifics and health status. Recent reviews of lower back disorder causality have indicated that factors inherent to the individual, workplace, physical factors, and organization factors all can contribute to biomechanical loading and lower back disorder (National-USA Academy of Science, 2001). Human body statics changes significantly with obesity. It is very well known that body fat deposition is rarely homogenous over human body; on contrary it is more likely that fat depositions would be in abdominal area. Abdominal obesity impairs human body balance causing postural muscles to counteract it.

From our knowledge the primary lower back muscles' (*erector spinae*) mechanical stiffness was never evaluated and correlated to obesity rate. Furthermore, it is very difficult to evaluate both lateral sides of *erector spinae* separately, to calculate lateral symmetry. Non-invasiveness and selectiveness of tensiomyographic method was regularly reported (Valenčič and Knez, 1997; Pišot et al, 2002) and its connection to muscle belly mechanical stiffness well established (Pišot et al., 2008; Šimunič et al., 2008).

Therefore our goal was to introduce obesity rate amongst Slovenian children population in five-year follow-up study. Furthermore, we have introduced a novel methodology (tensiomyogrpahy) for screening skeletal muscle contractile properties and evaluate lower back muscle stiffness and symmetry regarding to obesity occurrence.

Methods

CHILDREN: All measurements on children were performed in regulations of two three-year research projects conducted by Institute for Kinesiology Research ("T*he role of skeletal muscles' contractile properties in child motor development – 2001-2004"* and *"Monitoring of skeletal muscle contractile changes during early childhood and adolescence – 2004-2007"*). The sub-sample of 108 children (55 boys) was measured consistently for five consecutive years in six occasions. Children were randomly selected from nine elementary schools from Slovenian coast (Koper, Piran and Izola), Ljubljana and Maribor regions. National medical ethics committee approved both researches and parents signed written consent.

ANTHROPOMETRIC DATA: Anthropometric data collection consisted of body height and weight measurements and body mass index (BMI) calculation. Standard measurement tools were used for this purpose.

TENSIOMYOGRAPHIC DATA: Tensiomyographic measurement was performed on both lateral sides of *erector spinae* muscle (ES). Children were laid down on a soft table on the stomach with straight legs and arms beside the body. Total relaxation was achieved by detailed measurement introduction and 3-5 test trials. Breathing was controlled by oral commands (eg. "*Breath in*" and "*Breath out*"). Ramp stimulation of single rectangular electrical twitches was used to obtain maximal tensiomyographic response, where two maximal responses were stored and average further analysed. Maximal amplitude (Dm) and contraction time (Tc) were calculated from the response, and lateral symmetry calculated as presented in equation 1:

$$Symm = 0.5 \cdot \frac{\min(Tc\_right, Tc\_left)}{\max(T\_right, Tc\_left)} + 0.5 \cdot \frac{\min(Dm\_right, Dm\_left)}{\max(Dm\_right, Dm\_left)} \quad \text{Equation 1}$$

where Tc_right and Dm_right are Tc and Dm calculated from the tensiomyographic response on the right *erector spinae* muscle, while Tc_left and Dm_left from the left side.

STATISTICS: The data is presented with average and standard deviation values. BMI numerous was calculated on the basis of adopted percentile values from the literature. Correlation coefficient was calculated and tested using Pearson's coefficient. Statistical significance was confirmed with $P < 0.050$.

Results

From 283 children just 108 of them finished longitudinal study being measured in all six occasions from age 8 to 13 years. Further analysis was performed just on the sample of 108 consistently measured children from where 55 boys and 53 girls.

Distribution of BMI is presented in Figure 1 where we could conclude that the number of the obese children is decreasing from 15 (8 years) to 5 (13 years). Yearly average value is rising in correspondence with children's age (Table 1).

Table 1. Average body mass index with standard deviation (± SD)

	8 years	9 years	10 years	11 years	12 years	13 years
BMI / kg m^{-2}	17.1 ± 2.7	17.8 ± 2.8	17.4 ± 2.8	18.8 ± 3.1	19.5 ± 3.2	19.6 ± 3.0

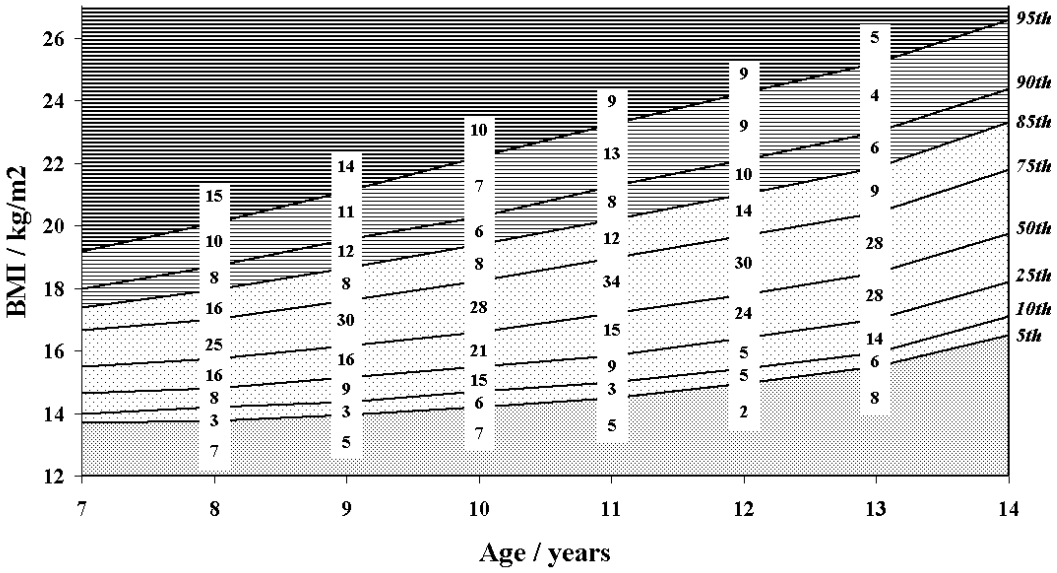

Figure 1. Body mass index (BMI) of 108 children measured on six occasions (from age 8 to 13). Lines present percentile values adopted from literature. Numbers of children divided into inter-percentile groups are given in columns.

Correlation coefficient of ES tensiomyographic response parameter Dm and BMI was generally negative as shown in table 2. Statistical significance was confirmed for all ages, except for age of 10 years. However, ES lateral symmetry was significantly impaired by high BMI just at age of 13 years (Table 3).

Table 2. Correlation coefficient (R) of erector spinae tensiomyographic response maximal amplitude and body mass index with level of significance (P)

	8 years	9 years	10 years	11 years	12 years	13 years
R	-0.3027	-0.2780	-0.1290	-0.2040	-0.2300	-0.2077
P	< 0.001	< 0.010	N.S.	< 0.050	< 0.020	< 0.050

N.S. Non significant

Table 3. Correlation coefficient (R) of erector spinae tensiomyographic response symmetry and body mass index with level of significance (P)

	8 years	9 years	10 years	11 years	12 years	13 years
R	-0.1206	-0.0213	0.0500	-0.0673	-0.0940	-0.2737
P	N.S.	N.S.	N.S.	N.S.	N.S.	< 0.010

N.S. Non significant

Discussion

From altogether 283 only 108 children were present in all six measurement occasions. Therefore the quality of the research was significantly impaired. However, we manage to establish significant correlation between BMI and Dm of *erector spinae* tensiomyographic response. Parameter Dm is not mechanical stiffness of the muscle belly but previous findings showed that it is correlated to it in great proportion (Pišot et al., 2008; Šimunič et al., 2008). Consistence of the data from all six measurements confirmed that BMI and Dm are significantly related. Evetovich et al. (1997) and Barry et al. (1990) have proven that mechanical vibrations of muscle belly could be explained by stiffness/compliance properties of muscle itself. Barry et al. furthermore proposed mechanical response to be a diagnostic tool for evaluation of some myopathies that impair muscle stiffness (eg. muscle spasticity, myotonic dystrophy).

Lateral symmetry was independent of BMI in first five measurements. In sixth measurement we have found that children with higher BMI have significantly lower lateral symmetry. It seems like time constant of few years is needed to reflect higher BMI into lower lateral symmetry. This is in context with many other factors, which reflects from childhood to adulthood. However this finding is not surprising, but more investigations have to be made to confirm it.

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METRIC CHARACTERISTICS OF SPECIFIC PHYSICAL PREPAREDNESS TEST FOR FIGHTERS IN JU JITSU AND SUBMISSION WRESTLING

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Abstract

Purpose of this scientific work is to establish metric characteristics of JJS test which is presumed to be an excellent indicator of one aspect of specific conditioning preparedness for fighters in combat sports, ju jitsu and submission wrestling. Modified form of presented test is used by top ultimate fighter Mirko Filipović and JJS test itself is used in training process for fighters in mentioned sports. Results obtained on sample of 22 fighters showed that this test is very reliable in measuring more than one physical quality. This fact is very important in combat sports which demand extremly high level of all qualities and in this way JJS test is one step closer to real fight conditions.

Key words: *musculare endurance, mobility, fight, testing, jump-jump-sprawl*

Introduction

Specific conditioning preparedness tests can in excellent way indicate competence of athleets in combat sports. Because of that they can show valuable return information about training process level. Most of scientific works on this theme are conected to tests applied in wrestling and judo (Marić, Baić, Sertić,2005.).

Purpose of this study is to establish metric characteristics of test called JJS – "jump-jump-sprawl". Modified form of this test is used in his trainings by top ultimate fighter Mirko Cro Cop Filipović. Some different form of JJS test is used at ju jitsu and submission wrestling. With this research we want to establish characteristics of one JJS test form which can indicate one aspect of specific conditioning preparedness for fighters in mentioned sports.

Methods of research

Sample was made of 22 athleets, 18 to 26 years old, with average weight 83.7kg +/-12.9kg. All of them participated in active training and compete in ju jitsu and/or submission wrestling. Among these athleets there were top competitors in national and international category. Measuring was performed on several occasions in the gym during evening practice between 6 and 9 pm. JJS test was measured 4 times. Each measuring presented one item of measuring instrument and each item was measured in different days.

For data processing we used moduls for caculating basic statistic parameters: arithmetic mean, standard deviation, minimum, maximum, kurtosis and skewness. Distribution of variables was tested by Kolmogorov-Smirnovljev test. For metric characteristics we used RTT program. Validity of measuring instrument was determined by factor analisis and for reliability we used matrix of intercorelation and Cronbach`s alfa.

Sample of variables

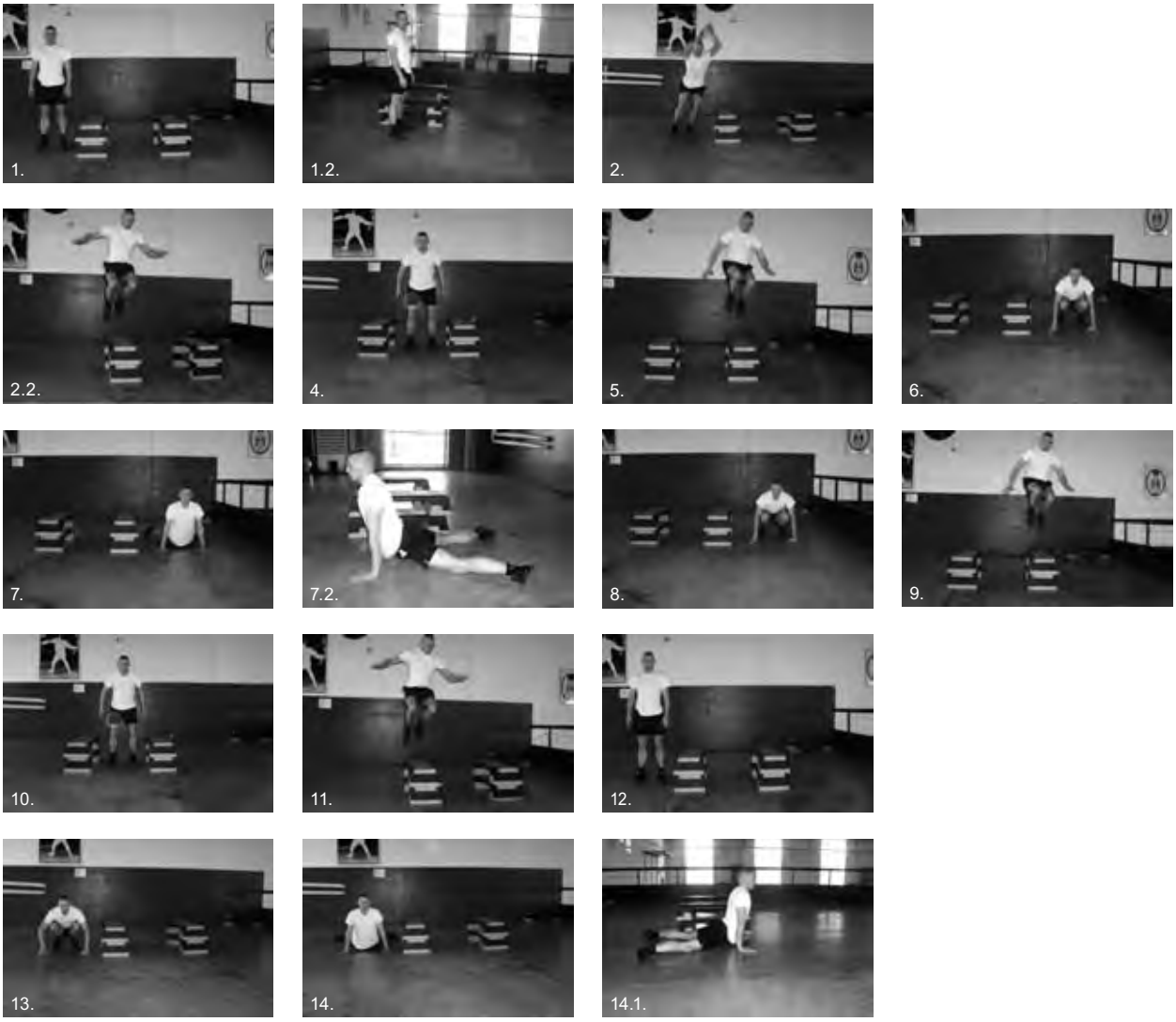
Besides this new-made measuring instrument examinees were measured by other standardised tests. Their function is helping in establishing metric characteristics of JJS test.

Sample of variables is made of these tests: sidesteps - MAGKUS, test of coordination - MKOOR, squat jump in distance - MFESDM, chin-ups – MRAZGP, sit-ups – MPRR, squat/push-up – MCU_SKL, 300 yards running – F300Y.

Discription of JJS test

On examiner`s mark examinee`s task is to jump over first bench beside him in space between two benches. Emediately after first jump he jumps over second bench. Both jumps are performed sideway and by both feet._While jumping body is always directed in same direction it was at start position. Direction mustn`t be changed-turned to the other side. Help of hands is allowed while jumping. After jumping over second bench an examinee makes sprawl - simulation of dodge tehnique when an oponent wants to grab his leggs and throw him from standing position to the ground . Dodge tehnique

means to get down as soon as possible from standing position to position where arms are fully extended on the ground, leggs are put behind and spreaded, chest are slightly pushed out and look is directed up. From this position he raises in start position. This makes one count or one repetition. After first count comes a new count of jumping over benches followed by dodging to sprawl and lifting up, but now start position is behind second bench. Test is performed in 1 minute.



Results

Table 1. Descriptive statistics of items in JJS test measuring instrument

	Valid N	Mean	Minimum	Maximum	Std.Dev.	Skewness	Kurtosis
JJS1	22	18,50000	15	25	2,714843	,466448	-,378674
JJS2	22	18,42857	15	24	2,379365	,406442	-,464086
JJS3	22	18,64286	15	24	2,280583	,133614	-,311845
JJS4	22	18,89286	15	23	2,114137	,125889	-,767255

JJS1-first measuring, JJS2-second measuring, JJS3-third measuring, JJS4-forth measuring

Table 2. Results of Kolmogorov-Smirnovljev`s test

K-S	d=,1071535,

From table of critical values for K-S test it is visible that for n=22 critical value for p=0.05 totals 0.250 and for p=0.01 it totals 0.300. Test doesn`t significantly differ from normal distribution. It is sensitive enough for population we measured and for distinguishing enteties in measured qualities.

Reliability:

Table 3. Matrix of corelations between items of JJS test

	SSS1	SSS2	SSS3	SSS4	
JJS1	1,00	0,92	0,91	0,92	
JJS2	0,92	1,00	0,90	0,90	
JJS3	0,91	0,90	1,00	0,89	**ΣΣr**
JJS4	0,92	0,90	0,89	1,00	
Σr	3,75	3,72	3,7	3,71	**14,88**

JJS1-first measuring, JJS2-second measuring, JJS3-third measuring, JJS4-fourth measuring

By test-retest method we calculated Cronbach`s alfa which totals 0.972495088 while average intercorelation of test`s items totals 0.908271673.

$$\alpha_{SB} = \frac{m}{m-1}\left(1-\frac{m}{\sum\sum r}\right) = \frac{4}{4-1}\left(1-\frac{4}{14{,}88}\right) = 0{,}974910394$$

Table 4. Projctions of items on first main measuring component

	Factor 1
Eigenval	3,722958
% total variance	93,07395
SSS1	0,972424
SSS2	0,965693
SSS3	0,959369
SSS4	0,961457

SSS1-first measuring, SSS2-second measuring, SSS3-third measuring, SSS4-forth measuring

Based on factor1 (Table 4.), metric characteristics of JJS test were measured by RTT algorithm (Table 5.).

Table 5. RTT

RTT	Alpha	Alpha1	Alpha2	Lamda6	Rho1	Rho2	Tau	MSA	AVR	Hom1
,975186	,975195	,534941	,927852	,968335	,937672	,998997	,937323	,998226	,907620	,991731

Validity:

Table 6. Factor Loadings – Varimax Rotated - Extraction: Principal Components

VARIABLES	FACTOR 1	FACTOR 2	FACTOR 3
MAGKUS	-,021215	-,248953	**,916030**
MKOOR	-,335196	,134298	**,817324**
MFESDM	,020347	**,865598**	-,123999
MRAZGP-nathvat	**,725744**	-,002629	-,316643
MPRR	**,764984**	,487868	,060536
MCUC-SKL	,678004	-,443571	-,325060
F300Y	-,558993	,044570	,032409
SSS	,672643	,383178	-,435248

Legend: MAGKUS – sidesteps, MKOOR – roll foward, jump, right turn, roll backward, jump, turn left, MFESDM – squat jump in distance, MRAZGP – chin-up, MPRR – sit-ups in 2 minutes, MČU-SKL – squat, push-up, squat in 1 minute, F300Y – 300 yards running, JJS – jump, jump, squat

Table 7. Eigenvalues - Extraction: Principal components

Factor	Eigenval	% total Variance	Cumul. Eigenval	Cumul. %
1.	3,297477	41,21846	3,297477	41,21846
2.	1,346041	16,82551	4,643518	58,04397
3.	1,141668	14,27086	5,785186	72,31483

Discussion

Standard deviation values in each item of measuring show that arithmetic mean is valuable representative of other results. They also show that differences in weight of examinees (+/- 12.9kg) and in their training level didn`t significantly influence on variability of results. Kurtosis shows that JJS test is very sensitive and skewness tells us about relative simetricity of results. Finally we conclude that JJS test is suitable for examinees and for population they are taken from. (Table 1.)

Cronbach`s alfa shows high reliability based on test-retest method. RTT algorithm also shows high reliability of test in Haris and Gutman`s matrix. As presumed, a new-made JJS test isn`t specific for any quality, but it spreads it`s variance on three aspects (Table6.). JJS test contains movement`s structure of mentioned sports and it measures more qualities at once. It is also realistic considering that during fight there is activation not only of some but most of phisical qualities. That is exactly why JJS test is valuable indicator of specific conditioning preparedness for fighters. We could say that JJS test spreads its variance on three factors: muscular endurance, explosivity and mobility. All of these qualities are very important for efficiency in mentioned sports, but some of gotten factors aren`t interpretated by sufficient numbre of statistically significant variables. Because of that in further researches we should extend numbre of variables. It is possible that MCUC-SKL variable was less significant in forming first factor because it was performed only for 1 minute in difference of MRAZGP and MPRR. MRAZGP was performed to failure and MPRR for 2 minutes. In that case first factor could be called factor of musculare endurance and it would contain largest part of new-made JJS test variance.

Conclusion

Based on obtained results we conclude that JJS test isn`t a homogen test. It contains at least three dimensions in its structure: musculare endurance, mobility and explosivity. We could improve this test by adding some more defining variables to each one of these dimensions. Anyhow, this test can be valuable indicator of conditioning preparedness for athleets from population we made this research on. That is because good result at JJS test demands high level of more qualities which are expressed and important in sport competition-fight. JJS test is sensitive enough to distinguish examinees in one aspect of conditioning preparedness and it is also highly reliable.

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PREDICTIVE VALUES OF MOTOR ABILITIES AT THE PERFORMANCE IN THE ARTISTIC GYMNASTICS FLOOR EXERCISES

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Abstract

Determination of the motor abilities predictive values at the performance in the artistic gymnastics floor exercises was performed at the selected sample of 180 male examinees, aged 16 to 18. In this research we used the set of 24 motor ability variables, as a predictor system, and criterion system consisting of 11 artistic gymnastics floor elements. Prediction – prognosis of the influence of the motor abilities predictor system at the floor exercise criterion variable can be done with more reliability by the use of complete system of the predictor variables compared to the reliability done by the use of partial (Beta) regression coefficients, e.g. partial influence of predictor variables at the criterion variable.

Key words: *regression analysis, effects, artistic gymnastic, floor exercises*

Introduction

Knowledge about the multiple factor relations in the artistic gymnastics and their changes in relation to the time and to the results, represents a significant problem. Scientific research results in the past confirmed that the quality of artistic gymnastics movement performance depends on many factors, amongst which the most significant function have the morphological characteristics, motor abilities, cognitive abilities, willpower, motivational structure, as well as the pedagogical process of teaching and training.

Based on the results of the scientific research that the motor abilities have one of the most dominant influences at the artistic gymnastics floor elements performance, this research is focused at the determination of motor abilities predictive values at the artistic gymnastics floor performances. Determination of the predictive values and motor abilities relations with the artistic gymnastics performances were the subject of some of the scientific researches in the past: Acković, N. (1971); Ljasotović, S. (1975); Babijak, J. (1980); Sejdić, P. (1982); Čaklec, I. (1983); Šipetić, D. (1983); Goljubev, I. O. (1983); Wagner, I. (1984); Hmjelovjec, I. (1989); Tabaković, M. (2000, 2003).

The findings of these researches determined that the success in the artistic gymnastics elements performance depends mostly on the following latent motor abilities factors: coordination, flexibility, speed, strength and balance. These researches also determined that the higher level of the mentioned motor abilities facilitates more successful realization of the artistic gymnastics specific movement structures.

Considering that artistic gymnastics has a large number of different movement structures, the requests for their performance in a exactly defined space and time specified conditions are high. For this reason the successful performance of the artistic gymnastics requires a certain level of the motor abilities.

Basic objective of this research is to determine predictive values of the motor abilities at the artistic gymnastics floor elements performance success, or to determine significance and relative level of motor abilities variables effect at the one-dimensional criterion represented by the artistic gymnastics floor elements performance success.

Determination of the results prediction in criterion variable represented by artistic gymnastics floor elements performance success, based on the predictor system of the motor abilities variables can be defined as an objective.

Method

Sample of examinees for this investigation consisted of male student population, 16 to 18 years old. All of the examinees were the students of the Sports Gymnasium. Sample can be considered as a pre - selected, because the students had to pass a specific entrance exam to enter this high school, which included testing of their motor abilities. Total number of 180 examinees were included in to the registration of variable values, final data processing and result analysis.

Twenty-four (24) test were included in the sample of predictor variables for the motor abilities assessment in this investigation. For the assessment of the balance factor with open eyes following test were used: Two Foot Cross Balance – Eyes Open - MBAP20, Two Foot Lengthwise Balance – Eyes Open -MBAU20, One Foot Cross Balance – Eyes Open - MBAP10, One Foot Lengthwise Balance – Eyes Open -MBAU10.For the assessment of the flexibility factor following test

were used : shoulder flexibility-MFLISK, Toe touching-MFLPRK, toe touching with tape -MFLPRT, front split-MFLCES. For the assessment of the simple movement frequency speed factor (speed of limb movement) following tests were used (Plate Taping-MBFTAR, Arm Circling-MBFKRR, One Foot Tapping-MBFTAN, Two Foot Tapping- MBFTNZ). For the assessment of the coordination factor following tests were used (Floor Agility- MKOONT, Air Agility -MKOOUZ, Baton Coordination-MKOKOP, Backward Obstacle Course- MKOPOL. For the assessment of the explosive strength factor following test were used: Standing Broad Jump - MESSDM, Vertical Jump-MESSVM, Medicine Ball Put – lying -MESBML, Basketball Throw–standing -MESBKL. For the assessment of the repetitive strength factor following test were used :Push – ups - weighted-MRSSKL, Sit-ups-MRSPTL, Reverse Sit-ups-MRSZTL, Half Squat – weighted - MRSPCT.

Sample of criterion variables for the assessment of the artistic gymnastics floor elements performance in this investigation was consisted of 11 elements set (Forward Roll, Backward Roll, Forward Roll into Straddle Stand, Backward Roll into Straddle Stand, Flying Roll, Cart-wheel, Cart – wheel with turn – flick, Headstand, Handstand, Handstand to Forward Roll, Backward Roll to Handstand). Evaluation of the floor elements performance success was performed by the four judges, which had to be competent and had to have completed Faculty of physical education, have theoretical and practical knowledge on the artistic gymnastics. Evaluation was marked exclusively by the full number from one (1) to five (5). Final mark was derived by the condensation of all marks from judges. After the evaluation its objectivity was analyzed by the factorial analysis, main component method, were we isolated one criterion variable from the mentioned floor variable system, which has the largest amount of whole system information and is called FLOOR. The analysis of marks (evaluation) metric characteristics showed that the judges were good evaluation instrument in a judgment of a floor elements. We found very high correlation between judges marks and main component (theoretical evaluator, fifth imaginary judge). High objectivity of evaluation was reached, which indicates the equal importance of each judge in the process of the floor elements performance evaluation. It has been concluded that all of the members of the jury, despite individual differences, were competent in a valorization of the floor exercises.

Regression analysis was performed for the determination of the motor abilities predictive values at the floor gymnastics performance success, or for the determination of the significance and relative amount of influence of the motor ability variables at the one - dimensional criterion called floor gymnastics elements performance success.

Results

Criterion variable (FLOOR) regression analysis in the manifest space of motor variables (table 1.), gives us enough information about the effects of applied motor variables at the performance success in the mentioned criterion variable. Predictor system of variables explained 71 % (R Square = 71 %) of the common variability using criterion. Multiple correlation coefficient is .84 which is considered as a high value. Significance of that relation is at the .00 level.

In the explanation of the common variability the remaining 29 % can be added to the other characteristics and abilities not included in this investigation (other motor abilities, morphology characteristics, functional abilities, cognitive, motivational, testing conditions and other characteristics).

Table 1. Criterion variable FLOOR regression analysis of the of motor variables scores

RO	R Square	Adjusted R Square		Std. Error of the Estimate	
.845	.713	.669		.5753113	
	Sum of Squares	df	Mean Square	F	Sig.
Regression	127.698	24	5.321	16.076	.000
Residual	51.302	155	.331		
Total	179.000	179			

Explanation: RO – multiple correlation coefficients, R Square – criterion variable determination coefficient, Std. Error of the Estimate – standard error of the criterion variable prognosis , Sum of Squares Regression – variance explained, Sum of Squares Residual – residual variance, Sum of Squares Total – Total variance, df – degrees of freedom, F – test – determination test of multiple correlation significance coefficients, Sig.- multiple correlation significance level.

Effects analysis of the partial (Beta) regression coefficients (table 2.), shows that statistically significant effect at the criterion variable FLOOR have two variables of predictor system of the motor abilities for the coordination assessment (baton coordination-MKOKOP and backward obstacle course-MKOPOL), and one variable for the balance assessment(One foot cross balance – eyes closed-MBAP10), which has the significance level of .05 (Sig = or < .05).

Table 2. Partial results of the regression analysis of the motor abilities predictor system at the criterion variable FLOOR

Varijable	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
	B	Std. Error	Beta			Zero-order	Partial	Part
MBAP20	-.004	.033	-.008	-.135	.892	.298	-.011	-.006
MBAU20	.044	.034	.072	1.302	.195	.382	.104	.056
MBAP10	.074	.039	.113	1.911	.050	.352	.152	.082
MBAU10	-.004	.014	-.019	-.329	.743	.346	-.026	-.014
MFLISK	-.007	.006	-.083	-1.160	.248	-.628	-.093	-.050
MFLPRK	-.016	.015	-.094	-1.031	.304	.629	-.082	-.044
MFLPRT	-.010	.013	-.088	-.796	.427	-.706	-.064	-.034
MFLCES	-.002	.008	-.024	-.286	.775	-.630	-.023	-.012
MBFTAR	-.023	.017	-.090	-1.339	.183	.359	-.107	-.058
MBFKRR	.038	.022	.118	1.708	.090	.465	.136	.073
MBFTAN	-.014	.032	-.040	-.435	.664	.571	-.035	-.019
MBFTNZ	.012	.032	.037	.390	.697	.618	.031	.017
MKONNT	-.064	.052	-.125	-1.240	.217	-.739	-.099	-.053
MKOOUZ	.112	.124	.115	.903	.368	-.740	.072	.039
MKOKOP	-.220	.083	-.370	-2.644	.009	-.788	-.208	-.114
MKOPOL	-.123	.062	-.250	-1.969	.047	-.749	-.156	-.085
MESSDM	.007	.005	.112	1.240	.217	.420	.099	.053
MESSVM	-.004	.012	-.030	-.355	.723	.333	-.029	-.015
MESBML	.000	.001	.023	.194	.846	.410	.016	.008
MESBKL	.001	.001	.106	1.019	.310	.281	.082	.044
MRSSKL	-.003	.012	-.023	-.233	.816	.645	-.019	-.010
MRSPTL	.005	.010	.046	.487	.627	.587	.039	.021
MRSZTL	-.003	.011	-.028	-.320	.749	.562	-.026	-.014
MRSPCT	.001	.003	.021	.404	.687	.131	.032	.017

Explanation: Std. Error – regression coefficient standard error, Beta – partial regression coefficient, t –significance of each predictor variable, Sig.- partial regression coefficients significance level, Correlations Zero-order - product - moment correlation coefficients, Correlations Partial – partial correlations.

Discussion and conclusion

High multiple correlation, the percentage of joint variability of the predictor variables system with the criterion, as well as the small number of the valid partial regression coefficients given by the regression analysis lead us to the conclusion that the prediction - prognosis influence of the predictor at the criterion variable can be performed only using complete predictor variables system.

The reasons for the formation of the partial parameters in this way, by the partial influence of the motor variables at the criterion variable, can be seen in the movement structure of the artistic gymnastics floor elements performance and in structure of the motor abilities tests.

The complexity of body movement structure during the artistic gymnastics floor elements performance, demand a very high level of gross body coordination, which is defined as the ability to perform complex motor structure by the movement of the whole body in space. Motor test (Baton Coordination Test -MKOKOP), is one of the tests for the body coordination, so it is logical that it has the statistically significant influence at the floor elements performance .

Performance of the certain floor elements used in this research (Backward Roll, Backward Roll in to Straddle Stand and Backward Roll to Handstand), the structure of the movement is to the backward, so the overcoming of the inertia action of the existing dynamic stereotype is present – reorganization of the movement stereotype. Motor test (Backward Obstacle Course -MKOPOL), is one of the tests for the reorganization of the movement stereotype, is defined as the ability to overcome the inertia action of the already existing dynamic stereotypes, and it is also logical that it has a statistically significant influence at the floor elements performance.

During the artistic gymnastics floor elements performance (Cart – Wheel, Headstand, Handstand, Handstand to Forward Roll, Backward Roll to Handstand), the athlete body goes through the certain phase of stances, where is necessary to maintain a balance. Considering that the mentioned elements have the most complex structure, it is completely logical that in order to perform them the examinees had to have grater level of the open eyes balance, which is defined as the ability to maintain the balance on the basis of the visual analyzer information about the body position in reference to the orientation point.

Further analysis gave an example of the backward roll to handstand performance (Illustration 1.) which shows why all of the three mentioned motor variables have significant partial influence at the criterion.

In this research backward roll to a handstand element showed as the most complex and technically most demanding, so that for its successful performance the examinee had to have the higher lever of certain motor abilities. The complexity of the movement structure by itself demands a higher level of the gross body coordination, during the performance of this complete element.

Fallowing phases of body movement during the backward roll to handstand (lowering of the body from a standing straight to seated pike, rolling back the body, driving the body to a handstand and lowering the body from a handstand to a straight position), demand the reorganization of the movement stereotype, the overcoming of the inertia action of the existing dynamic stereotypes initiated by the backward movement.

The phase of the hand support stance demands the body balance maintenance, and by that the certain level of the balance as the motor ability.

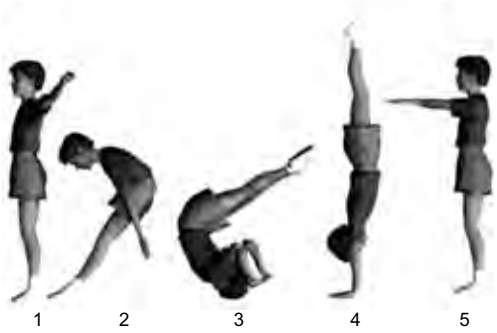

Illustration 1. Backward roll to a handstand

Based on the presented values of the regression analysis parameters (high multiple correlation, percentage of the common predictor system variability with the criterion and small number of statistically significant partial regression coefficients) it can be concluded that the prediction – prognosis of the influence of the motor variables predictor system at the criterion FLOOR, can be done with more reliability by the use of the complete system of the predictor variables compared to the reliability done by the use of the partial (Beta) regression coefficients, e.g. partial influence of predictor variables at the criterion variable.

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EFFECTS OF BASIC SOCCER TRAINING ON QUANTITATIVE CHANGES

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Abstract

The purpose of this study was to investigate the effect of a new experimental 12 weeks program on the power and anaerobic performance of elite soccer players. A hundred and seven (n=107) elite male junior soccer players, members of the First League Team, volunteered to participate in the study. T-test for dependant samples was used to determine differences between measurements within two trials. In all test quantitative differences between first and second trial are obvious. Results in Long jump have improved for 23 centimeters, triple jump results for 50 centimeters, height jump for 5 centimeters and agility has improved for five hundred of a second. Significant differences were found between the first and second measurement in VO2max, LJ, TJ, HJ, SP20 and AGK ($p<0.01$). In conclusion, the most significant contribution of this study was the finding that high intensity interval bouts do not only improve aerobic capacity, as previously known, but the enhancements were observed in power test LJ, TJ, HJ, SP20 and soccer agility.

Key words: *soccer, power, anaerobic performance, T-test, VO2max*

Introduction

In literature soccer is still often perceived as an aerobic-anaerobic sport, however, a better insight into modern games reveals a high volume of aerobic load during the game. In addition to this, the aerobic abilities of elite soccer players appear to be more and more alike to the aerobic abilities of athletes with a background in aerobic sports such as cycling, rowing or long distance running. This is not surprising considering that the game has become very active in the past decade. The published papers claim that players spend 1-11 % of the game sprinting, constituting 0.5-3.0% of effective time with the ball in play and most of the game running or walking, signifying the need for exceptional oxygen transport mechanisms (midfielder walks 2.6 km, jogged for 5.2 km, runs 1.8 km and sprints 1.1 km, total 10.9 km)[2]. For example, various studies have reported that the male player covers between 9845m and 11.527m during the game. This is easily confirmed by modern technologies such as motion analysis systems. New technologies enable the coach to promptly discover the inactive players, so that players with low aerobic capacities become "obsolete" regardless of their technique quality. New programs are always difficult to implement. It is also very hard to control the effects of a new program as soccer is a complex sport requiring a combination of individual skill, power, endurance, speed, and experience, along with the ability of a team to function as a cohesive unit. All of soccer's complex elements are important and have to be considered when designing a training program. The purpose of this study was to investigate the effect of a new experimental 12 weeks program on the power and anaerobic performance of elite soccer players.

Methods

Subjects

A hundred and seven (n=107) elite male junior soccer players, members of the First League Team, volunteered to participate in the study. All of the participants provided written consent after being informed of the test protocol, but not of the aim of the study. The protocol of the study was approved by the Ethical Committee of the Faculty of Sport and Physical Education, University of Sarajevo, Bosnia and Hercegvina Kinesiology, and according to the revised Declaration of Helsinki.

Procedures

The study was carried out in two phases: at the beginning of the 2007/08 summer preparations and at the beginning of the 2007/08 competitive season (twelve weeks). In both phases the testing period was two weeks, and it was done by experienced professionals. Every day the testing was carried out in a different club. It always began at 10 am and finished by 1 pm. Every player was instructed and verbally encouraged to give the maximum. The duration of the training program, technical-tactical preparation as well as the intensity and extensity of those in training were strictly controlled. The main intervention was conducted in the conditioning part. For the purpose of this study four power test were used: Long jump – LJ, Triple jump – TJ, Height jump – HJ, Sprint over 20 meters – SP20 and one agility test AGK.

Statistical analyses

The statistical Package for Social Sciences SPSS (v13.0, SPSS Inc., Chicago, IL) was used for statistical analysis. Standard statistical parameters (mean, standard deviation, maximum, minimum, skewness and kurtosis) were calculated for each trial of the mentioned agility tests. The Kolmogorov-Smirnov test was used for testing the normality of distribution, while the homogeneity of variance was tested by Leven´s test. The statistical power and effect size were calculated using the GPOWER software. T-test for dependant samples was used to determine differences between measurements within two trials.

Results and discusion

All of the variables in all three measurements had normally distributed data. Leven´s test showed no violation of homogeneity of variance.

Table 1. Firs trial, descriptive parameters

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
LJ	107	171,00	244,00	205,1308	17,59239	,129	-,760
TJ	107	541,00	731,00	626,1121	46,65456	,497	-,451
HJ	107	29,00	60,00	41,6075	6,94419	,604	-,189
SP20	107	2,90	4,30	3,4841	,27785	,955	,897
AGK	107	7,70	10,30	8,8052	,55043	,249	-,204

Table 2. Second trial, descriptive parameters

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Kurtosis
LJ	107	200,00	260,00	228,5981	14,95771	-,134	-,703
TJ	107	560,00	726,00	679,0748	37,83821	-,415	-,721
HJ	107	37,00	60,00	47,3178	5,52968	,065	-,827
SP20	107	2,90	4,00	3,3758	,19584	,298	,491
AGK	107	6,30	9,80	8,2047	,68424	-,421	,276

In all test quantitative differences between first and second trial are obvious. Results in Long jump have improved for 23 centimeters, triple jump results for 50 centimeters, height jump for 5 centimeters and agility has improved for five hundred of a second.

Table 3. Paired Samples Test between firsrt and second trial

		Paired Differences		t	df	Sig. (2-tailed)
		Mean	Std. Deviation			
Pair 1	LJI - LJF	-23,46729	16,00137	-15,170	107	,000
Pair 2	TJI - TJF	-52,96262	43,23017	-12,673	107	,000
Pair 3	HJI - HJF	-5,71028	5,77406	-10,230	107	,000
Pair 4	SP20I - SP20F	,10832	,20528	5,458	107	,000
Pair 8	AGKI - AGKF	,60056	,68358	9,088	107	,000

Significant differences were found between the first and second measurement in VO2max, LJ, TJ, HJ, SP20 and AGK ($p<0.01$). The changes in maximal anaerobic capacities after the 12-week program were not the subject of interest in this study as it was proven before that interval training enhances the aerobic endurance in soccer players by increasing the distance covered, enhancing work intensity, and increasing the number of sprints and involvements with the ball during a match. Also, the similar training intervention was found to be effective in improving of maximal aerobic capacity over a short period of time but the influence on blood lactate and sprint ability was not monitored. In their paper the 4x4 min bouts were dribbling activities at moderate intensity, while in our study during the 4x4min bouts the players performed high intensity runs. None of the published study investigated the effect of similar intervention in conditioning program on shuttle run test performance. Though, the modern soccer game tends to accumulate the number of repeated sprints and there often exist a one-minute period with several sprints for the same player. In conclusion, the most significant

contribution of this study was the finding that high intensity interval bouts do not only improve aerobic capacity, as previously known, but the enhancements were observed in power test LJ, TJ, HJ, SP20 and soccer agility. The main advantage of the study was the fact that group did not consist of different players because the same players were tested in two subsequent seasons. That significantly contributed to the reliability of the observed values.

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RELIABILITY OF FLEXIBILITY TESTS FOR SOCCER PLAYERS

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Abstract

In order to know the state of flexibility in specific joint or group of joints as well as in particular topological region this paper deals with evaluation of reliability of flexibility tests. A hundred and fifty (n=150) elite male junior soccer players, members of the First Junior League Team, volunteered to participate in the study. A hundred and fifty (n=150) elite male junior soccer players. All the variables had normally distributed data. A study of the kurtosis values in the six agility tests showed that their distribution tends to be leptokurtic. Leven's test showed no violation of homogeneity of variance. The statistical power for all the statistical tests was 0.95. The effect size for the correlation coefficient was large (0.50), and TuKey post hoc (0.25) was medium. The average values of all the trials recorded during the flexibility tests showed a very small unsystematic variation. It can be concluded that out of the three flexibility tests used in this study the VSRT is the most reliable for estimating the flexibility of soccer players.

Key words: *reliability, flexibility tests, soccer*

Introduction

Many authors offered definition of flexibility as a motor skill which provides body motion with the absolute range of movement in a joint or series of joints that is attainable in a momentary effort, with the help of a partner or a piece of equipment (Anderson i Burke, 1991). There is no disbelief that appropriate level of flexibility is necessary to insure better life quality, as well as optimal performance in competitive sports. Regardless to achieving great flexibility as a fundamental motor skill in some sports requests (rhythmic gymnastics, artistic gymnastics, figure skating) today flexibility is recognized as valuable part of athletes physical fitness program for the purpose of injury prevention, better and efficient performance, or more quickly and secure rehabilitation. As late as De Vries published in 1961 that static flexibility provides reduction of muscular tension and reduces muscular excitation (Alter, 1996) flexibility, as mean of injury prevention, has been the topic of many scientific publications. Studies show many opposite conclusions. Gleim and McHugh (1997) reviewed 18 studies of connection between flexibility and injury prevention and they concluded that there is not enough empirical evidence which confirm common belief that flexibility reduces injury rate. However Ekstrand (1983) reports of 82% decreased risk of injuries in his study "Prevention of football injuries". Herbert and Gabriel (2002) didn't found statistically significant difference (p=0.61) in decrease of injury risk of 5%, based on 2 studies of Popa, Herberta and Kirwana (1998 i 2000). Despite lack of affirmative scientific studies in flexibility benefits as mean of prevention, it is often used precisely in this purpose. In order to positively reflect on prevention of injuries flexibility should be developed and maintained with help of precisely determinate methods in specific moments of athletes multiannual periodization (Tkalčić i sur., 2006). Also it should be developed in volume and intensity appropriately to individual athlete's needs as well as needs of specific sport (Ingraham, 2003). In order to know the state of flexibility in specific joint or group of joints as well as in particular topological region this paper deals with evaluation of reliability of flexibility tests.

Methods

Subjects

A hundred and fifty (n=150) elite male junior soccer players, members of the First Junior League Team, volunteered to participate in the study. All of the participants provided written consent after being informed of the test protocol, but not of the aim of the study. The protocol of the study was approved by the Ethical Committee of the Faculty of Kinesiology, University of Zagreb and according to the revised Declaration of Helsinki.

Procedures

The study was carried out in two phases: at the beginning of the 2006/07 summer preparations and at the beginning of the 2006/07 competitive season. In both phases the testing period was two weeks, and it was done by experienced professionals, members of the Sport Diagnostic Centre at the Faculty of Kinesiology. Every day the testing was carried out

in a different club. It always began at 10 am and finished by 1 pm. Every player was instructed and verbally encouraged to give the maximum.

1.) SIT AND REACH- SAR

Test is conducted indoors, with a static apparatus – seat and reach box with centimetre ribbon. Subject sits with both legs stretched out together in front of him, so that his feet (shoes off) touch the first step, shoulder-width apart. Both knees are held flat together on the floor. On the step starts scale in centimetres on which the distance can be measured. The end of the feet, or the beginning of the step represents the starting point of scale that is measured with zero. All centimetres above zero are positive, while the ones below, towards knees, are negative. Task is to perform as larger front bent as possible with arms stretched out, and hands on top of each other, palms facing down. That position needs to be held for 2 seconds so the distance can be measured. Test is performed three times (three trials). Purpose of this test is lower back and hamstring muscles flexibility evaluation.

2.) V-SIT REACH TEST - VSRT

Test is conducted indoors in from of a wall. Two strait 2 meter long lines are drown on the floor making a 45" angle whose peak touches the wall. Centimetre ribbon is placed on the floor vertically towards the wall. The subject removes their shoes and sits on the floor with legs on the measuring lines, and back pressed to the wall. Hands are clasped together, palms facing down and placed in front of her. During frontal bent legs needs to stay extended on the floor. Task is to reach forward slowly as far as possible so that the fingers along the centimetre ribbon on the floor. Task is performed 3 times. Result is maximal length reached from the starting position on the centimetre ribbon. This test measures the flexibility of the lower back and hamstring muscles.

3.) LEG RISE - LR

Test is conducted indoors next to the wall that has a degree scale drawn on it. Scale is measured from 0" till 180", with 5" punctuality, so that the x-axis (horizontal axis) starts 10 centimetres from the floor. Subject lays back down on the floor parallel with the wall so that his right side touches the wall. Hips needs to be in the same level with line that marks 90". Legs are straighten out together, while the hands are placed down beside upper-legs. Task is to slowly rise fully extended right leg next to the wall and to perform maximal leg rise and hold it for a few moments. Task is performed 3 times with short breaks. Test result is the angle that subjects leg closes with the x-axis, and is expressed in degrees. Results of all 3 trials are accounted for. Test is used for assessment of hams flexibility.

Statistical analyses

The statistical Package for Social Sciences SPSS (v13.0, SPSS Inc., Chicago, IL) was used for statistical analysis. Standard statistical parameters (mean, standard deviation, and range) were calculated for each trial of the mentioned agility tests. The Kolmogorov-Smirnov test was used for testing the normality of distribution, while the homogeneity of variance was tested by Leven´s test. The statistical power and effect size were calculated using the GPOWER software. An analysis of variance with repeated measures and the correction for sphericity was used to detect a possible systematic bias between the trials for each agility test. A TuKey post hoc test was used when appropriate. The average inter-trial correlation coefficient (AVR), interclass correlation coefficient (ICC) and Cronbach's alpha reliability coefficients (α) were used to determine the between-subjects reliability of the agility tests. The within-subject variation for all the tests was determined by calculating the coefficient of variation (CV) as outlined by Hopkins.

Results and discusion

All the variables had normally distributed data. A study of the kurtosis values in the six agility tests showed that their distribution tends to be leptokurtic. Leven's test showed no violation of homogeneity of variance. The statistical power for all the statistical tests was 0.95. The effect size for the correlation coefficient was large (0.50) and TuKey post hoc (0.25) was medium. The average values of all the trials recorded during the flexibility tests showed a very small unsystematic variation.

*Table 1. Descriptive (mean ± SD, range) and Reliability (AVR, α, CV) Statistics for All the Flexibility Tests.**

	Mean ± SD	*Range*	*AVR*	*ICC*	*α*	*CV%*
1. SAR	12,33 ± ,27	1,27				
2. SAR	13,23 ± ,26	1,40				
3. SAR	13,43 ± ,28	1,32				
SAR	13,11 ± ,23	1,20	0,786	0,928	0,932	2,1
1. VSRT	62,11 ± ,90	3,86				
2. VSRT	63,21 ± ,94	4,00				
3. VSRT	64,21 ± ,96	3,85				
VSRT	63,76 ± ,92	3,72	0,944	0,992	0,992	2,3
1. LR	87,34 ± ,39	1,94				
2. LR	88,33 ± ,35	1,70				
3. LR	89,32 ± ,36	1,71				
LR	***88,89*** ± ,35	1,72	0,876	0,923	0,934	2,4

* SD = standard deviation; AVR = average intertrial correlation; ICC = interclass correlation coefficient; α = Crombach's alpha reliability coefficient; CV = coefficient of variation; SIT AND REACH - SAR; V-SIT REACH TEST - VSRT; LEG RISE - LR

Having taken into account the coordinative demands of the flexibility tasks and the specifics of the population tested in the study, we can conclude that the variability was very low. There were small unsystematic variations in the average values of the trials of all flexibility tests. The lower data variability of professional athletes can be explained as a logical consequence of the selection process. The authors believe that the professional soccer players should be tested using a more specific test (by being given a football or by being obliged to perform a specific soccer task) to increase the data variability. It can be concluded that out of the three flexibility tests used in this study the VSRT is the most reliable for estimating the flexibility of soccer players. Flexibility is one of the determinants of performance in soccer. It can be successfully developed if the training is based on the changes of direction which are done quickly and easily. By working on flexibility and improving the balance and coordination, soccer players will be able to move faster and change directions more quickly while maintaining control. Some objectives of agility training are enhanced power, balance, speed and coordination. The results of this study have the following implications for the assessment of flexibility in soccer: (a) All flexibility tests used in this study have an acceptable between and within-subject reliability and they can be used to estimate the flexibility of soccer players.

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ROLE OF SPORT IN REGIONAL POLITICS IN THE EU – THE CASE OF A HUNGARIAN AND AN AUSTRIAN REGION

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Abstract

In the spirit of the Declaration on Sport in the Amsterdam Treaty (1997) and later in Nice (2000) has emphasised the importance of sport's social function. These documents stresses the need to preserve and promote the social function of sport in the European Union. The aims of this paper is to focus attention on a controversial situation that everyone adheres to the declared role and benefits of sport in society and the utilization of its potential, but the data of our researches demonstrate the reality of the situation.

Key words: *multifunctionality of sport, sustainable development, regional development, social economic cohesion*

Introduction

Sport as multifunctional phenomenon has become a significant factor of society with enormous potential. It has been declared as the main social movement in Europe. Many millions of European citizens consider sport as the important part of their every day life, because it is first and foremost a source of wellbeing and or personal achievement. It has a major role in intercultural communication, it is an instrument of active citizenship and participation, it concerns and affects a considerable majority of Europeans of all age groups and occupational or socio-cultural categories. Its impact is immense in terms of occupying the media, and also in social and economic terms.

Sport has also been playing a significant part in the European integration processes. "The interest and willingness to cross national boundaries is more noticeable in this sphere than in many other areas of society" (Tokarsky et al., 2004, 50.). Actually it has been seen sometimes to lead the political and economical "Europeanisation" processes. It takes place in the political, economic and social environment and is subject to external influences. We can consider it as a creative culture which contributes the sustainable development of this massive trans-national political-economical and cultural creature - which we called EU- with its special possibilities.

The support of underdeveloped regions is the declared goal of the European Union regional policy. To realize social and economic cohesion all around EU is a real challenge for the Community. The future of its harmonious development could depend on it. The area of sport is one of the many options which politicians should take into consideration when designing different development projects. The benefits and advantages of sport have already been declared many times in different reports and declarations (*Attached Declaration of the Amsterdam Treaty, Helsinki Report* etc.). "*The Magglingen Declaration*" (2003) calls upon governments, communities, organisations to use sport for development to create a better world through sport. The document suggests that:

- "Sporting activity can improve people's physical and mental health at a low cost, and is essential for development.
- Making physical education and sports a part of the schooling system helps kids perform better, and improves their quality of life.
- Play and recreation can help to heal emotional scars, and overcome trauma for people in situations of conflict, crisis or social tension.
- Local sports is the ideal place for bringing people from all walks of life together, and help to build societies.
- Sport can help to overcome barriers of race, religion, gender, disability, and social background.
- Sport is effective when practiced free of drugs or doping, in a fair way, with respect, and including everyone.
- By committing to ethical practices, the sports goods industry adds value to its products, and helps to build society in a positive way.
- Partnership between the sports world, media, and development workers will boost understanding of the contribution sport can make to sustainable development.
- All this can be achieved by making sport an important part of national and international development work. Therefore, we call upon governments, United Nations agencies,

- sports federations, the sports goods industry, media, businesses, NGOs, and ordinary people, to contribute to sport for development". (www.ilo.org/public/english/ universitas/download/events/maggldecl.pdf)

Considering the multifunctional nature of sport, it is difficult to understand why the potential of this sphere has not been utilized as much as it could be. It is more often the case that the social potential of sport is very often under represented amongst the different political policy making circles. The aim of this paper is to examine the attitudes of politicians, development officers, regional development officers, mayors and sport journalists in County Vas and in Burgenland to the potential of sport to act and be considered as a social catalyst in the planning of development projects in different regions. This paper is only part of a thesis in process titeled: "*Sport Contribution to Sustainable Regional Development*" (Dancs, 2006).

The goals of this paper are:

1. To examine the attitudes of the sample population as to how each of the political spheres implements policies of planning with respect to sport in two neighbouring regions of County Vas and Burgenland.
2. To analyse the attitudes of the sample population to how different levels of sport can contribute to this socialisation process in two neighbouring regions of County Vas and Burgenland.

Methods

The research was carried out in two regions, County Vas (Hungary) and Burgenland (Austria). The sample population included: sport development officers (N=38), regional development officers (N=24), mayors and sport journalists (N=31), tourism experts (N=27) and coaches/PE teachers (N=120) in County Vas and in Burgenland. This is a sample that has a personal, political and professional interest and knowledge of how sport and society should develop. A specially designed questionnaire was used to sample opinions and attitudes to sport, sustainable development, policies and planning in Burgenland and in County Vas (N=240, 120 in each area). The original questionnaire included 30 closed questions that enabled scaled responses.

Results

Attitudes to the implementation of political policies and sport

According our experience it is considered that sport seems to be an underrepresented sphere in different regional development documents in both countries, but in particular in county Vas. Generally speaking it is a sphere which interest is quite often very low (or missing) in the integrated regional development projects. Sport wasn't even mentioned in the first "*National Development Plan*" in Hungary. It is quite understandably why the potential of sport has not been utilized as much as it could be.

To get more objective data about the situation we have measured of the different attitudes of the sample population to how each of the spheres implements policies of planning with respect to sport in two neighbouring region County Vas and Burgenland. According to the data (see Table 1) we can see that the attitude of the sample population clearly perceive that the requirements of sport are not being considered at the different levels of policy making, as the maximal values in each attitude column with respect to the different spheres are skewed below the average attitude of 'not characteristic'. Three of the columns most important are represented in bold. Each of the rows was tested against each other statistically for significant differences using Chi-square test on SPSS 12.1. All sets of data were found to be extremely different ($\boldsymbol{P}<0.001$).

It is surprising how the data reflect a poor opinion of spheres such as education, regional development, equality (equal opportunities) and the health policies. Even industry, which has a peak in support of policy implementation with sport, of 48 in the 'Significantly' column, has very similar values in the 'Absolutely not' and 'Little bit' columns. So this does not come out to well either in the opinions of the sample. The total values of the columns along the bottom of the table reflect an accurate summary of the overall opinion of the sample (see Figure 1).

Table 1. A measure of the different attitudes toward implementation of planning of different policies with respect to sport

Spheres / Categories	Absolutely not (1)	Little bit (2)	Not characteristic (3)	Significantl (4)	Very significantly (5)	Don't know (6)
Education	**15**	**109**	38	**53**	5	17
Health	**18**	**61**	30	**84**	24	16
Environment	**45**	**66**	72	**19**	2	33
Employment	**48**	**49**	49	**51**	10	26
Equality	**31**	**73**	53	**38**	3	38
Industry	**46**	**38**	43	**48**	36	26
Finances	**45**	**64**	32	**50**	13	31
Region-development	**29**	**91**	39	**30**	6	40
Trading	**30**	**58**	34	**61**	29	24
Country development	**27**	**80**	44	**47**	6	27
TOTALS	**334**	**680**	**434**	**481**	**134**	**278**

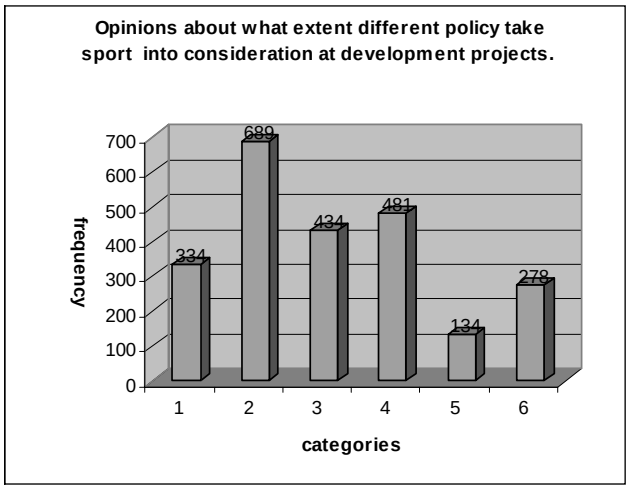

Figure 1. Data which show attitudes of the sample population to what extent different policy areas take sport into consideration in development projects.

These total data are represented in Figure 1, which shows that we have high values in the value at column "2" and very law at column "5"which strengthen our hypothesis that sport has law involvement at different policies. With other words the horizontal links of sport does not function efficient enough. It is also clear to see that there are territories (1st column environment 48 and employment 45) where the potential of sport is are absolutely undervalued sphere by decision makers.

Attitudes toward the contribution of different levels of sport to the socialisation process

In spite of knowing the benefits that sport can bring to the socialisation process, sport development officers and experts neglect them quite often in the planning process. The background to this phenomenon is, more often than not, politically motivated.

Nevertheless it was interesting to analyse the attitude of the sample as to how politicians, regional development officers, mayors take into consideration the different areas of sport when designing regional development projects in the two neighbouring regions: County Vas and Burgenland. According to the data (Table 2), it can be seen that top sport (64) and sport tourism (53) have the highest values at column "4", which means that these are relatively appreciated areas of sport in regional development according the samples opinion.. We have to underline the world "relative" as these two areas also have values 59 and 60 at column "2". The values of handicapped sport (92) and leisure sport (83) are high at column "2" and very low (29, 15) at column "4". The data at column "3" are also very high or leisure sport (76) and sport tourism (73). It can be concluded then that leisure sport and sport of handicapped are under-represented at regional development projects, according to the opinion of the sample population. These data are represented in Figure 2.

Table 2. Opinions about consideration of different territories of sport at designing different regional development projects

Territories	Absolutely not	Little bit	Not characteristic	Significant	Very significant	Don't know
Categories	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Top sport	25	59	53	**64**	18	23
Leisure sport	30	**83**	76	29	2	19
School sport	68	**95**	44	10	0	21
University sport	57	**88**	30	3	1	53
Sport tourism	18	60	**73**	53	7	21
Handicapped Sport	50	**92**	41	15	3	33
TOTAL	**240**	**447**	**347**	**174**	**31**	**170**

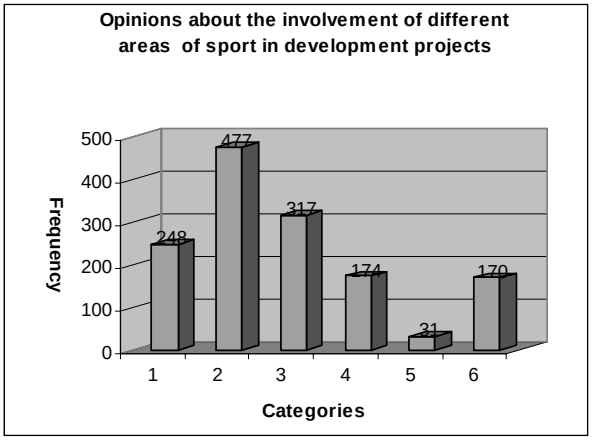

Figure 2. Totalled data (see Table 2) of the sample population's attitude to the involvement of different territories of sport in the different regional development projects.

Discussion

Our data have strengthen the opinion of those researchers (Nadori, 2003; Dancs, 2003) who describe the prestige and the importance of the sphere sport as very low in development politics in Hungary. They (Nadori and Dancs) suggested that in addition sport can significantly contribute to the sustainable development of a region in many ways and this should be declared. These are the following:

- support the regeneration and compatitiveness of the region,
- help create more jobs,
- support healthy lifestyles,
- support life long learning,
- develop the cultural life of the region,
- help communication with people and also with neighbouring regions
- help tackle crime at young people
- help create a high quality living environment,
- help create equality of opportunity, social justice and social inclusion,
- help provide quality services and opportunities,
- create opportunities for young people and older people.

It is suggested that politicians' decisions should not based on party political interests (Foldesi, 1995) in the case of sport as well, but better on objective data , on scientific analyses. Our data showed that the potential of sport is basically not utilized properly in the opinion of our sample. It would be advisable if regional politics should include the sphere of sport as well and decision makers – mayors and development officers, etc. – should use the benefits of the sphere of sport more often as it has evident horizontal links to different socialisation processes. But it would seem in the opinion of the sample that there is a lack of knowledge relating to sport, and this combined with different political interests, is a

significant factor in the decision making and the designing of development projects - particularly in Hungary. The goal of the above mentioned researches was also to give an overview about these possibilities. The *National Development Plans* are strategic long term plans with different operative programmes of each EU countries. Accordingly, this receives financial support from the Community. In the first one (in the Hungarian ones) sport was totally missing, which tells a lot about the prestige and role of sport in the Hungarian society.

The aims listed above demonstrate well the value orientations meaning the principles of the regional sustainable development and politics, and at the same time show an agreement with the declared functions of the European sport (see the "*Nice Declaration of Sport*"). The protection of the natural values, the establishment of an attractive environment of the settlement and the development of the economic potential, the establishment of a local society "capable of renewing" appear in the area developmental documents and the "*National Developmental Plans*" (**NDP**) of the individual countries as a fundamental expectation. The plan declares the encouragement of the balanced territorial development, as well as the fact, that a country or a region must become connected with the European configuration, as an overall strategic aim. One of the five operative programmes of the Hungarian NDP is the "*Regional Operative Programme*" (ROP, 2006). It is an overall programme document including all the three, social, economic and environment protecting dimensions of the sustainable regional development with that - by virtue of its content - sport and its spheres (sport tourism and recreational sport) can be best connected. We also would like to stress those otherwise obvious, rational, but in practice, neglected aspects, that the infrastructural and other developments of the touristic, within this the sport and health tourism enterprises serve not only the recreational activities of the sport and health tourists, but also of the local population, so it is not a matter of different activities that must be absolutely separated.

Conclusion

The aim of this paper was to focus attention on the controversial situation (particularly in Hungary) that everyone declare the role and benefits of sport in society and the utilization of its potential, but policy makers on the field of development policy do not realize the real value of sport as much they should do it. Our data demonstrate the opinions of the sample population which concur with this statement.

It should be highly recommended that sport has the potential to serve the regional sustainable development on many ways. It might be a significant factor in the success of the preservation development connecting health and environment protection, it might strengthen the communication to people and also between different regions, might be an supporting factor in the social economical integration. But it can only fulfil these functions, if the sphere of sport and the interest of different levels of it will be not just declared but they will be taken into consideration at decision makings and at designing of integrated development projects.

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PHYSICALLY ACTIVE AND INACTIVE LIFESTYLES, A SOCIAL RISK PERSPECTIVE

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Abstract

The study of the epidemic of sedentariness is dominated by a biomedical paradigm, pointing at health concerns for the individual person. In this presentation physical (in-) activity is observed from a sociological point of view. The rise of a sedentary lifestyle is analyzed as a social risk, based on the concept of the risk society as developed by Beck & Ritter (1992).

Three hypotheses on the social construction of a sedentary lifestyle will be discussed and highlighted by empirical studies:

- a sedentary lifestyle in youth is culturally learned, confirmed and rewarded
- a sedentary lifestyle is the result of a socialization process towards inactivity developed in youth and continued into adulthood
- a sedentary lifestyle in youth is reinforced by social inequality

Interventions to prevent the growth of physically inactive lifestyles need to be based on an integrated social policy. Therefore intervention strategies need to be positioned in the interplay between three major players in the social field: the public policy of the state, goods and services provided by the market and the initiatives of the civil society.

It is concluded that the academic field of social kinesiology can provide the knowledge and the social skills to understand the emergence of sedentariness as a social problem and to discover pathways to cope with it.

Key words: *sedentary lifestyle in youth, social risk perspective*

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AN OUTLINE FOR FURTHER SYNTHESIS OF NEW PLAY-SPORT CULTURE

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What of fatherland! Thither striveth our helm where our children's land is! Thitherwards, stormier than the sea, stormeth our great longing!

"Why so hard!" said to the diamond one day the charcoal; "are we then not near relatives?" Why so soft? O my brethren; thus do I ask you: are ye then not my brethren? Why so soft, so submissive and yielding? Why is there so much negation and abnegation in your hearts? Why is there so little fate in your looks?

Old and New Tables, Nietzsche: Thus spake Zarathustra

Abstract

Our intention in this paper is to shortly address some of the basic categories that determines the paradigm of sport culture as we know it. We do believe that by understanding these basic categories the changes of prevailing sport paradigm, which is without any shame revealing all the pathologies of modern man, can be made. The call for active reflection and indirect careful intervention into sport is loud enough to recognize the stormy times that the presence has put in front of sport. Such active reflection demands from us to travel into the field which was for long time neglected by sport theoreticians, and only a couple of mochicans has shown courrage to step beyond usual. Above all, as long as sport is trapped by quasi-academics, politics, economics and other ideologists nothing much will happen. Therefore we are calling upon those who value human being above the sport, learner above the curriculum, and are setting liveliness of life before depressing statistics. We are calling upon those who care for the child within and the children in front of us.

Key words: *sport culture, sport paradigma*

Active principle

Every human community can be defined by certain paradigms. These paradigms work as the most substantial patterns that direct key relations among members of community and to nature as well. Sport as we know it from Anglo-American and European culture mostly incorporates the paradigm of progress, growth, awards the winning side, and is inferior to institution, which governs, standardize and colonize it in order to keep the power position of leading socio-political structures. Sport toward which we will devote further reflection in this paper is somehow almost the opposite. The only thing in common is that it is about the form of physical culture that we call sport. Our focus, intention and structure are completely different from usual understanding of sport.

Changing the paradigm

First change, which should be regarded very seriously, is that we took things in our own hands now. No more can we blindly accept what our cultural legacy and valued centres of power are offering to us. The environment in which we are must not be seen as static and conceptualized as something given in advance and self-understood. Any environment is a result of relations among subjects and/or objects that are in it, and is further always set in even larger environment that defines its meaning as a whole. The environment is therefore inherently relating space, where the subject is always active partaker of the structure and intention. We need to internalize the approach that says that environment in which we find ourselves is not found but made. With the sole presence of children and teachers the place where we do sport instantly becomes different. We can modify such place further by changing the technology and equipment which enable us to actively approach in creation of movement-game environment that transcends into the safe world of play where the child is the main acteur. If we manage to do this well, we then face the world, which is - by experiencing the whole - holografically impressed into child. Such experience reveals the connatural way of living, where we cannot exist without considering personal and natural restraints, and where communication with every partaker (subjects and objects) is of high importance. In this sense the child is open to everything that surrounds him/her, and this is the way of spreading oneself further and deeper into the environment. This is the way to accept the surroundings as part of itself and respectively actively interweave in network of relations and therefore changing the network alone. In this moment the ethics of our

concept is firmly placed; it is about responsible acceptance of ourselves and the environment together with all possible relations, that has emerged by our entering into the play-ground.

Experiential quality

We have been talking shortly about paradigm of progress, growth and awarding as outer motivation, and now we will turn to paradigm of experiential quality, which derives from active understanding approach. If the first paradigm is a subject of constant growth and narrow task-motoric specialization, we can now turn to psiho-motoric literacy and versatility where the focus is on the approach to oneself and others (on method) and not on in advanced given motoric structure (remedy, tool). We are talking about functionality which has no hindrances going beyond tradition, since this is the only way to outgrow the rigid sport-related movement patterns. No longer are we interested in sport as an institution that forms the rules of the practice in order to enable standardized circumstances according to which competition is possible. We are now interested in sport not as competition but as playful movement into which we can consciously dive in order to constantly and actively reapproach the movement-game structure by which we allow the children to co-create the playful environment according to their powers and interests. This is the core element of new play-sport culture, which reflects an ecological principle and is as physical activity of primal interest in education for sustainable living. Active principle further demands that both, child and teacher, being as planners and co-creators of play environment, do have well developed practical sense.

Practical sense

Paraphrasing Hocart[1] we can say that the time has passed, when sport ceased to be just practice. The cognitive capabilities of the human are limited in time and space, subjectively and objectively. We are in the world consciously only to a certain extent; as needed in a given moment or as engaged we are, and as it is in our power (will). To know might mean to be able to identify or describe and explain something, or to have the same experience as the one we are trying to understand. Our everyday life is primarily experienced as the place for actual and possible actions, and only secondly as an object of our thoughts. We are now facing the challenge of bridging the gap mentioned, where Bourdieu's (2002: 139) practical sense might show us a way:

> *"There exists the time of science, which is not the time of practice. [...] The science is possible only in relation to time, which is contrary to practice. Science wants to overlook time in order to detemporalize practice. The one who is involved in the game, seized within, does not conform to what he sees, but to what he fore-sees (pre-voir, sees in advance in directly perceived presence)."*

It is believed that with the aid of scientific-logical reasoning, based on the principles of formal logic, man will – ever faster and more successfully – change the stock of knowledge of everyday life, a life based primarily on the rules of 'common sense'. Man tends towards the explanation of a practice, its generalization, ordering, systematization and rational explanation. This, however, is already a transition from concrete life to the abstract, from practice to theory, from lived to reflected or to discursive consciousness. And this is exactly the point, we believe, where attention should be placed in order to develop a theory of sport; the gap between the lived and the reflective, and between practice and theory. Regarding this gap, an important paradigmatic change is occurring; scientific positivism is being transformed into, or perhaps more accurately, being replaced by, the science of perspective (Jošt, Hosta, 2004).

The world of play and sense for play

Building the context of development of new play-sport culture, we are very much interested in approach, which prioritizes practical sense. For this sense implicitly carries pedagogical intuition and pedagogical eros as well, and is - while firmly grounded in presence - consciously directed towards future. This sense is well grounded in here and now in practice, being fully aware of learning environment, which is created and changed according to its will. This will is precisely because of the practical sense harmonized with the children's will, and pedagogue does not project his perspective onto children. Namely, practical sense enables one to seize the child's play in child's way, and then actively immerse into the world of children's play or respectively reinstate itself as a coordinating organ, which enables the safety of activity and ensures that everybody is involved in it.

> *"This practical sense, which is not being loaded neither by rules nor with principles (except in the case of failure or defeat), not even with calculations or derivations, that are in any case disqualified from action, which does not stand any delay, is the one, which enables us to evaluate on the spot with one look only, and to judge in the flow of the action the meaning of the position and promptly reply properly." (Bourdie, 2002: 179, translated by Hosta)*

[1] *Hocart in Bourdie (2002: 62): "It has been for a long time since man stopped just to live, and began to think life."*

Towards the new play-sport culture

Emancipation of the new play-sport culture from institutional rule dictation is a key to assert the practical pedagogical sense. Practice demands immediate action in general, and sense for children's play possessed by pedagogue. In sport this means that anyone participating has to follow the rules of the game, and in our case this means that rules, if we happen to set them up, can be simultaneously changed as well. Learning environment explicitly requires constant harmonization of all the parties (subjects), including technology, requisites and rules (objects). It is not about creating a place first that would serve for further orientation. In the sole moment of orientation we simultaneously create space from which we then orient ourselves. We cannot have the first without the latter, and nothing has come into being prior to the other. The world in the new play-sport culture is not already made, and ready to serve and eat as an instant meal. Our concept presupposes that people enter into it with responsible manner, since they are aware of the fact that this world – even if this is only a world of play – is co-created by everyone, who accept this relation, and therefore take the responsibility and change this world according to theirs and others interests, abilities, and needs. If these are the basics then the next step, when talking about cooperation among children and peer assistance offered to those who cannot manage with the environment yet, is further pedagogical stage. Namely, the sense for environment, being material or social, is a matter of all partakers and by development of one, the whole develops. If we wish that new play-sport culture will flourish, we need to always set the perception of space, ourselves, and movement into the context of joined environment, which is indivisible and cannot at all be the puzzle of many abstract elements; moving subject and objects as obstacles. If, as pedagogues, we prepare the children for the 'world out-there' and take over the political responsibility, then we might say that with new play-sport culture we influence the change from liberal-individualistic and atomistic to communitarian and holistic perception of social environment.

The environment in which we teach in proposed manner should be understood as habitus. Habitus can be understood as social organism, which is restored through the relations in the group and in space and time occupied by it. Habitus is the materialization of all relations, of all that individuals (subjects and objects) bring into this space, along with the past experiences. The structure set up by new play-sport culture is creating such habitus, where development of different paradigm of sport is possible. With no hesitation and no violence such a habitus excludes those elements of the old paradigm, which no longer wished to be reproduced.

Etc.

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ALGORITHM PROPOSED FOR THE OBJECTIVIZATION OF INFORMATION WITHIN THE SOCIAL PHENOMENON OF PHYSICAL EDUCATION AND SPORT

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Abstract

This paper presents a possible algorithm propose for the objectivization of information within the social phenomenon of physical education and sport, whose operations are based on the axioms of its modelling.

Key words: *modelling, axioms, objectivization, physical education, sport, motor activities, cybernetic system*

Introduction

One may say that the forms of practicing physical exercise diversified according to the social interests, individual on of group. By taking part in the life of the members whose society it influences, physical education and sport becomes a social issue of national interest, considering the number and increasing variety of its performers.

In this situation we may say that in order to be made efficient physical education must be studied as a social phenomenon - complex, dynamic at national scale, with implications, motivations, concepts, individual or interests, varied and changing, etc.

Solving so many problems supposes realistic, scientific, objective concepts, capable of providing the respective decisions permanent information, ONTIC and OBJECTIVE. It can no longer be accepted the concept according to which the system of physical education has only three sub-systems: institutionalized (learning), performance and recreative, because there are, besides the three sub-system, many other categories of performers with direct or indirect motivations, direct or changing purposes, organized up to a central level or unorganized individual, who integrate the requirements of physical exercise by practicing it.

We understand that the social phenomenon - physical education and sport groups all the categories people, relations and all the categories and forms practicing physical exercise.

It is very interesting to point out that this phenomenon with its multiple and diverse facets, influencing, the life of people of all ages and genders, from all social categories, is sought for, supported and monitored by the management of society for its purposes: educational, formative, recreative, and also political and material.

A complex, dynamic social phenomenon, physical education and sport follow the same laws of progress conditioned in the present stage by the objective quantity and, mainly, quality of information and its management. Ignoring these two subjects necessary to social progress means not ensuring PHYSICAL EDUCATION AND SPORT the development in the needed rhythm, comparable to the international level, at which all our society aims.

The model in system thinking (cybernetics) is an objective reproduction or transformation of information into values with objective existence for the social phenomenon of physical education and sport, too.

Both the reproduction operations - determination, and also the ones of transformation into values with objective existence must he seen as scientific axiomatic obligations for the social phenomenon of physical education and sport to settle and define the STATUTE OF SCIENCE of processes, activities and motor activities based on: THE HUMAN AND PHYSICAL: EXERCISE with social purpose.

Discussion

Starting from these realities and from the requirements, principles and laws of these sciences, we advance a possible algorithm, whose operations are based on the axioms necessary for the objectivization of P.E.S. - a social phenomenon at national level.

Operation 1: all levels, from government to the last performer, accepting the concept according to which: **physical education and sport in Romania is a social phenomenon at national level in which there are involved people who, one way or another, interact with physical exercise practiced in various forms, out of various reasons, material motivations included.**

Definition: Physical education and sport is a national, autonomous social phenomenon that comprises all processes, activities, actions and logistic structures which are based on physical exercise or on a particular form of it, whose essence is the achievement of physical, mental and material welfare of people in agreement with the social interest.

Operation 2: a national social phenomenon, both hyper-complex and dynamic, physical education and sport at national level must be researched permanently in an interdisciplinary manner as a **cybernetic system** (**hierarchical**), opening wide the windows of human research sciences, the only ones that can ensure inter-disciplinary objective information, necessary to progress at international level.

As a hierarchical system (cybernetic), the national, social phenomenon of P.E.S. complies with all the requirements formulated by these sciences.

The definitory fundamental elements of the hierarchical system physical education and sport are:

- PEOPLE;
- PHYSICAL EXFRCISE.

These fundamental elements of physical education and sport interacting, they condition each other and starting from this level of the fundamental informational field there are built structures of levels and adjacent areas, which themselves become sub-systems - subjacent systems of the HIERARCHICAL SYSTEM OF P.E.S.- SOCIAL PHENOMENON, its most general structure. All the structures are subordinated to its purpose or finality, respectively the positive influence of states: physical, psychological, physiological, motor, biochemical, moral, spiritual and material on the physical exercise performers.

Operation 3: Modelling, as a method for researching the model of a SYSTEM, takes into account the fact that the researched system will exist only through its concepts: structure, state, essence, organization, etc. and ONLY for the moment of research that aims a certain purpose.

The social phenomenon physical education and sport has, by its processes, activities and structures, an objective existence, outside our senses and independent of them, a posture in which it is researched. The hierarchical system physical education and sport has an ephemeral existence, only for the moment of its research.

Operation 4: For an inter-disciplinary research, the hierarchical system P.E.S. can use modelling at national level as a research method and operational method, the only one capable of acquiring, processing, conveying and assessing objectively the optic information of the phenomenon.

The mathematical method obtained by this method will be permanently completed with philosophical models obtained on the basis of the same modelling axioms, thus meeting the requirements of the laws and principles formulated by CYBERNETICS, by which any theoretical philosophical statement must be confirmed or denied by mathematics-physics and the other way around, when any mathematics-physics statement must be supported or denied by philosophy - the theory of processes or respective phenomena.

There will be operated with models from macro-structural level: government, ministries, and federations to micro-structural level: sport branches as physical exercise and performers as fundamental models of the informational field of physical education and sport social phenomenon.

Operation 5: In order to acquire the models of the hierarchical system P.E.S. - national social phenomenon, the determining of its structures is necessary and sufficient. This axiom supposes that any philosophical, mathematical or physics model which will be elaborated should he preceded by its structure.

The structure of the national social phenomenon is made up of the groups specific to the people who practice and the groups specific to the physical exercise practiced by people as ELEMFNTS (E) which condition and influence each other by INTERNAL RELATIONS (IR) of the system as its theoretical definition. Its mathematical definition is represented by S=E+IR according to the requirements of inter-disciplinarity.

The essence of the social phenomenon P.E.S. at national level consists of:

- Positively influencing people by means of physical exercise with the purpose of state: physical, moral, psychological, physiological, motor, spiritual and material in agreement with the general interest of the Country.
- The mathematical definition of the essence of the social phenomenon P.E.S. starts from the most general mathematical structure of the system, respectively:

$$ES_{PES} = \frac{\text{Human + Physical exercise}}{\text{Finality / Purpose}}$$

The general essence of the phenomenon formulated above is conveyed by the adjacent areas, operating according to thee sub-systems and their internal and external relations up to the last one, in fact the first sub-system of the informational field off P.E.S.:

$$S_1 = \text{Human + Physical Exercise}$$

If there is an essence of the national, autonomous social phenomenon defined above, then there surely is an essence all the level of each sub-system - subjacent structure, subordinated P.E.S.-F.S.N., but specific, to every analyzed sub-system.

This means that there will be an essence of P.E.S. at every level of five, **but attention: at every level there will be an essence for each element - sub-system on that level.**

We are pointing out the concept, according to which the human and physical exercise become at the active execution moment A UNITARY WHOLE – A CYBERNETIC SYSTEM that can be studied in an inter-disciplinary manner for obtaining objective information, with all the concepts related to TGS, the system essence included.

Operation 6: the action necessary to maintaining the objective character in studying the P.E.S. phenomenon by means of models, all along them consists of: describing the elements (people - physical exercise), and their internal and external relations and also their finalities by **means of state** parameters (physical, psychological, moral) which should reflect both the structure - organization and the dynamic - functional behavior of the whole system - sub-system. Note that in physical education and sport three main model categories are operated with:

- Philosophical, conceptual, theoretical models;
- Mathematical models - software;
- Physical models - hardware and software.

Operation 7: in determining the OPERATIONAL MODELS, the REVERSE PATH principle applies, from the final model back through intermediate models up to the initial moment of research: **operational objectives**.

The reverse path principle used in modelling covers all the requirements of OPERATIONAL PROGRAMMING, ensuring the objectivization of processes.

Conclusions

1. PHYSICAL EDUCATION AND SPORT is, first of all, a social phenomenon of national level with a pronounced specific practical content and it must be studied with this objective existence.
2. Physical education and sport - hyper-complex, dynamic social phenomenon with an objective existence, can be influenced at national and international level only by an inter-disciplinary approach, as the only way to obtain the objective information necessary to the processes and activities specific to all the structures.
3. The positive influence of the social phenomenon of P.E.S. must start with the change of the general fundamental concepts on physical education and sport in a society in transition. The new concepts should meet the entire requirement: needed by social, individual and group interests. In this situation, physical education and sport must he studied as a complex, social phenomenon, dynamic at national level with implications, conceptions, individual and group interests, varied and always changing.
4. As a complex and dynamic social system, physical education and sport must benefit from a system of permanent informing as a condition of its unitary existence.
5. Forming the specialists and the structures necessary to the interdisciplinary research of the system is the acute problem of the social phenomenon physical education and sport at national level, in this present-day stage.

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ANALYSIS OF FUNDAMENTAL VALUES OF OLYMPISM AND SOCIOLOGICAL ASPECTS OF CHANGES OF THESE VALUES IN THE CONTEMPORARY SOCIETY

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Abstract

Olympism is a philosophy of life promoting and exalting a balanced whole, in which qualities of body, will and mind are united. Drawing upon ancient tradition and the noble plemenitoj Greek thought, combining sport with culture and education, Olypism seeks to create a way of life based on the educational value of a good example, on respecting universal ethical principles and joy resulting from an effort. Sport represents for the Olympic movement an educational means whose aim is to achieve a harmonious development of the youth in the Olympic spirit through physical and moral education, mutual understanding, friendship, solidarity and *fair play*, excluding any form of discrimination.

Key words: *Olympism, sport, society, education, sociology of sport*

Introduction

The Olympic movement was started by the French educator and historian Pierre de Coubertin in the late 19th century. The revival of the Olympic games and promotion of the Olympic idea were inspired by the ancient Greek Olympic games and the overall approach of the Greek culture to a harmonious development of spirit and body. The Olympic idea has developed into a philosophy of life, which promotes and exalts a balanced whole, in which the qualities of body, will and mind are united. Drawing upon ancient tradition and the noble Greek thought, by combining sport with culture and education Olympism wants to create a way of life based on educational value of a good model, the respect for universal ethical principles and the joy found in effort. A few days before his death Pierre de Coubertin wrote down: "Effort is the highest pleasure. The success is not a goal but a means to aim higher. The value of an individual lies in their aspiration towards positive values; the individual is created to act, not to give up and die resigned to their fate" (Jajčević, 2000). Sport represents for the Olympic movement an educational means for achieving a harmonious development of the youth in the Olympic spirit which includes physical and moral education, mutual understanding, friendship, solidarity and *fair play*, and excludes any form of discrimination. The Olympic movement fulfils its aim through sport as its main sphere of activity, in various and specific conditions in countries and areas with different social structure and system. The spirit of Olympism exceeds the narrow limits of sport by affecting positively the whole society through its fundamental values. Olympism thus becomes a social phenomenon aimed at achieving a unique goal within a broad social context. The Olympic games represent the peak of the Olympic movement whose role is to bring together world's athletes to the magnificent celebration of sport. In ancient Greece during the Olympic games wars and all hostilities were brought to a halt, truces were signed, so as to assure equality of chance for all those who would test their strengths and skills at the contest.

Beginnings of change

Olympism has undergone the greatest change in the 60s and 70s of the 20th century with a new phenomenon of total professionalization and commercialization of sport, which has thus become ever more business and less sport oriented. Ever since entrepreneurship, economic interests and television entered the realm of sport, it has become business, and its original values have been considerably distorted. Gain and profit have taken over the most important place, causing thereby inversion of all the values inherent to sport and Olympism as a movement. Since Olympism represents the most prominent part of sport, these changes in the society have become especially conspicuous within its most precious part – Olympism. The first signs of diversion from the fundamental idea of the movement and original values incorporated in the Olympic movement can be traced to the period between 1920 and 1924. Having noticed that everything is going in the opposite direction from its original orientation, Coubertin held a prophetic speech at the session of the International Olympic Committee in Prague in 1925, in which he points to a "treason" of Olympic guidelines and opposes the activities which he regards as diversion from the original Olympic idea (Jajčević, 2000). Today after more than a century of modern Olympic games, in the work of Pierre de Coubertin - an educator, historian, founder of modern sport, both a man and a visionary – the aspriation for higher values can be noticed, along with exulting human and athletic performances. By reviving the idea of Olympism Coubertin wanted to imbue the sport competition with a pedagogical approach, thus

additionally empowering the Olympic movement as a whole, since it is not regarded as complete without its pedagogical component and it cannot exist as such, according to Eilert Herms, a theologian from Tübingen (Ommo Grupe, 1997). Without such educational basis the Olympic games and sport competitions would be reduced to sheer *gladiatorial* test of strength as in ancient Rome. The most precious aspect of Olympism – in Coubertin's view – is not achieving praiseworthy top sport results and setting world records, but education and development of moral-ethical values of an individual who is a basic unit of a society, and consequently affecting positively the society as a whole. In the very beginnings of his work Coubertin wanted by these reforms to provide a new meaning to sport, and the main part and driving force of these reforms is contained in the very idea of Olympism which is the main instrument of bringing about change through moral, ethical and educational values. The reforms were based on education and on the five Olympic principles as the main factor and promoter of the idea of development not only of a human being as a whole, or an Olympic athlete but the society as well.

Fives principles of Olympism

The first principle is based on the unity of mind and body, and on a harmonious holistic development of a person. Playing a particular sport and being involved in a training process is not enough to stimulate the development of all human potentials. Education takes a very important place as well as an even and harmonious development of intellectual and physical potentials, best illustrated by the old Latin proverb *Mens sana in corpore sano*, and confirmed by the Olympism advocating harmonious development of the spirit and body. The second principle aims at achieving personal perfection. Sport activities must incite an individual to their personal development and perfection – both of body and mind – and in such a way ensure a complete growth of an individual and the development of all of their capacities. The outcome of such an approach will result in a development of a mature person, acquiring of new knowledge and building up a society based on solid values. The third principle is the principle of amateurism, which was widely discussed throughout history. The task of this principle is to endow sport with a "soul", or rather the spirit of nobility and chivalry. Coubertin wanted with the idea of Olympism to purify sport, so as to reach more easily to the ascetic ideals contained therein, and in such a way ensure and preserve the idea and philosophy of sport as a whole by rejecting its negative aspects, like for example the desire for winning at all costs or turning Olympic athletes into modern *gladiators.* The fourth principle is fairness and it points out that with this very value, along with respecting written and unwritten sport regulations – well known in sport as *fair play* – all the competitors are guaranteed equal conditions, as well as respecting of fundamental principles of a modern and civilized society. In such a way the control of aggressiveness and impulsiveness is also attained, and athletes thereby learn how to control themselves and their emotions. The values like kindness and noble intentions make a man civilized, and they are taught in the *Pedagogy of Olympism*, as emphasized by Coubertin (Ommo Grupe, 1997). With the fifth principle Coubertin expressed the desire of the whole mankind, the desire for peace. Ensuring peace between nations through sport and via sport is not an easy task. However, this is exactly the central philosophy of the founders of Olympism which is by no means in contradiction with basic principles of sport, sport competition and pushing the limits of your own achievements. The Olympic games and sport competitions must be the factors in the society which will bring people of different races or political and religious beliefs together by their sheer existence and message, acting in the spirit of mutual respect. The key moment of the process, as emphasized by Coubertin, represents the companionship which the Olympic games and the spirit of Olympism create and provide. Being together and having an opportunity to get directly acquainted with human diversity, or a fellow man next to you, is the first step towards surmounting and overcoming prejudices, scruples and a gap between people, as well as achieving better interaction and understanding of diversity as something which can enrich your life and accepting a challenge instead of condemning it.

Olympism in the contemporary society

However, the contemporary society indicates that the world of sport has departed a lot from these values. It is interesting to note that Coubertin himself was aware of this controversy at his time already, when the exalted slogans (just as today) had been used for disguising the real intentions which often became prominent in economic and political interests of an individual or a society. In such a way the value of sport has not just become questionable, but it has become an instrument of double moral and hypocrisy because of those who use the above-mentioned principles for the stated purposes. Everyone who honestly adopts the principles of Olympism will have a chance for personal growth and pushing human and sport boundaries. This opportunity is offered even today to all people of good will, although the conditions for achieving it have considerably been changed. Top sport of today, which we are familiar with, has changed not only in terms of quantity, but it has become an unprecedented political, economic, social and media event – a phenomenon which evokes global interest of the public, as well as a range of different interests on a personal plan, like profit as a category *per se*. There are a lot of those who want to use up sport for their own selfish goals, like exerting influence, stabilizing their position of power or gaining profit, and thereby consciously depart from the basic idea and principles promoted by Olympism. In such cases one can often come across the adjective *Olympic*, but it has not really much to do with Olympism, it is moreover in contradiction with and exerts utterly negative influence. In the present-day business and marketing oriented society

which puts profit and business indexes ahead of human well-being, causing in such a way a complete inversion of values, the demands that athletes face daily become ever bigger. The first places are asked for, setting world records and setting new limits, but at the cost of health, sometimes even athlete's life, and ever new and greater excitements. The opening ceremonies of the Olympics, which become more and more spectacular and expensive, resemble competitions in prestige, so undoubtedly some other values come through, whereas the permanent values inherent to sport fade away. In such a way the Olympic motto and its strong message *citius, altius, fortius* (Lat. swifter, hither, stronger), originally borrowed from Henri Martin Dideon, begins to be falsely interpreted and as such exerts an additional pressure on athletes, since the success has become the only point of reference. The Olympic ideals are thus being used for "un-Olympic" purposes, and in order to avoid this trend, a forth word is suggested to be added to this motto – the word *humanius* (Lat. humane) according to a philosopher and an Olympic champion Hans Lenk (Ommo Grupe, 1997). Sport has undergone many changes, and it is dynamically developing on all levels from day to day. Coubertin's wish was to provide sport with a new legitimacy and find answers to questions of risk and new limits, which athletes face daily, regardless of the danger to their health – all this with the aim of achieving higher viewer ratings and profitability of sporting events; Coubertin advocates a truly holistic approach to a person, and offers a way how to prevent such a negative trend. The omnipresence of doping and the use of prohibited substances, the beginnings of training processes at the earliest age, winning at all costs, profit as more important than moral and ethical values are only some of the questions that the contemporary society must find an answer to. Due to the universal nature of today's sport it is clear that the implementation of the principles of Olympism is impossible without certain modifications. However, the principles belonging to the category of basic human principles, like inviolability of human dignity, should not be changed or modified.

Conclusion

Olympism in today's society represents an educational concept which is intended for the modern man and sport, as well as for its bold and audacious competitors, who in accordance with what has been said become better people building a society based on permanent values. At the Olympic games and sport competitions the most refined athletic performances are recognized of those athletes who have made great sacrifices and prepared themselves for the occasion in the course of several *Olympics.* Coubertin identifies exactly those competitors as the ambassadors and promoters of the Olympic principles and as a model to young people. Olympism is also a demonstration of abilities and skills, but it is also far more than just a result which can be recorded by means of measuring instruments and then evaluated and ranked. Olympism represents a desire for personal perfection and achieving your own potentials, as a result of striving for ever better results and proving one's values, as well pushing sport limits where the results do not matter most, but the effort invested into their realization. However, the effort itself in an attempt of achieving the perfection of movement (although it cannot be called Olympism) reflects exactly part of that spirit (Ommo Grupe, 1997). Thereby Coubertin's motto once again comes to the fore: "It is not important to win, but to take part". In the Olympism the idea of justice and *fair play* is incorporated, which thereby raises sport above sheer physical competing, ensures it greater value and gives it a human dimension. Only by respecting this principle sport will ensure a brighter future. A noble idea of peace among nations, inherent to Olympism, does not solve alone conflict situations, but it represents a milestone how to cope with conflicts - cultural, ideological, racial, sexual and religious differences, and all other forms of discrimination. Keeping all these ideas in mind sport retains the right direction, and in such a way it becomes a lot more than just a sport. Permanent criticizing and questioning of these values affirm the fact that these topics are neither wrong nor superfluous to the contemporary society. Just the opposite, they send a clear message that the above mentioned values remain unchanged the whole time, by stressing that their implementation represents a challenge to the society. Inspired by *Olympia*, Coubertin includes in sport values like moral and ethics, ideas which he found in the philosophy, and he wants thus to set an example not only for athletes, but also encourage also others to engage in sport, and also to develop the modern society as a whole. Today, like at times of Coubertin, the society must strike a balance between differences which are noticeable in the field of scientific, technical and physical development. Moral and ethical values, and their implementation in everyday life must contribute to the development of an individual, and also make a contribution for a better society as a whole. In order to make the spirit of Olympism take hold completely and ensure that athletes develop into integral persons, Coubertin himself proposed a solution many years ago - sport based on values of Olympism and its principles. It is a guideline and a milestone, but also a responsibility and a challenge to every sport loving person, which can is also recognizable in a modified Olympic motto: *Citius, altius, fortius – humanius*!

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MORALS, ETHICS AND FAIR PLAY AS PERMANENT VALUES OF SPORT

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Abstract

Ethics in sport is a manifestation of moral values which are used to appraise man's conduct in sport and around sport. A code of moral norms and behavior of athletes, called by the English term '*fair play*' or '*gentlemen's rules*', has been devised in the sporting environment to deal with this issue. According to some of the numerous definitions, fair play is "an impeccable, open, generous respect of the rules, the interests of others and equality; a set of unwritten ethical norms of athletes; the capacity to control oneself, develop correct and friendly relationships with opponents, and comply with sports rules and decisions of sport judges". However, the syntagm 'fair play' means much more than playing by the rules – 'fair play' is also a philosophy which underlies the necessity to respect all those involved in a sport on the basis of lessons and values provided by sport.

Key words: *philosophy, morals, ethics, fair play, sport*

Introduction

Before we define ethics and its role in sport, we should point out that ethics is a philosophical discipline and as such a part of philosophy. Therefore, in order to better understand the impact of ethics on sports, we should primarily define philosophy itself. Philosophy (Greek *philosphia*) originally means "love of wisdom". It is derived from the Greek word *philos*, meaning friend, and *sophia*, meaning worldly wisdom (Halder, 2002). It was a Greek term for the actions of those in pursuit of wisdom (Kalin, 1983). According to legend, the first to use the word philosophy was Pythagoras, while Socrates and Plato put it to general use. These great philosophers and thinkers modestly claimed that they were not sages but just lovers of wisdom, wise to that measure to which they strove for wisdom. It is not possible to find a definition of philosophy that would be unanimously acceptable, because through history philosophers have given different definitions of the issue and concept of philosophy. Nevertheless, one could not go wrong in making a sufficiently general definition by which philosophy represents the scrutiny of and a quest for the essence; it is the study of Being, world and truth, while its results provide the outlook on the world and life. A wide variety of philosophical disciplines have been developed within the historical context of philosophy, but in general, philosophy is divided into theoretical, practical and poetic. Theoretic disciplines include ontology, gnoseology, philosophy of nature and others; practical disciplines comprise ethics, philosophy of politics, philosophy of law, philosophy of history, etc., while poetic philosophy relates to aesthetics, poetics, rhetoric, philosophy of technique, etc. These branches of philosophy are not separate units but are its closely intertwined parts, and so are the solutions arising from the set problems that represent different aspects of the same questions.

Ethics through history

Ethics (Greek *ethos*, custom or habit, morality) is moral philosophy that represents an essential part of practical philosophy; it investigates the origin, motives, norms and purposes of moral actions and judgments. Its theme is *good* as the leading thought of right actions and consequently, of moral life. Depending on the definition of the final goal, there are, among others, the following ethical forms: eudaimonism (the ethics of happiness), hedonism (the ethics of pleasure), utilitarianism (the ethics of utility), and perfectionism (the ethics of excellence). According to Alois Halder, each form of ethics is determined by a profound understanding of a human being rooted within the basic life attitude, the character, to which ethics relates critically. The current difficulty of formulating ethos in the traditional sense arises from the fact that any determination of the self, and particularly of the human self, has become questionable, and from the fact that critical ethical reflection is the expression of the crisis of ethos. Through history, a number of theorists have dealt with ethics and its impacts; we shall mention the more important ones and compare their thoughts. In the cosmological period of Greek philosophy, the most important representative of ancient Atomism was Democritus (460 – 370), the famous thinker from Abdera. Democritus maintains that man should suppress sensual pleasures and transient desires for worldly goods and replace them with the achievement of more permanent values, such as cognition, reasoning, wisdom, goodness, friendship, moderation, cheerfulness and tranquility, because "men should value the soul rather than the body" (Kalin, 1983). The ethics of Democritus is in accordance with his general realistic outlook. In the anthropological period of Greek philosophy, and after the victory over the Persians in the mid 5th century, Greek civilization and culture came to its full

blossom. This is the time of Aeschylus, Sophocles and Euripides, Pindar and Phidias, sophists and Socrates, and later Plato and Aristotle. At that time, the focus of philosophical interest moved from the question of cosmos to the question of man himself. Thus, ethical issues of virtue, right, customs, justice, education – in other words, issues of the human race, took on pivotal importance. Sophists and Protagoras as their representative believed that man was the measure of all things. It was Protagoras' way of advocating the relativity of ethical principles. One of the most popular philosophers was Socrates (469 – 399), whose mission was to improve the society, reform his co-citizens, and direct them towards ideals. He points out that the essence of human life is in virtues such as respect for the law, moderation, self-control, and pursuit of excellence, and formulates the famous gnome "Know Thyself". Significantly, Socrates equalizes virtue with knowledge, and knowledge with virtue. Thus, ethical intellectualism leads to ethical optimism. Another great thinker, Aristotle (384 – 322), claims that man will be happy if he develops a specific and wise nature both in practice and in ideals. The philosophy of Christianity advocates the ethics of love – the commandment of non-violence, forgiveness and mercy swept the world. The focus is on purity of intention and on the act itself rather than its form.

Moral values and sports ethics

Every society and milieu rests on valid norms that govern both individuals and the community. Morality, as one of these norms, is a form of man's social conscience, which is historically present and deeply rooted in the man and his relationship towards others, towards the world around himself and ultimately towards himself. A part of ethics, the main branch of moral philosophy, relates to sports. Thus, sports ethics is recognized as a problem of morals in sport. Sports ethics deals with a manifestation of moral issues and evaluates an individual's actions in sport and around it. Based on the above, a code of moral standards of athletes' behavior under the commonly accepted syntagm 'fair play' or 'gentlemen's rules' has established itself in the sporting world. According to some of the many definitions of fair play, fair play is an "impeccable, open, generous conduct of respecting the rules, the interests of others and equality; a set of unwritten ethic norms of athletes; the ability to control oneself, develop correct and friendly relationships with opponents, and comply with the rules of sport and the decisions of judges". However, the syntagm 'fair play' means much more than playing by the rules – fair play is a philosophy that supports the necessity of respecting all the participants involved in a sport through lessons and values provided by sports. Not only is fair play a set of rules, but it also guides athletes towards correct conduct by which they show respect for other athletes and other participants in a contest. Through playing by the rule and respecting fair play, athletes find themselves in a situation in which they must make a decision, select the right choice and avoid the wrong one. Fair play is one of the fundamental issues for the future of sport and ethical principles in sport itself, and a personal task of each and every athlete. It is also a key to solving the problem of violence on sports venues. In order to promote fair play, we must recognize a variety of issues, such as differences among sports branches, levels of performance and cultural backgrounds. Abidance to fair play is a duty to be upheld by all those participating in a sporting event: athletes, sports officials, sports federations, government bodies, and the media. Sports bodies encourage and promote the compliance of fair play through sports rules and education of coaches, judges, medical staff and sports officials. Government bodies are responsible for the dissemination of the message of fair play via education, especially among the youngest. The process of education should not be targeted exclusively towards athletes but also towards spectators. The media have a responsible role in fostering the principles of fair play, and so do the supporters. However, fair play is a difficult concept to promote despite all the actions undertaken with this view. New methods should be sought in order to ensure the correct attitudes of athletes and other participants in a sporting event. Different aspects of this moral category in sports should be emphasized; not only those aimed at eliminating violence on sporting venues, but also those particular aspects that are less conspicuous, such as ensuring that all participants receive equipment of equal quality and compete against athletes of equal ability, size and power. The implementation of fair play may be divided into two categories: individual and organizational. In the former, the task of each athlete is to accept the rules and play and behave by the rules; show consideration for other athletes; and achieve the best possible result ("not lose on purpose"); outplay the opponent by better abilities and not by aggression; react promptly and accept the decision of sport judges; show self-control both in victory and defeat, or in other words, show modesty in victory and dignity in defeat. In the latter, the duties of sports federations are to formulate rules that will make a sporting competition more dynamic, exciting and attractive; organize competitions of such a rank in which all the competitors will have an equal chance; control the conditions in order to ensure safety for all the competitors; devise training programs to match the age of contestants, but at the same time preserve a high level of their motivation, and monitor the influence of commercialization and politics on sports. Fair play may be summarized in the following ten principles: 1. Play for victory, 2. Play fair, 3. Observe the rules of the game, 4. Respect your opponents, team-mates, judges, sports officials and spectators, 5. Accept defeat with dignity, 6. Promote the messages of sports, 7. Reject corruption, doping, racism, violence and other threats facing sports and mankind, 8. Help others say no to the negative aspects (under Item 7), 9. Do not follow those who want to discredit sport, 10. Respect and follow those who disseminate the true message of sport." Human dignity, as pointed out in the United Nations Chart, must always take precedence, both in life and in sport (CIFP, 1992). The maxim, "without fair play there is no sport" was an essential and dominant idea of the founder of the Olympic Movement, Pierre de Coubertin himself. Coubertin also warns of the danger of applause, which he characterized as a "first-rank seducer and corruptioner (Jajčević, 2000). In the spirit of the Olympic Games and the motto "The most important thing is not winning but taking

part", we may also quote the old English saying: "For when the One Great Scorer comes, To write against your name, He marks-not that you won or lost-But how you played the game." Fair play, as an unwritten but ever present rule in sport, is fraught with obstacles and resistance. These are, first of all, significant combating and aggressive components of an athlete. Highly developed sports fighting moral seeks its parallel presence in competitors so that insistence on fair play is not only the fundamental necessity of modern sport but also a phenomenon representing a particular cultural achievement of humankind. It is for this reason that Lombardi's motto, "Winning is not everything; it is the only thing", should be rejected and the Olympic maxim "The most important thing is not winning but taking part" embraced instead in the spirit of true sportsmanship. The quote comes from a sermon that the Pennsylvania bishop Ehelbert Talbot held for the participants of the 1908 Olympic Games in London.

The unethical aspect of doping

One of the most serious problems facing modern-day sport is doping. From a perspective of sports as a movement, the message it conveys to delighted participants worldwide and all the positive traits that playing a sport develops in an athlete, doping is in complete contradiction with sports ethics. Athletes who live in the spirit of true sportsmanship and spread its message across the world, find doping absolutely unacceptable. From the aspect of ethics, doping is unethical in the face of the true nature of sport and belongs to the category of cheating and disobeying the rules. Cheating implies the intention of getting around the rules and norms at any cost regardless of the consequences. Fairness, on the other hand, implies compliance with the rules and exposing conduct which breaks the rules as unfair and unjust. An athlete, if one may call him that, who uses doping substances damages his own health and the health of other (non-doped) athletes by artificially raising the limits of sporting results. This also has a reflection on the society as a whole, and especially on the youngest members, who idolize athletes. The term doping generally relates to the practice of taking and administering forbidden substances and methods in sport with the goal of achieving a sporting advantage in an unfair way. With the development of new, advanced doping substances in the last fifteen years, the doping issue has reached such proportions that it now concerns society as a whole. The International Olympic Committee classified doping in the following manner: "Mindful that the use of forbidden substances and methods (doping) is unhealthy and in contradiction with sport ethics, the physical and spiritual health of athletes should be protected and so should the values of fair play and competitions, as well as the integrity of sport and the right of those who participate in sport at any level" (IOC, 1990.a: 1). By competing without the use of any doping substances, athletes begin their sporting careers in the freedom of their own decisions and explore the limits of their own possibilities, which they choose to develop in a natural way, through hard work and self-denial. Finally, all true athletes should constantly bear in mind that sport is a contest of skills, abilities, characters, physical and mental readiness and hard work, and not a competition of pharmacological substances. The use of forbidden substances and methods in sport should be banned in the name of true values and in the name of respect for the athlete and his integrity at the physical, spiritual and mental levels that embody an all-round and integral person.

Conclusion

In the time dominated by moral relativism and permissiveness, in which all ethical norms appear to be buried, is there anything more important than to focus on the basics of ethics, on moral order and its unchangeableness. In the world that encourages the consumer way of life, it is hard to adopt the concept of discipline, i.e. self-control of one's instincts and desires (Pozaić, 1988). On the other hand, sporting activities and achievements testify to the fact that perseverance and enduring effort and self-denial, when undertaken consciously and freely to reach higher values and achievements, are the only guarantee of success, true joy, tranquility and self-fulfillment. True sport "must not be an end in itself" (Jurjević, 1982), but should be at the service of the all-round man without impeding his intellectual and moral improvement. It is understandable, therefore, that virtues acquired in a sport are transposed to other fields of a man's life: "Sport has become a training ground not only for a game of sport but also for a game of life – a school of powerful virtues, training for achievements and victory of the spirit (Paul II, 1981).

Sport is the mirror of a society, and all changes in society are reflected on sport itself. For this reason, it is of utmost importance to emphasize and highlight values such as morals, ethics and fair play in sport as everlasting values. Devoid of these values, the human society will crumble and sport will cease to be sport.

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UNIVERSITY STUDENT ATHLETES AND DRINKING BEHAVIOUR

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Abstract

The research was conducted on 619 student athletes aged 18-27 with the aim to examine the consumption of alcoholic drinks. The sample was made of student athletes who compete in ball games (basketball, handball, football and valleyball). Anonimous questionnaire USADE(University students athletes drinking behaviour) was applied. Relative frequencies for each variable were calculated. The differences between frequencies in answers were processed by χ^2 test. Data were processed by statistical method SAS 8.2 and Excel. Compared to the results of some European research the results of this research show that Zagreb student athletes consum less alcoholic drinks. There is a statistically significant difference in gender regarding drinking beer and strong drinks. Other variables do not differ in the tested sample.

Key words: *college students, drinking behaviour, sport*

Introduction

Recent research shows that students are included in different types of health hazardous behaviour. One of these refers to alcohol consumption. Among numerous alcohol drinking researches most were conducted on student population (Johnson et al. 2004., Wechsleret al. 2002., Mohler-Kuo et al. 2003., Gledhil-Hoyt et al 2000., O'Melley and Johnson, 2002, Gfroereret al. 1997., Paschall and Fleweling, 2002, in Ford, 2007., Stutskeet al. 2004.). Most alcohol consumption research done on this population used the measure "binge drinking"[1] (5 and more drinks in a row for males and 4 and more drinks in a row for females) (in Meilman et al. 1998). American research on students – athletes (Hildebrand et al. 2001., Leichliter et al. 1998., Martenset al. 2003., Wilsonet al. 2004., Nelson and Wechsler,2001., Wechsleret al. 1997., Greenet al., 2001.) report that 60% of male student athletes and 50% of female student athletes consumed alcohol in the last two weeks (Leichliter et al. 1998, Nelson and Wechsler, 2001., Wechsleret al. 1997). In doing so they used extreme styles of taking alcohol, heavy drinking in high percentage and a great urge to consume alcohol with the aim of getting drunk (Hildebrandet al. 2001, Leichliter et al 1998, Wilson and Pritchard 2004, Nelson and Wechsler, 2001) Vicary and Karshin, 2002., Wechsler et al.,2001, point out different causes of increased risk in student athletes such as high level of motor task performance which causes stress, balancing between academic and sports obligations, career that includes social isolation, injuries, hard work in order to achieve success, failure in sport, relationship with the coach, co-players, family, friends and lecturers.

Forda (2007.) tried to examine types of sport where students run increased risks of taking different substances. Results showed that male student hockey players and female student footballers report more on taking different substances compared to other student athletes. Martin (1998) stated that 56% of student athletes drank heavily in the period between competitions, and 35% in the competition season. Other researchers' results show that student athletes reduce alcohol consumption during the competition season (Bower and Martin, 1999, Selby et al 1999 in Brenner and Swanik, 2007). There are researches based on the differences regarding gender, race, competition level and sport (Capraro, 2000, Lemie, 1989, Werner, 1994, Wehsler, 1996,1997, Nelson, 2001, in Wilson, 2004). Generally speaking it can be concluded that male athletes drink more than female athletes, whites drink more than athletes of other races, athletes of Division I consume more alcohol than other student athletes (Green, 2001), athletes of contact sports drink more than athletes of non-contact sports (Martin, 1998, Nattiv,1997: in Brenner and Swanik, 2007).

Research on alcohol consumption in Croatia was conducted on student population (annual report of HZZJ) and on athlete population (Madunović, 1998), but as far as the authors of this research are informed, there is no research on the problem of alcohol consumption among student athletes in Croatia. The results of available international research show a big problem of high percentage alcohol consumption in student population. In accordance with that, the goals of this research are: 1. to determine the level of alcohol consumption in student athletes of the University of Zagreb, 2. to find out if there is a statistically significant difference in the applied variables estimating alcoholic drink consumption with regard to gender, year of study, sports game and the level of involvement in it, 3. to compare the results with the results of other research conducted on student population, 4. to suggest directions which can contribute to more quality observation of this problem and 5. to stimulate those in charge of student sport and education to take precaution measures.

Methods

The research was carried out in the second semester or 2006/2007 academic year on student athletes who participated in the system of competition in the University Championship in Zagreb. The total of 619 student athletes (63,65% males i 36,35% females), aged 18-27 participated in this research. Participants of this research are competitors in four team sports: basketball, handball, football and volleyball. A questionnaire intended for determining university student athletes' drinking behaviour was applied. The "USADB" (University students athletes drinking behaviour) consists of 11 items, a Likert ordinal scale questionnaire that describes gender, sports activity, study year drinking behaviour and binge drinking. The frequencies of students' answers were calculated and presented graphically. The differences in the frequency of answers concerning students´ drinking behaviour with regard to gender, sports activity, study year and level of sports achievements were tested by χ^2 test for the each variable. All analyses and graphic presentations were done in the statistical package SAS 8.2 and Microsoft Excel.

Results and discussion

Table 1 shows sample characteristics regarding gender, sports activity, study year and the drinks' variables. The sample consists of the 63,65% male and 36,35% female University students. Of the 619 student athletes included in the analysis, 24,88% named basketball, 29,56% named handball, 14,38% named soccer and 31,18% named volleyball. According to the study years the participants were: 24,07% freshmen, 24,07% 2nd year, 22,13% and 29,72% others of higher study years. The second part of table 1 shows the percentage of the consumption on each drink variables. We expected more frequent application of mineral and vitamin drinks, but in this sample we got that roughly 24% of athletes take these often or very often (Table1). The surprising fact is that almost more than 40% of student athletes took mineral and vitamin drinks never or very rarely, which suggests the need for further research of this segment as well as of the consumption of other supplements on the sample of student athletes. We are satisfied that our students mostly do not consume Red Bull (round 80%) although it is present in the young population.

Table 1. The frequencies and proportions of students athletes participating in the study

Gender	f	%
Male	394	63,65
Female	225	36,35

Sport/ team affiliation	M n	M %	F n	F %	Summary n	Summary %
Basketball	123	19,87	31	5,01	154	24,88
Handball	102	16,48	81	13,09	183	29,56
Soccer	89	14,38	--	---	89	14,38
Volleyball	80	12,92	113	18,26	193	31,18

Study year	F	%
1	149	24,07
2	149	24,07
3	137	22,13
4	78	12,60
5	11	1,78
6	3	0,48
Other	92	14,86

Drink	1 %	2 %	3 %	4 %	5 %
Vitamin drink	11,63	**30,05**	**34,41**	16,80	7,11
Red bull	**35,86**	**43,94**	16,16	2,42	1,62
Vine	16,16	28,92	**35,70**	13,09	6,14
Beer	20,68	19,55	**32,15**	**17,61**	**10,02**
Spirits	18,58	**35,70**	**31,99**	8,72	5,01
Cocktail	**41,03**	**40,06**	14,22	3,07	1,62
Binge	**22,46**	**39,90**	**27,95**	**6,46**	**3,23**

Agenda:
1 – never
2 – very rarely, (several times during one year)
3 – rarely, (1-2 times per month)
4 – often, (more than once per week)
5 – very often, (2 and more times per week)

In wine consumption we point out that 35,70% consume wine occasionally, 13,09% often and 6,14% very often. The authors of this research explain such results by acquired habits with regard to the parts of Croatia which have the tradition of wine production and consumption. Analyzed by sports (Table 2) it is visible that, on this sample, wine is mostly consumed by male and female students who train handball (round 17%, occasionally, often and very often). Compared to other alcoholic drinks, the consumption of beer is frequent – 17,61% (at least once a week) and very frequent – 10,2% (two or more times a week. χ^2 analysis showed that there is a statistically important difference in the consumption of beer $\chi^2(12) = 49.7938$, $p < .0001$. With regard to the socio-cultural environment in which we live where the consumption of beer is advertised through the media and connected to sports events, it was logical to expect the increased beer consumption compared to other alcoholic drinks. High 31,99% of student athletes drink strong alcoholic drinks (cognac, brand, whisky, etc.) 1-2 times a month, and 13,73% consume them once or more times a week. Observed from the point of view of sports, in this sample the most volleyball (15,83%) and handball (14,54%) players consume strong drinks occasionally, often and very often. Analyzing each sport individually it turned out that male athletes statistically significantly differ $\chi^2(12) = 27.223$, $p=0.0072$.

Table 2. Drinking behaviour regarding the sports activity

Vitamin drink	**1**	**2**	**3**	**4**	**5**	
Basketball	2,75	7,11	8,56	4,36	2,10	
Handball	3,07	9,21	10,34	5,17	1,78	
Soccer	0,81	3,72	5,01	3,07	1,78	
Volleyball	5,01	10,02	10,50	4,20	1,45	
total %	**11,63**	**30,05**	**34,41**	**16,80**	**7, 11**	
red ull b	**1**	**2**	**3**	**4**	**5**	
Basketball	9,53	10,50	4,36	0,16	0,32	
Handball	11,15	13,73	3,72	0,48	0,48	
Soccer	3,88	6,62	2,42	0,97	0,48	
Volleyball	11,31	13,03	5,65	0,81	0,32	
total %	**35,86**	**43,94**	**16,16**	**2,42**	**1,62**	
vine	**1**	**2**	**3**	**4**	**5**	
Basketball	3,32	7,59	9,85	3,23	0,81	
Handball	5,82	7,11	10,50	3,55	2,58	
Socer	0,97	5,01	4,52	2,75	1,13	
Voleyball	5,98	9,21	10,82	3,55	1,62	
total %	**16,16**	**28,92**	**35,70**	**13,09**	**6,14**	
beer	**1**	**2**	**3**	**4**	**5**	
basketball	3,23	5,33	10,66	3,83	1,78	
handball	5,98	5,98	6,79	6,95	3,88	
Socer	1,62	2,42	4,68	3,23	2,42	**$\chi^2(12) = 49.7938$, $p < .0001$**
Voleyball	9,85	5,82	10,02	3,55	1,94	
total %	**20,68**	**19,55**	**32,15**	**17,61**	**10,02**	
spirits	**1**	**2**	**3**	**4**	**5**	
Basketball	5,33	9,62	8,08	0,81	0,97	
Handball	5,82	9,21	9,37	3,72	1,45	
Socer	2,26	6,62	2,75	1,29	1,45	**$\chi^2(12) = 27.223$, $p=0.0072$**
Voleyball	5,17	10,18	11,79	2,91	1,13	
total %	**18,58**	**35,70**	**31,99**	**8,72**	**5,01**	
Coctail	**1**	**2**	**3**	**4**	**5**	
basketball	9,69	11,31	3,07	0,65	0,16	
handball	13,73	10,50	4,20	0,65	0,48	
socer	6,46	5,01	1,78	0,65	0,48	
voleyball	11,15	13,25	5,17	1,13	0,48	
total %	**41,03**	**40,06**	**14,22**	**3,07**	**1,62**	
binge	**1**	**2**	**3**	**4**	**5**	
basketball	5,33	10,66	7,27	1,29	0,32	
handball	6,79	11,63	8,40	1,78	0,97	
socer	3,23	5,17	4,04	0,81	1,13	
voleyball	7,11	12,44	8,24	2,58	0,81	
total %	**22,46**	**39,90**	**27,95**	**6,46**	**3,23**	

With regard to the results of available research the analysis of the targeted need of student athletes to drink alcoholic drinks in order to get drunk (be drunk) is of special interest. Table 1. shows the results expressed in percentage for binge drinking. The analysis of the answers of the Lickert scale shows that 22,46% of students do not have a necessity to drink alcohol in order to get drunk, 39,90% very rarely and 27,95% occasionally (1-2 time per month). Although there is no statistically significant difference among the tested student athletes it is interesting to observe that a frequent and a very frequent need for alcohol consumption is noticed in 10% of student athletes. Observed by individual sports it is visible that 11,63% of volleyball, 11,15% of handball and 8,88% of basketball and 5,98% of football players has an occasional, frequent and very frequent need to drink in order to get drunk. With regard to a very small number of subjects among football players we judge that these results should be taken with caution and that additional research should be carried out. Namely, some researches proved that students who train football are a highly risky group with regard to taking certain substances (Jason, 2007, Wilson et al. 2004., Nattiv et al. 1997)

Taking into consideration that such researches on student athletes have not been carried out in Croatia it is not possible to make comparisons with other research results. We point out that it is important to research the reasons why somebody has the need to drink in order to get drunk, since it is known that in the background of such a problem there may be dissatisfaction, stress, depression, etc. (Wilson et al. 2004, Brenner i Swanik, 2007).

The analysis of alcohol consumption with regard to the rank of competition did not show the statistically important difference among student athletes. Moreover, the year of study does not show that student differ in the consumption of alcohol. Therefore, regardless of the competition rank and the year of study there is no statistically significant difference among student athletes which leads into the conclusion student athletes drink equally regardless the sport they are involved in.

Conclusion

The research of the inclination towards alcohol consumption in student population is the first such research at the University of Zagreb. We consider that it is necessary to carry out more researches based on the motives of taking substances, socio-cultural, family and peer influence. From the aspect of practising sports, in further research it is suggested to research the following in detail: 1. the level of involvement and strain in sports combined with alcohol consumption, 2. to establish the periods of the training cycle when alcohol consumption is more pronounced (in competition period, preparation period and during the break between competitions). Based on the results of this research, another research is planned based on the relation of alcohol consumption with other health risky behaviours on the population of student athletes and students who are not included in regular sports and recreational activities.

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THE STRUCTURE OF VALUES DETERMINING THE FORM OF SPORT CULTURE DEVELOPMENT

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Abstract

The main purpose of the study was to establish on a representative sample of adult Slovene population (n=1,685) the structure of 26 values or attitudes which could be the factors for the development of sport culture. Indeed, it is the public which can decisively contribute to the orientation of sports in a given social environment. In order to attain as representative assessment as possible of the values of the Slovenes, we used an adjusted the quota sample, corresponding to the Slovene population with respect to the region of residence, sex, age, and education. The content of the subject of research was focused on the most recognized values. The results of the research confirmed the basic hypothetical assumption that a hierarchical model of values which are the factors of sport culture development could be constructed. By means of factor analysis four types of values factors were obtained: the *Apollonian factor, factor of sport culture*, the *Dionysian factor* and the *factor of defence ability.* The values and value factors are involved in important aspects of our cultural behaviour and decision making. The results clearly show that by the range evaluation of importance the Apollonian type of values - preservation and improvement of health, fair play, development of motor abilities, personal satisfaction, raising of the quality of life, development of own personality were dominant.

Key words: *sport culture, structure of values, Apollonian & Dionysian factor*

Introduction

At every moment in history, culture of sport, as a constituent of civilisational development of a given society and its members, depends on a system of symbols (Y. Allaire, M.E. Firsirot, 1985) which are expressed in myths, ideologies, rules, values, paragons and other various cultural artefacts (rituals, customs, special vocabulary, metaphors, acronyms, stories, legends, tradition, architecture, etc.). To comprehend and understand culture is the first goal of human civilisation. Coherent understanding of culture is possible only on the basis of the knowledge of human activities and human cognitive abilities involved in the explanation of social life. Everyday man's life and actions are interwoven with the influence of practical, reflective and discursive consciousness. The capacity of man to know the world is limited in space, time and socially. Man moves consciously in the environment he knows only to a certain extent. The conscious part of the environment is that part of the world which is within man's direct reach. From this world there stems man's subjective experience which guides him through life. Man experiences his everyday world above all as a space of his actual and possible acts, and only secondly as a subject matter of his thoughts and values. He is usually interested in the acquisition of values of his everyday world only to the extent to which he needs such values to act successfully in it. In everyday life there prevails practical consciousness which consists of all that which is self-evident to the agent, i.e. it is self-evident how it takes place, while at the same time the agent is not able to give to it a discursive (=theoretical) expression (Giddens, 1984). However, in his empirical world man is constantly involved in an eddy of new, unexpected events, processes, phenomena which trigger in him surprise, doubt, questions. First we ask ourselves about the meaning, then why we are doing something, what is the reason for that which forms our life. All of these questions give rise to doubt and desire for clarification, understanding and knowledge which will enable to clarify and explain phenomena, events, processes and circumstances in which man lives and formulates his culturele view. Many recent theories define sport using the term *human physical activity.* Moreover, sport is one of the basic elements of human's physical culture. It is also a modern, organized, systematic, elated and sophisticated manifestation of social culture. Culture is the general feature of all human beings and of all human activities. The transfer of cultural values is done mostly through enculturation. The sport culture in every community creates a different and a specific life style as well as different forms of behaviour in relevant activities and values. The values create and represent culture and they are a generator for the development of the sport culture phenomenon. The qualitative development of sport culture could be understood much more easily if we knew the structure of the values held by the people who live in a social environment in which sport culture is manifested. According to C. Kluckhohn (1951), values are defined as the interpretation of what is considered desired and they have an influence on how people decide on their actions and how they evaluate various phenomena. In the evaluation of sport, individuals ascribe different importance to individual values. On the basis of the study of the value system, the researchers (Ebbeck, Gibbons, & Loken-Dahle, 1995; Hastings, Kurth, Schloder, & Cyr, 1995; Hofstede, 1980) tried above all to

identify the structure of values that affect participation in sports. The factor analysis carried out by Ebbeck et al. (1995) on the sample of 422 adult subjects pointed to the existence of four value types likely to encourage people to engage in sporting activities: interdependence, personal satisfaction, self-image and instrumental reasons. The research by McCarthy (1994) conducted on the sample of 390 citizens of Ireland showed the existence of three factors: competitiveness, well-being, and recreation. According to the theory model suggested by Musek (2000), at the most general level of the entire structural hierarchy Dionysian and Apollonian factors of values belong to the two highest macrocategories of values. The Dionysian factor could be subdivided into two groups, hedonistic values and potency values. Hedonistic values contain the values connected with sensual and material pleasures, while the potency values include the values, which have to do with achievement, success and reputation, but also with patriotism. The Apollonian side could subdivide the general factor into the moral-type values - traditional, democratic and social values, and into the fulfilment-type values - self-actualization, spiritual values, aesthetic values, actualization, religious values, beauty, nature, knowledge, progress, truth, wisdom, faith in God. The main goal of the present study was to find out the latent structure of the values which could be the generator of further development of sport culture.

Methods

In accordance with the electoral system in Slovenia (division of the country into eight regions), 1,685 adult persons (52% men, 48% women) aged between 18 and 75 years were included into the research. As for the age structure, the subjects between 26 and 35 years (26%) dominated; they were followed by 25.5 % of the subjects belonging to the lowest age class between 18 to 25 years. After them were those belonging to the age groups between 36 and 45 years (21.2%); then between 46 and 55 years (18%); between 56 and 65 years (6.6%); and those over 65 years (2,7%). According to the educational status, the subjects (41.4 %) with at least higher education dominated. They were followed by the subjects that have finished a secondary four-year school (31.7%), a secondary three-year school (19.1%), and a primary school (8.1%). The value base consisted of 26 variables (see Table 1). The data on the values and attitudes were obtained by means of a survey questionnaire of a closed-ended type in June 1998. The subjects surveyed were asked to answer the question: "What importance do you ascribe to the effect of sport on an individual factor (sport-related value)?" To evaluate the significance of individual variables, a 5-grade qualitative scale from 1 to 5 (1 - absolutely insignificant, 2 -insignificant, 3 - moderately significant, 4 - significant, 5 - very significant) was used. Differences between the groups were established by using t– test for the independent samples. Factoral analysis (Principal component analysis) was used to determine the latent structure of values. The algorithm (Oblimin rotation method with Kaiser normalization), consisted of oblimin transformation of latent dimensions obtained by orthoblique transformation of the characteristic vectors (rotation converged in 9 iterations) of the variable intercorrelation matrix.

Results

By means of factor analysis (see Table 1), 4 positively generalised latent dimensions (Guttman-Kaiser criterion, lambda=>1.0). It was possible to explain 56.6% of the total variance (TV) of the manifest variables.

Table 1. The structure of factors and factor loadings for the factors which in the opinion of the Slovenes are likely have an effect on the qualitative development of sports

FACTORS	Factor Loadings				
Factor 1: APOLLONIAN FACTOR	**Fac1**	**Fac2**	**Fac3**	**Fac4**	**Cum.**
Quality of life	**.64**	.28	.00	.14	.51
Beauty of movement expression	**.51**	.36	.00	.30	.48
Development of motor abilities	**.56**	**.46**	.00	.00	.54
Pleasure, enjoyment	**.68**	.13	.30	-.14	.59
Personal satisfaction	**.80**	.10	.14	-.00	.68
Development of own personality	**.78**	.15	.10	.19	.69
Peace and harmony	**.67**	.19	.00	.40	.67
Preservation and development of health	**.58**	**.41**	-.00	.00	.51
Play, playfulness	**.50**	.30	.32	-.00	.45
Formation of a sports collective	**.41**	**.41**	.29	.26	.50
Factor 2: FACTOR OF SPORT CULTURE					
Quality of sports facilities	.00	**.69**	.34	.00	.62
Preservation of the Olympic idea	.13	**.67**	.21	.25	.58
Fair play	.39	**.62**	.00	.00	.55
Taking care of technical aids in sport	.17	**.59**	.36	.27	.59

Appeal of sport in the media	.26	**.57**	.20	.00	.44
Awareness and knowledge of sports	.40	**.55**	.21	.00	.52
Development and preservation of working abilities	**.43**	**.53**	.13	.14	.50
Factor 3: DYONISIAN FACTOR					
Competitiveness	.23	**.51**	**.50**	-.11	.58
Domination, superiority, triumph	.00	.19	**.78**	.00	.64
Sport stardom	.00	.16	**.70**	.23	.58
Earning money, profit	.00	.18	**.67**	.17	.52
Suspense of not knowing the sport result	.16	.26	**.64**	.00	.51
Political power, gaining political position	.00	-.11	**.61**	.47	.61
Attractiveness, excitement that sport offers	**.46**	.17	**.54**	-.25	.60
Asserting oneself in a company	**.43**	.00	**.45**	.43	.59
Factor 4: FACTOR OF DEFENCE ABILITY					
Development of defence abilities	.13	.27	.27	**.62**	.55
% of total variance (TV)	**19.6**	**15.8**	**15.1**	**5.9**	**56.6**

On the first APOLLONIAN FACTOR (19.6% of TV) mostly the loadings of values which are ascribed in literature to the Apollonian type of values were dominant - raising of the quality of life, beauty of movement expression, development of motor abilities, pleasure - enjoyment, inner satisfaction, development of own personality, peace and harmony, preservation and improvement of health, play - playfulness, formation of a sports collective. The projections on the second FACTOR OF SPORT CULTURE (15.8% of TV) suggest the hypothesis on the utilitarian specific culture factor of sport-related values.

On the third DIONYSIAN FACTOR (15.1% of TV) the projections of values for which the Dionysian potency type of evaluation was characteristic prevailed - the type of sport evaluation associated with competition, dominance-superiority-triumph, sport stardom, earning money-profit, suspense of not knowing the achievement in sport, political power - gaining political position, attractiveness or excitement of sport and assertion of oneself in a company. On the fourth more specific FACTOR OF DEFENCE ABILITY (5.9% of TV) the value associated with the preservation and the development of defence abilities prevailed. Rang of values and differences between groups of male and female are shown in table 2.

Table 2. Rang of values, differences between male and female (T – test)

				SEX				
	NAME OF VALUE			**MALE**		**FEMALE**		
		M	SD	M	SD	M	SD	sig. F
1	Preservation and development of health	4.26	0.91	4.23	0.91	4.30	0.89	0.10
2	Fair play	4.15	1.00	4.15	0.99	4.16	1.01	0.85
3	Development of motor abilities	4.12	0.95	4.16	0.95	4.08	0.95	0.07
4	Development and preservation of working abilities	3.87	1.02	3.87	1.04	3.87	1.01	0.97
5	Personal satisfaction	3.84	1.03	3.83	1.02	3.85	1.03	0.73
6	Quality of life	3.80	1.06	3.79	1.06	3.83	1.07	0.45
7	Development of own personality	3.80	1.08	3.79	1.09	3.81	1.07	0.69
8	Awareness and knowledge of sports	3.78	1.01	3.79	1.00	3.77	1.02	0.58
9	Competitiveness	3.69	1.05	3.92	1.04	3.54	1.04	**0.00**
10	Pleasure, enjoyment	3.68	1.02	3.67	1.03	3.69	1.01	0.58
11	Formation of a sports collective	3.51	1.11	3.52	1.14	3.49	1.07	0.67
12	Preservation of the Olympic idea	3.50	1.13	3.49	1.15	3.51	1.10	0.66
13	Quality of sports facilities	3.48	1.17	3.52	1.16	3.44	1.18	0.18
14	Play, playfulness	3.47	1.03	3.49	1.04	3.45	1.01	0.51
15	Peace and harmony	3.45	1.08	3.40	1.10	3.51	1.06	**0.04**
16	Appeal of sport in the media	3.42	1.09	3.44	1.07	3.39	1.11	0.31
17	Attractiveness, excitement that sport offers	3.38	1.06	3.52	1.05	3.22	1.05	**0.00**
18	Beauty of movement expression	3.37	1.03	3.30	1.04	3.44	1.02	**0.01**
19	Taking care of technical aids in sport	3.26	1.11	3.26	1.16	3.26	1.06	0.89
20	Asserting oneself in a company	3.11	1.09	3.19	1.12	3.03	1.06	**0.00**

21	Earning money, profit	2.97	1.14	3.04	1.19	2.90	1.08	**0.01**
22	Suspense of not knowing the sport result	2.89	1.07	3.07	1.08	2.69	1.02	**0.00**
23	Development of defence abilities	2.86	1.20	2.88	1.24	2.84	1.15	0.50
24	Domination, superiority, triumph	2.82	1.16	2.96	1.20	2.68	1.11	**0.00**
25	Sport stardom	2.74	1.18	2.80	1.23	2.67	1.13	**0.02**
26	Political power, gaining political position	2.04	1.00	2.12	1.05	1.96	0.94	**0.00**

Discussion and conclusions

In evaluating the degree of usefulness of the contribution of 26 sport-related values, the adult population of Slovenia expressed their views in a way that allows the acceptance of the hypothesis on the existence of four relatively independent types of sport values. As we can see from the table 1, the entire structure of the specific value could be well established through second level of hierarchical structure, from the specific at the bottom to the most general on the higher level. Higher range categories are based of course on the correlations between the values on lower degree of generality.

Thus from the aspect of the structure of the first *Apollonian factor* and the third *Dionysian factor* and taking into account the classification of values according to Nietzsche (1969) we could speak about two entirely opposite poles of personality values. In both factors the values that originate from the personality of an individual are expressed. Ruth Benedict (1934) suggested that culture behaviour might depend on these two basic types of values named after the opposing cultures of Greek tragedy - Apollonian (peaceful and restrained) or Dionysian (aggressive and excessive). This basic idea has been modified and expanded through the years. In exploring such concepts, the movements and preferred activities of a sport culture are critical. Although two personally types of values may pursue leisure activities such as skiing, for example, one person may be oriented towards competitive sport and the other towards recreational sporting activities.

The values directly connected to sport culture had their own independent structure from the personality-determined type of values. Both personality-types of values hypothetically formed the *second factor of sport culture* in some way. Under consideration are the values which are indispensable for the building of sport culture: quality of sports facilities, preservation of the Olympic idea, fair play, taking care of technical aids in sports, development and preservation of working abilities. Competitiveness, namely, that part of competitiveness which has a specific sport-culture importance also somehow belongs to the aforementioned values. The *factor of sport culture values* and the *factor of defence ability* in our study were components rather independent from personality traits.

We can therefore conclude that the sport culture values and personality values represent independent segments of personality, but also share some common culture dimensions oriented to improve the quality of life. While most everybody aims at good living, there is considerable disagreement about what exactly it is. For somebody it includes material things, successful career, social status, to be rich and famous etc. For others there are fewer criteria for evaluating the good life, for example being healthy and happy, loving one another, having faith in God etc. There are probably more ways to achive something called the good life, and there are undoubtedly many patterns of culturale behavior that are comparably good. One person might emphasize excellence, another truth, another friendship, another achievement, and all of these lives can rich high levels of goodness. Values have a definitive leading role in the context of individual personality integration on the way to good life.

The result of the research points to the fact that specific sport culture values are more and more frequently manifested also as a component of the cultural life of people independent of their personality type of values. Sports culture does not emerge personally, but only based on the cultural activity of the majority of a public (Moorhead & Griffin, 1995). The values and value factors are involved in important aspects of our cultural behaviour and decision making and they reflect massive social, economic and political changes in social system. The results clearly show (table 2) that by the evaluation of importance the Apollonian type of values were dominant - preservation and improvement of health, fair play, development of motor abilities, personal satisfaction, raising of the quality of life, development of own personality, beauty of movement expression, pleasure - enjoyment, inner satisfaction, peace and harmony, play - playfulness, formation of a sports collective. On the other side the values for which the Dionysian potency type of evaluation was characteristic (attractiveness or excitement of sport and assertion of oneself in a company, earning money-profit, suspense of not knowing the achievement in sport, dominance-superiority-triumph, sport stardom, political power - gaining political position) were not important on the rang of values. Higher range of values are based on Apollonian factor.

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ATTITUDES TO DOPING AMONG PLAYERS IN SLOVENIAN TOP-LEVEL BASKETBALL TEAMS

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Abstract

Competitive sports have become a huge business involving a variety of economic aspects. Sports medicine and pharmacology have also evolved, allowing athletes to increase their strength and stamina, recover faster after injuries or illnesses, but they are also pushing athletes' abilities beyond their 'natural' limits. The aim of our research was to establish the value orientation regarding the use of doping among basketball players competing in the Slovenian championship. Using a sample of 105 male players, we ascertained that elite basketball players do not approve of doping as a legitimate way of achieving top-level results. Such a rejection is slightly more evident among Adriatic league players. They seem to be aware that doping is harmful to both athletes and sport as a whole. Athletes did not express themselves definitely regarding doping at lower levels of competition or among athletes in individual sports.

Key words: *team sports, comparison*

Introduction

In the past few decades, competitive and elite sports have evolved from being 'simple' entertainment to a huge business involving a variety of economic aspects including sponsorships, endorsements and labour relations. This caused – and was to some extent caused by – advancements in the media and technological industries as well. Research, science and technology had led to developments in medicine and pharmacology, allowing athletes to increase their strength and stamina, as well as recover faster after injuries or illnesses.

The massive investments made also led to abuses in medical science and research, pushing athletes' abilities beyond their 'natural' limits. Some argue that the practice of enhancing performance through foreign substances or other artificial means is as old as competitive sport itself. By the 1920s it had become evident that restrictions regarding drug use in sports were necessary and in 1928 the International Amateur Athletic Federation ('IAAF') became the first international sport federation to ban the use of stimulating substances (WADA, 2008).

Nowadays, doping is defined as the occurrence of one or more anti-doping rule violations prescribed in the World Anti-Doping Agency's *Code* (WADA, 2003). The current list of Prohibited Substances spans 11 pages.

Doping is most often encountered among athletes competing in individual sports – primarily track & field, heavyweight lifting, and cycling. Here athletes have to deliver their maximum effort to achieve a good result, whereas athletes performing in team sports need to display an optimal performance. The 100 m dash will be won by the *fastest* runner, while a football game will be won by the *most efficient* team. The number of goals scored counts, not the speed of the ball after the kick.

From a sociological perspective, the most striking paradox in the case of doping is the athlete's disregard of the spirit of the sport. The imperative of winning thus takes precedence over the ideal of a fair contest. Further, the expansion of illegal substance use among athletes in lower ranks of competition, junior athletes and even amateurs is quite concerning. The need for the appropriate education of athletes of all ranks is thus self-evident (Lueschen, 1993; Waddington, 2001).

A fair contest, respect of the rules, and reverence for the spirit of the sport should be fundamental values of everyone involved in sports. Building in an awareness of the possible consequences of doping abuse is also an essential (but unfortunately not a sufficient) part of athletic training.

The aim of our research was to establish the value orientation regarding the use of illicit substances among basketball players competing in the Slovenian championship. Further, we compared the answers of athletes playing in the Adriatic (regional) league to those of athletes only playing in the national championship. Both competitions are professional.

Methods

The participants encompassed 105 male basketball players who played for nine Slovenian teams competing in the Slovenian championship in the 2005/06 season (48.4% of all registered players). On average, they were 22.9 years old (SD=4.24 yrs) and had been playing basketball for 11.9 years (SD=4.5 yrs).

The participants were then divided into two groups with regard to the competition in which they were currently competing. The first group included players from teams playing in the Adriatic league (n_1=36), while the second group comprised players only competing in the national championship (n_2=69).

Data were gathered through a questionnaire made up of nine questions related to the respondents' attitudes to doping. Athletes marked their answers on a five-point Likert-type scale, with a score of 5 representing *strong agreement* and a score of 1 *strong disagreement.*

Players were surveyed during several sessions towards the end of the 2005/06 season (in May and June 2006). To overcome the language barrier with foreign players we used questionnaires in the Slovenian, English and Croatian languages.

Descriptive statistics for each statement were calculated. Differences between the two groups of players were determined using a one-way analysis of variance ('ANOVA'). Data were processed with SPSS 15.0.

Results

The first group of questions confronted the athletes with five statements regarding their 'general' attitudes to doping.

Table 1. Statements regarding the athletes' general attitudes to doping

	Adriatic league		National league			
Item	M	SD	M	SD	F	Sig.
Even though an athlete is unwilling to use prohibited substances, he can aim at top achievements and rankings.	4.77	0.770	4.35	1.069	4.345	.040**
Regulations that prohibit the use of some substances in sport conflict with an individual's right of free choice.	1.86	1.246	2.22	1.316	1.798	.183
Doping can also be found in lower levels of competition	3.82	1.359	3.48	1.248	1.633	.204
When it comes to elite sports, in team sports prohibited substances are less used than in individual sports	3.57	1.352	3.30	1.226	1.011	.317
If athletes were well informed about all possible consequences of doping use there would be fewer cases of doping	1.31	.832	1.87	1.162	.096	.757

A second group of questions included four statements regarding 'personal' attitudes to doping. Here, situations that might arise during the training process were described.

Table 2. Statements regarding the athletes' personal attitudes to doping

	Adriatic league		National league			
Item	M	SD	M	SD	F	Sig.
Somebody you trust claims a specific method or substance cannot be detected. Your sports achievements are just below the world's best and you need but a small leap in capacity to make it there. In this case you would resort to doping.	1.31	.832	1.87	1.162	6.330	.013**
Life is not black-or-white. I would resort to doping depending on the specific situation I would find myself in .	1.34	.838	2.07	1.129	11.408	.001**
I completely trust my team doctor when it comes to the use of products to increase the regeneration of my organism. I do not control the characteristics of such products.	3.46	1.358	3.48	1.341	.005	.942
In my competitive career I have already faced the dilemma of whether to use prohibited substances.	1.63	1.374	1.90	1.351	.902	.344

Discussion and conclusion

The analysis of the group of 'general' questions shows that the surveyed players strongly agreed that a top ranking can be achieved without the use of prohibited substances. This question was probably perceived as somewhat 'autobiographical' by the respondents; they compete at the highest national level, so they have definitely 'achieved the top level of performance'. This is especially true of players competing in the Adriatic league who expressed a significantly higher level of agreement with this statement. Perhaps the national players think prohibited substances are just what they might need to make it to the next level.

Players disagreed with the statement that regulations prohibiting doping in sports conflict with an individual's right of free choice. They obviously feel doping should be banned so its use is not a matter of an individual's free choice.

Athletes also disagreed with the statement that better information regarding the consequences of doping use would lead to a drop in the use of doping. They seem to believe that the truth is quite the opposite: sportsmen are aware of the consequences of such decisions; nonetheless, some of them still rely on the use of illicit substances.

The respondents could not decide whether doping can also be found at lower levels of competitions, and whether illegal drugs are more common in individual sports. This is probably due to their inexperience in both areas. Elite basketball players do not necessarily have many contacts with lower level/amateur players, nor with athletes involved in individual sports.

The respondents' personal statements show the rejection of doping use in circumstances where they would just need a small leap in performance to 'make it among the stars'. Such a rejection is significantly more expressed among the Adriatic league players – again, those already competing on a higher level. Similarly, the Adriatic league players strongly disagreed with the statement suggesting that the use of doping might be situation-specific, whereas the national league's players' rejection of this statement is significantly less vigorous.

An important factor for the Adriatic league players rejecting the use of doping might be the significantly greater risk of being found positive in medical exams or doping tests. Such tests are far more common in the Adriatic league and in other elite competitions where these players had competed (elite players are not likely to stick with one team for their entire career). Further, the pre-recruitment medical exams conducted by elite teams are far more meticulous than those carried out by national league teams.

So far, most players have not faced a dilemma of whether to use prohibited substances.

The surveyed players were obviously not prepared to trust their team doctors unconditionally. Namely, the players only slightly agreed with the statement expressing complete trust in their team doctors when it comes to organism-regenerating products. Players seem to be aware of the possible risk concerning this aspect as well.

All in all, it seems elite basketball players do not approve doping as a legitimate way of achieving top-level results. Such a rejection is slightly more evident among the Adriatic league players. We attributed this to the difference in the level of competition; Adriatic league teams are the three best-ranked teams from the past season's national championship. Sportsmen playing for these teams obviously already perform at a higher level so they do not need the 'extra boosts' afforded by illegal substances. Further, doping tests are far more common at this level of competition. Their reluctance to use illicit drugs could simply be a measure of precaution.

Perhaps slightly surprisingly, the athletes did not express themselves definitely regarding doping at lower levels of competition or among athletes in individual sports. They probably did not feel competent to comment on competitions with which they were not very familiar.

The results of our research thus show a negative attitude to illegal substances among elite basketball players competing in the Slovenian championship. They seem to be aware that doping is harmful to both athletes and sport as a whole.

In the future, we plan to continue our research by extending it to elite athletes involved in other (individual and team) sports. Another possibility would be to link attitudes to doping (or other ethical and moral issues) with demographic data concerning the participants.

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A STUDY OF THE PHYSICAL ACTIVITIES AND SPORTS FUNCTIONS IN SPAIN

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Abstract

A study of the physical activities and sports functions, developed by workers of institutions and sport centers throughout Valencia region (Spain), will contribute with interesting data about some aspects related to the labour market and professionals situation of physical activities and sports in Spain. The methodology applied was quantitative, in which a descriptive method and a cross sectional survey was carried out. Using a standardized model of interview based on a questionnaire to 600 professionals, a profile is obtained bearing in mind the past and current performance percentages of these functions and the type of sport centers in which these tasks are carried out. Results reveal that these professionals perform a variety of different tasks. The four functions regarding physical activities and sports with a higher amount of professionals in Valencia region are: teaching physical activities and/or sports, maintaining physical fitness in groups, organization and coordination tasks and training sport teams and/or individuals. In the same way, the place where physical activities and sports functions are mainly carried out is the multi-sport center.

Key words: *functions, sport, physical activity, sport center, Spain*

Introduction

Camy et al. (1999) in their study 'Sport and employment in Europe' claim that the sport sector creates some 700,000 posts. Specifically in Spain, there were around 56,300 jobs related to this sector in 1998.

In other words, in the last decade there is a 57% increase of employment related to sports in Europe due to an improvement in the economic conditions in the European area. In Spain, the sport employment growth is even bigger (100%), confirming that the sport area is a significant source of employment in the Spanish case (Del Villar, 2005).

Professor Campos Izquierdo (2001), in his study about the current situation of professionals working in the field of sports and physical activities in Ribera del Duero County (Burgos-Spain), marks up that tasks linked to maintaining physical fitness and teaching sports are the most practised by professionals with more than 13%. They are followed by teaching physical education and/or sports, and organization and coordination of physical activities and sports with 10.5%. Finally, training sport teams and/or individuals in order to compete and/or to overcome physical tests with 8.4%.

The study of Campos Izquierdo (2005), about the professional situation of people working in physical activities and sports functions in Valencia region (Spain), reveals that from the whole range of physical activities and sports functions, there were more than 40% carrying out teaching of physical activities and sports tasks. Also, more than 60% of this professionals were performing the teaching task during all their professional life. Moreover, more than 20% of workers were developing the functions of physical education teaching, maintaining physical fitness and organization, coordination and water sports lifeguard.

Methods

Following Campos Izquierdo, Pablos y Mestre (2006ª, 2006b) contributions, the methodology applied in this study was quantitative, in which a descriptive method and a cross sectional survey was carried out in two different periods of time: summer and winter seasons. The procedures followed in this study were the common ones used in a statistical survey through questionnaire.

The confidence level established was between +2 sigma as normal distribution values. Probability inside this interval is 95.5%. The margin of error established for the sample was +4%.

Interviews were conducted orally, individually, and following a standardized model based on a questionnaire to 600 sport professionals working for institutions and sport centers throughout the region of Valencia (Spain).

Results and discussion

Comparing the study of Martinez Serrano (2007) versus the research of Campos Izquierdo (2005), two identical features would be noticed: first, the wide diversity of the functions actually carried out by professionals and the fact that these functions are performed in all three provinces of Valencia region and by all population subgroups. Second, a low percentage of performance (less than 1%) of the counselling and certification functions regarding physical activities and sport and the function of inspection.

In both studies, the functions with a highest percentage of performance would be teaching physical activities and/or sports with 15% and maintaining physical fitness in groups with 20%. However, in the year 2007, the task of teaching physical activities and/or sports drops 2% and maintaining physical fitness increases 1.2%. This rise would be probably due to a larger offer of physical activities in private sport centers and franchise networks (such as Cardiobox, Body-pump, Body-balance, Cardio-gym, GAP, Spinning, Pilates, Yoga…) according to Martinez Serrano 2007 study.

In the precedent study of Campos Izquierdo (2005), the functions of water sports lifeguard and teaching physical education and/or sports were the third and fourth in percentage of performance. However, according to the study of Martinez Serrano (2007), these tasks are currently in fifth and sixth position, behind the organization and coordination of physical activities and sports task and the training of teams for competition and/or overcoming physical tests task. The latter increasing a 2.3%, in accordance with the rise of associated members among the Spanish and Valencia population (Garcia Ferrando, 2006; Garcia Ferrando, Llopis y Mestre, 2007). The most significant decrease in Martinez Serrano study (2007) would be in the water sports lifeguard task, dropping from 13.2% in 2005 research to 7.4% in 2007.

There would be a third group of functions in which it could be highlighted the increase ,in recent years, of recreational and leisure sports animation (from 4.7% to 6.6%) as well as the stability, in terms of percentage, of the personalized training and out-of-school physical and sport activities tasks.

In the last positions, as well as in Campos Izquierdo study (2005), there would be teaching physical activities and sports subjects in courses and rehabilitation-recovery through physical training. Teaching in courses rise from 1.7% in 2005 to 3.7% in 2007. This increase shows that there is a bigger training and teaching staff offer. The functions of counselling and certification regarding physical activities and sports and the function of educational inspection with less than 1% are hardly performed (Fig. 1).

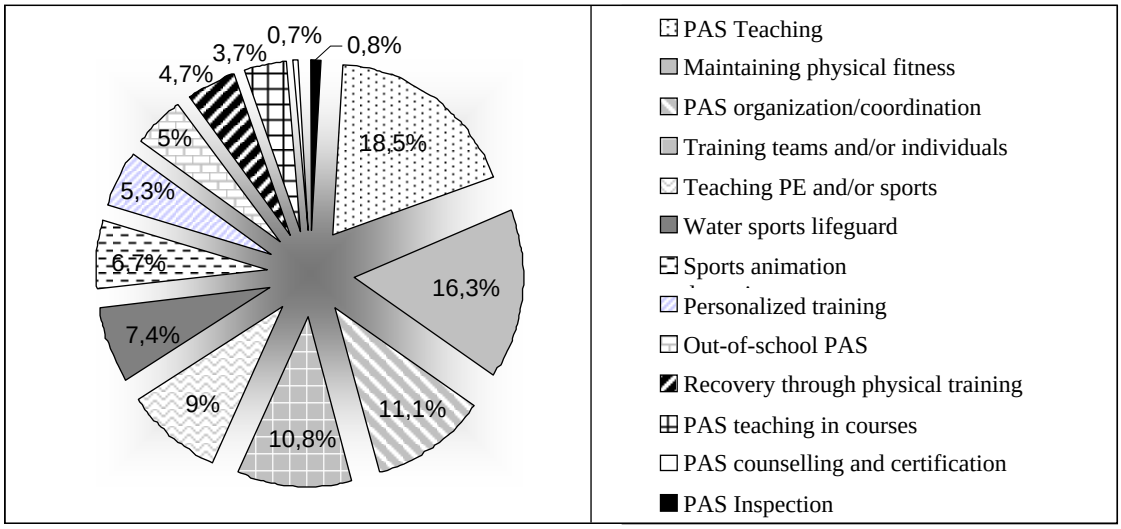

Figure 1. Percentage of physical activities and sports functions currently performed

Concerning the functions carried out during a whole working life, the out-of-school physical activities undergo an increase in recent years, from 9.6% in 2005 to 18.5% in 2007, followed by recreational and leisure sports animation, rising from 8.5% to the current 13%. And then teaching physical activities and/or sports, training teams and/or individuals and water sports first aid. According to Martinez Serrano study, results reveal that these functions tend to be carried out in the past (during the first stages as professionals) due to their precarious labour situation and instability (Fig. 2).

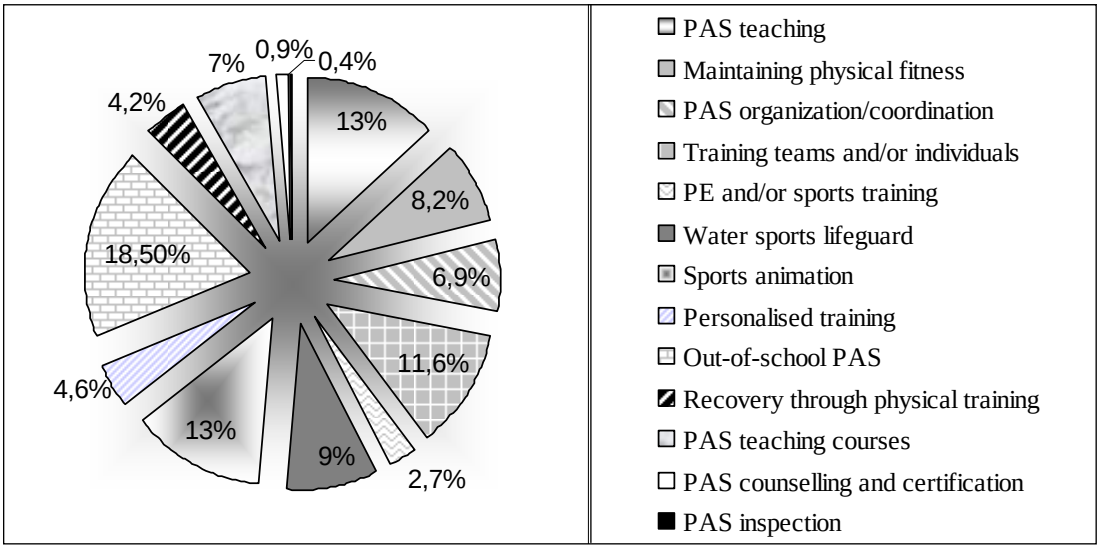

Figure 2. Percentage of physical activities and sports functions performed in the past

In the same way, Martinez Serrano research (2007) points out that multi-sports centers are the sport facility where takes place most of the physical activities and sports functions, with 25% (10% of increase compared to the 2005 Campos Izquierdo study). Water sport centers obtains 16.2% (4.4% decrease compared to the 2005 study). Educational establishments obtains 20.3% (very similar to the 19.2% in 2005 study). Finally, gymnasiums obtain 12.7% which is very similar to precedent studies (Fig. 3)

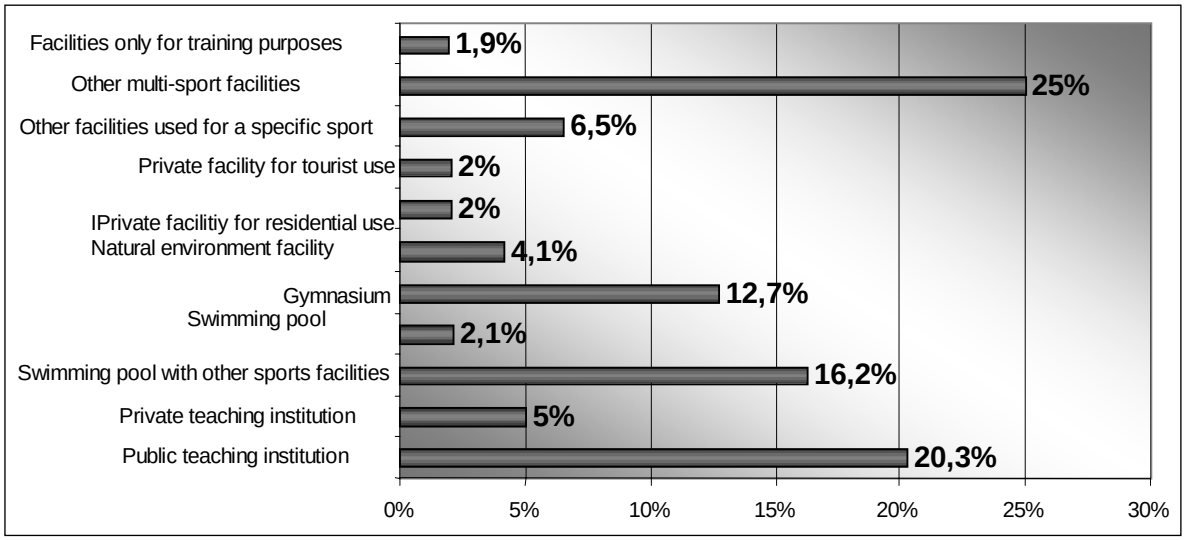

Figure 3. Sports facilities where physical activities and sports functions take place

Summary of conclusions

- The functions of physical activities and sports in the region of Valencia (Spain) are of a different nature.
- Teaching physical activities and/or sports is actually the most carried out function in this region. It is followed by maintaining physical fitness in groups, organization and coordination tasks and finally training teams and/or individuals. Moreover, these tasks tend to increase compared to Campos Izquierdo study (2005), as well as other minor functions such as recreational and leisure sports animation and teaching through lectures.
- Out-of-school physical and sport activities, recreational and leisure sports animation and teaching physical activities and sports have been always carried out and during the first stages as professionals.
- The most frequently used sports facility when performing physical and sports activities in Valencia region (Spain) is the multi-sport center.

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SOCIAL AND DEMOGRAPHIC CHARACTERISTICS OF PHYSICAL ACTIVITY AND SPORT HUMAN RESOURCES IN SPAIN

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Abstract

Researching the social and demographic characteristics of physical activities and sports human resources in the region of Valencia (Spain) will bring relevant data about specific aspects related to the labour market and professional situation of this activity in Spain. The methodology applied was quantitative, in which a descriptive method and a cross sectional survey was carried out. Using a standardized model of interview based on a questionnaire to 600 professionals, specific social and demographic characteristics are obtained bearing in mind the performance percentage of the physical activities and sports function for both genders, age of the professionals, origin and nature of the task as professionals grow older. Results reveal that the professionals of this region are mostly men, below 30 years old, and most of them come from Valencia region. Moreover, young professionals mainly perform the water sports lifeguard function. However, older professionals carry out the organization and coordination of physical activities and sports. Finally, the origin of this professionals is mostly from Spain, though there is an increase of immigrant population in recent years.

Key words: *society, demography, human resources, physical activity, sport, Spain*

Introduction

Concerning the social-demographic characteristics of Spanish population practicing sports, professor Garcia Ferrando (2006) marks up that male population practitioners of one or more sports is 45% versus 30% of women. There is an increase in the practice of sports among young population from 15 to 24 years old, being from 57% in 2000 to 58% in 2005. There is also an increase in elderly population from 55 to 65 years old from 22% in 2000 to 24% reached in 2005.

Population in the region of Valencia (Spain) in the last four months of 2006 was 4,806,908, which means 10.7% of Spanish population. Being 2,394,307 male population and 2,412,601 female population (IVE-Statistical Office of Valencia , 2006; INE-Statistical Office of Spain, 2006).

Professor Campos Izquierdo (2005) explains that female percentage working in physical activities and sports tasks in Valencia region is 41.5%, being 58.5% the males one, and the average age is 29 years old.

The above mentioned author adds up that the physical activities and sports functions carried out by young professionals are mainly water sports lifeguard, with 70% of people less than 25 years old, and out-of-school physical and sport activities and recreational and leisure sports animation, with 75% of professionals less than 35 years old. On the opposite side, teaching physical education and/or sports obtains more than 30% of population older than 39.

Finally, regarding the professionals origin in the region of Valencia, 77.1% are from Valencia region, 18.5% come from other Spanish regions and 4.4% are foreigners: 1.8% coming from the European Union area and 2.6% are from non European countries.

Methods

The methodology applied in this study was quantitative, in which a descriptive method and a cross sectional survey was carried out in two different periods of time: summer and winter seasons. The above mentioned methodology was developed in Campos Izquierdo, Pablos y Mestre (2006a, 2006b) studies.

The confidence level established was between +2 sigma as normal distribution values. Probability inside this interval is 95.5%. The margin of error established for the sample was +4%.

Interviews were conducted orally, individually, and following a standardized model based on a questionnaire to 600 physical activities and sports professionals working for institutions and sport centers throughout the region of Valencia (Spain). A cluster sampling was used, more specifically multistage sampling, that was stratified in the first stage.

Results and discussion

When comparing Martinez Serrano study (2007) versus Campos Izquierdo research (2005), it could be noticed that professional males carrying out physical and sport activities are superior in percentage to females (64% males compared to 36% females). Also, there is a 5% decrease of females compared to males in recent years. This results agree with the social context of women described by Santos et al. in 2005.

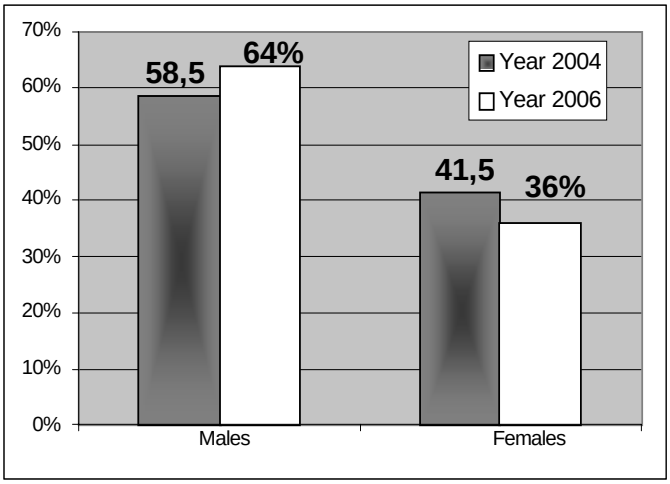

Figure 1. Gender of professionals working in physical activity and sport functions

In the same way, the average age has been increased from 29 years old established in Campos Izquierdo study of 2005 to 32.7 years old in Martinez Serrano study in 2007. In this sense and according to the 2007 research, the female percentage is not superior to the one of males in any age range. However, the data obtained for less than 30 years old reveals a gender balance.

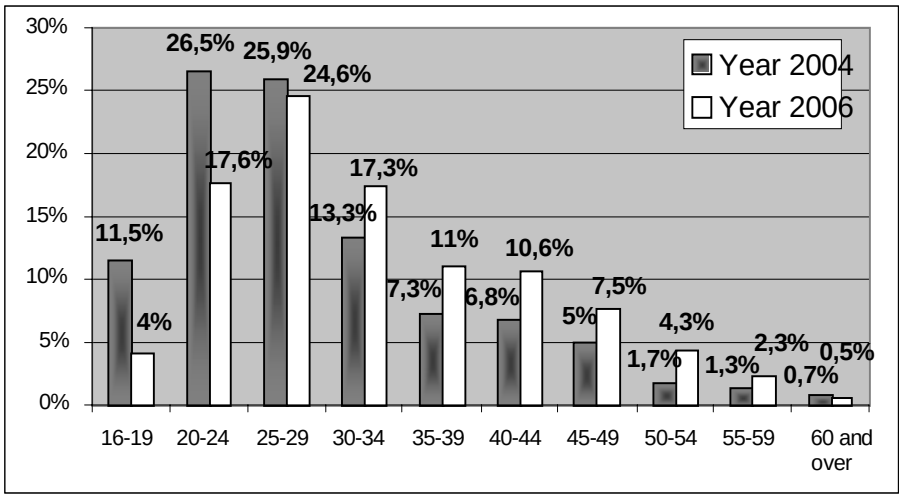

Figure 2. Age of professionals working in physical activities and sports functions

In both studies the most carried out function by males is training of teams and/or individuals. Being the most carried out female function the recreational and leisure sports animation. As well as both studies confirm that water sports lifeguard is the task performed mainly by young professionals.

On the opposite side and according to Martinez Serrano study (2007), from 35 years old the physical activities and sports organization and coordination tasks and teaching through lectures prevails. It is worth pointing out that non EU origin professionals are present in every physical activity and sport function, specially in water sports lifeguard, rehabilitation-recovery through physical training and personalized training.

Finally, compared to Campos Izquierdo research (2005), Martinez Serrano claims that professionals coming from Valencia region (Spain) increase 4.1%, professionals from other Spanish regions decrease from 18.5% to 13.8%, EU nationals keep a 1.5%, and non EU nationals increase from 2.6% to 3.8% according to the immigration process described in Campos Izquierdo study (2005), Martinez Serrano study (2007) and CSD-High Council for Sport of Spain, (2005).

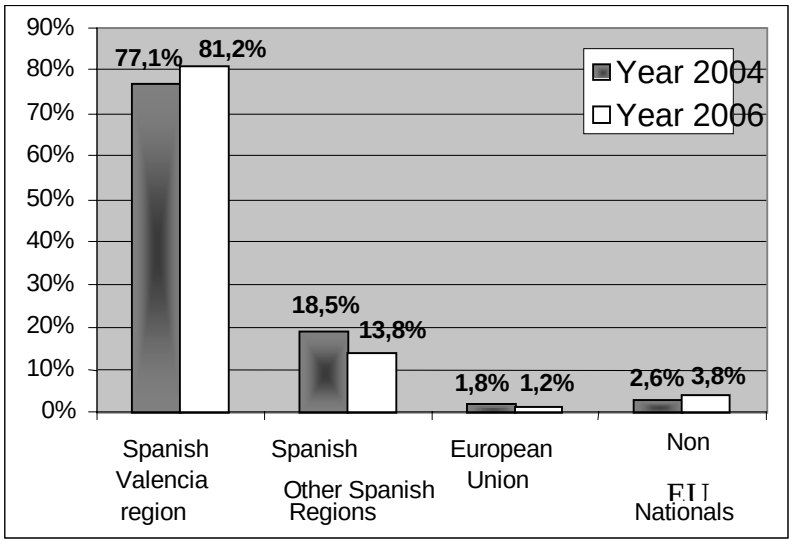

Figure 3. Origin of professionals working in physical activities and sports functions

Summary of conclusions

- Male population carry out most of physical activities and sports functions in the region of Valencia (Spain).
- The amount of female population working in physical activities and sports functions decreased, compared to Campos Izquierdo study (2005).
- The average age of professionals is slightly over 30 years old, which shows that young professionals prevail concerning the current labour market situation (Martinez Serrano, 2007).
- The function performed by youngest professionals is water sports lifeguard, evolving to more stable tasks such as physical activity and sport organization and coordination when professionals grow older.
- Most of the professionals are from Valencia region origin. However, an increase in the immigration process can be noticed.

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THE STRUCTURE OF ATTITUDES TOWARD SOME QUESTIONS WHICH TO A LARGE EXTENT CONCERN THE ISSUES OF THE DEVELOPMENT OF SPORTS CULTURE

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Abstract

The objective of the research was to establish on a representative sample of adult Slovene population (n=1851) the structure of attitudes toward some questions which to a large extent concern the issues of the development of sports culture in Slovenia. Indeed, it is the public which can decisively contribute to the orientation of sports in a given social environment. In order to attain as representative an assessment of the opinions of the Slovenes as possible, we used an adjusted quota sample, corresponding to the Slovene population with respect to the region of residence, sex, age, and education. The results showed a high degree of validity consensus of the surveyed sample in the majority of the attitudes. In the individual attitudes, a high bipolarisation of the answers was established. The results of the research confirmed the basic hypothetical assumption that among the Slovenes there is a similar opinion of the majority as regards the assessment of sports achievements, quality of the sports facilities, financing of sports, benefits of sports from the aspect of prevention of social pathological phenomena and content orientation of sports education.

Key words: *sports culture, values, attitudes, public opinion*

Introduction

The subject of the present research study was to establish the structure of the attitudes of the Slovene public toward some content-related issues in sports culture. The research thus limits its subject and problem of studying to some selected thematic clusters of the components of sports culture: marketing in sports, the system of animation in sports, successfulness of athletes, social conditions in which athletes live and work, financing of sports, sports facilities, and infrastructure. Sports culture is not something that emerges of itself. It is a product of an individual, a group, and of the entire society, where basic prerequisites and suitable value structure should be provided for its development. It is precisely the values in which according to Musek and Pečjak (1995:94) there always show the convictions about what is right, so that it seems valuable, good and precious to us. Sports culture is thus in the first place the product of the spiritual culture of an individual. According to Jambrek (1997:290), however, every product of spiritual culture has three possible components: an emotional, a value-related, and a cognitive one. Sports culture is a living spiritual component of every-day social life and shows in each time period in a different way and through changing manifestation forms. We could say that sports culture will achieve its true meaning once it is present in the consciousness of the widest possible circle of the members of the general and sports public. The agents of the development of sports culture should, therefore, know the value attitudes of the general public toward some essential questions concerning the development of sports culture. The opinions of the individuals can, in fact, be different; however as a whole they reveal a certain kind of common culture of the population. Doherty and Chelladurai (1999) explain the organisational structure on a continuum of diversity and similarity. The diversity emerges owing to various personal characteristics of individuals such as age, sex, race, nationality, religion, married state, family status, physical abilities, while similarity shows through a similar way of thinking, similar value system, similar use of language, symbols, customs, and behaviour of individuals (Adler, 1991; De Sensi, 1994). The knowledge of the structure of the value attitudes of the relevant public could help all those who take care of the strategic development of the Slovene sports and perform managerial functions in the various sports and other management organisation associated with sports. The basic hypothetical assumption of the present research was that individuals do not differ significantly in their attitudes toward some essential issues of sports culture and that a high level of validity consensus between them can hence be expected. Only sport that will attract a multitude of individuals to engage in sport activity will really become a socio-cultural phenomenon and will awake the interest in and the motivation for sports in the nation (George & Feltz, 1995).

Methods

The sample of the research subjects comprised 1851 (52.1% male and 47.9% female) subjects randomly selected from the adult population of the Republic of Slovenia. The surveyed subjects were completely randomly selected in all eight electoral regions of Slovenia (Kranj 268, Postojna 226, Ljubljana - centre 332, Ljubljana - Bežigrad 137, Celje 215, Novo

mesto 196, Maribor 226, and Ptuj 251). A large similarity of the composition of the surveyed subjects and the composition of the population of Slovene citizens enables us, taking into account statistical limitations, a hypothetical assessment of the representative opinion and the attitudes of all citizens of Slovenia in the age over 18 years. The sample of variables was designed on the basis of the content concept of the task. The variables or questions are given in the chapter dealing with the results and interpretation. The surveying was carried out by specially trained students of the Faculty of Sports who were previously acquainted with the objective of the research and the method of surveying. The surveying was carried out in June 1998.

Results

The results of the research are given separately by individual questions or attitudes in table 1.

Table 1. Questions or attitudes and the structure of answers

Question	Yes, very much	Yes	No	I don't know
Do you think that it is right that top-level athletes are increasingly becoming a means of marketing and advertising by means of mass media as well?	11,9	**61,9**	18,8	7,3
Does watching the sports events, athletes and equipment influence the extent and the selection of sports products and articles recently bought by you?	7,6	37,3	**50,4**	4,7
Did following the sports events influence your active participation in sports recreation?	10,1	34,9	**54,9**	
Do you think that the organisers of sports events should even more promote them in the public?		**70,4**	11,3	18,3
Do possible failures of your favourite athletes turn you away from further watching and following the sports events?	2,2	21,5	**72,9**	3,3
Are you content with the results achieved by Slovene athletes in the highest international competitions?	23,0	**61,7**	10,7	4,6
Do you think that the medals won in the highest international competitions (Olympic Games, world championships) in the various sports have different weight and value?		18,4	**64,1**	17,6
Do you think that sports events have the same cultural value as concerts, theatrical performances, film performances?		**41,6**	45,6	12,8
Do you think that more frequent participation in sports could substantially contribute to the reduction of socially detrimental phenomena?	**53,8**	36,0	4,9	5,3
Do you think that sports education in the primary and secondary school prepared you well for the role of a spectator and visitor of sports events?	12,7	30,4	**41,3**	15,6
Do you think that compulsory school sports education should contain only selected sports?	4,3	16,4	**70,1**	9,2
Do you support the prohibition of smoking and drinking of alcoholic beverages during sports events?	**76,2**	9,3	8,9	5,6
Do you agree with the opinion that the conditions in which Slovene athletes live and train are good and enable them sports preparation of the same quality as available to their peers in the world?	12,2	**40,8**	31,2	15,7
What do you think of the outfitting and up-to-dateness of the facilities you visit as a sport spectator?	**3,0**	41,9	29,8	25,2
Do you think it is right that the Slovene state finances sports from the budget funds?		**68,7**	11,1	20,2
Would you contribute with a self-imposed contribution your share for the modernisation of sports facilities and areas in your residential environment?		**62,4**	17,1	20,5
Do you think that sports in Slovenia should be selectively financed from budget funds (only competitive high level sport, or only recreational sport, or only educational sport, etc…)?		24,9	63,7	11,4

Discussion and conclusions

The results of the survey research point (table 1) to a hypothesis according to which the Slovene public support that Slovene top-level athletes are increasingly becoming the means of marketing and advertising also by means of mass media. The majority of the surveyed subjects (61.9%) are of the opinion that the said should be present to a normal extent. For the majority of the surveyed subjects (50.4%), the following of sports events, athletes, and their equipment did not affect the scope and the selection of sports products and articles recently bought by them. Failures of the favourite athletes do not turn the majority of the surveyed subjects (72.9%) away from the further following of sports events. However, this has only partly affected approximately one fifth of the sample of the surveyed subjects. Such a result can mean that the public understand a sports event in a broader sports cultural context, in which not only the achievements of own athletes but of all athletes are appreciated. Every competition separately brings with it also the hope of succeeding. As a rule, this hope never runs out and precisely this is the magnet attracting all participants in sports. The largest part of the sample of the Slovene public (61,7%) were satisfied with the results achieved by Slovene athletes in the highest international competitions. The satisfaction of the Slovene public with the sports achievements is that which gives a numerically small

nation a special greatness. More than a half of the surveyed subjects (64.1%) did not agree with that the medals of Slovene athletes from different sports could have a different weight in the Olympic Games.

The largest part of the respondents (45.7%) were of the opinion that watching the sports events did not affect their recreational sports activities. A considerable part of the surveyed subjects (34.9%) obtained by watching the sports events an additional encouragement for pursuing recreational activities in sports; however, this occurred only occasionally. The sum of the subjects with a positive opinion is approximately the same as that of the subjects with a negative opinion and approaches one half of the total sample of the surveyed subjects. This means that following or watching the sports events despite all to a considerable extent encourages people to pursue recreational sports activities.

The majority of the surveyed subjects (40.8%) agreed only partly with the statement that the conditions in which Slovene athletes live and train are good and that they enable them sports preparation of the same quality as available to their peers in the world. Approximately one third of the surveyed subjects (31.2%) does not agree with such an opinion or assertion. The quality of sports facilities is without doubt the largest problem in Slovene sports. Top-level sport events cannot anymore be carried out on unsuitable facilities. In Slovenia, the majority of the most successful sports is faced with the problem of survival in the organisation of largest sports events (Planica, football stadium in Ljubljana, grounds for Alpine skiing at Kranjska gora, etc.) when the international associations already threaten with prohibition of competitions.

The largest number of the surveyed subjects (41.3%) were of the opinion that sports education in the primary and secondary school did not sufficiently prepared them for following the sports events. Approximately one third of the surveyed subjects were of the opinion that sports education positively contributed to the following of sport events, yet sports education could do even more. Only 12.7% of the respondents agreed with the opinion that sports education influenced the education of spectators for following the sports events to a sufficient extent. Such results of the survey research point to the fact that sports education did not to a sufficient extent instilled into the individual the need or motivation for the following of sports events. Sports education should become a driving force of the cultural transformation of the consciousness of the young in sports. However, such a transformation is not possible if too little is done in this direction in the process of active system socialisation. A weak half of the surveyed subjects (46.2%) were of the opinion that sports education should not contain only the selected sport, but that it should also teach the pupils about the largest possible number of the sports recognised in the world, irrespective of the competition rank. A weak fourth of the surveyed subjects (23.9%) also do not support the selective choice of sports in sports education, but say that the programmes of sports education should contain all sports pursued in competition sport in Slovenia. A considerable part of the surveyed subjects (16.4%) would support, within the programmes of sports education, only some sports, while other sports should be presented only informatively. There were rather few of the respondents (4.3%) who would include in the programmes of sports education only some selected sports. In the Slovene public there shows clearly the general conviction that sports education should teach the young about the largest possible number of sports. In the young, this will elevate the basic sports education and will educate them to become personalities knowledgeable about sports.

As regards the opinion on whether sports events have the same cultural value as concerts, theatrical and film performances, the surveyed subjects gave a completely bipolar answer. The percentage of those who ascribe the same cultural value to sport events as to culture and art (41.6%) is almost the same as the percentage of those whose opinion is quite the opposite (45.6%). The result of the survey research points to the fact that sports manifests more and more also as a component of the cultural life of people. Sports culture does not emerge unconsciously, but only based on the conviction and activity of the majority of any public (Moorhead & Griffin, 1995). It were certainly necessary to make the public aware of the cultural value of sports events and activities through various approaches (Lawrence & Werner, 1998). The sports culture shows completely the same basic components and structure as all other cultures and should therefore not have less importance. To this contributes, in all probability, considerably too little information and animation of the public for the following of sports events. The majority of the surveyed subjects (70.4%) were of the opinion that the organisers should promote sport events more in the public. Quite a number of the respondents did not state their opinion concerning this issue (18.3%).

The majority (89.8%) of the surveyed subjects were of the opinion that more frequent participation in sports could substantially contribute to the reduction of pathological social phenomena such as are alcoholism, drug abuse, various forms of crime, etc. Only 4.9% of the respondents did not believe in the positive effects of sports in reducing such phenomena. The majority of the surveyed subjects (76.2%) supported the prohibition of smoking and drinking of alcohol beverages during sports events. An opposite opinion was expressed only by 8.9% of the surveyed subjects.

Achieving of a relatively high level of the validity consensus is certainly a firm guarantee for the future development and integration of sports culture in a given social environment (Moorhead & Griffin 1995). Sport certainly still has a national connotation. From this aspect, the results of the sample of the Slovene public can be a useful aid in the further guidance associated with the management of Slovene sports. Public opinion resembles the spiritual culture of a nation in the field of sports, which creates the phenomenon of organisational climate for sports (Mail-Dalton, 1993). The latter, however, is a foundation for the development of the organisational sports culture, both on the macro level as well as on all lower levels of sports organisation.

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VOLLEYBALL AND BODILY COMMUNICATION: THE ROLE OF GESTURE IN THE SPORTING RESULT AND THE POSSIBLE IMPLICATIONS FOR THE TECHNICIANS FORMATION

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Abstract

The aspects of non-verbal communication in volleyball, its codes and the technical and tactical usage of gesture, are the result of the meeting between tacit and implied dimension that comes from experience gained on the range of activities and a theoretical dimension that scientifically characterizes and justifies the expressive and communicative potential of body.

The scientific aims of this research work are:

- to define a first inventory of signs used more frequently in volleyball according to the principles of bodily communication (Argyle, 1988), the aspects of perceptive senses (Berthoz, 2002) and the neurobiological implications (Rizzolatti, 2006)
- to give a general plan for training that includes knowledge about the function of gestures, signs and mimicking, the structure and the mean of non-verbal messages and the effects of bodily communication on behavior in order to build expressive and communicative skills of volleyball coach.

Key words: *pragmatic, empirical research, observation*

Introduction

The paths of training for team sports coaches reflect the guidelines of studies and research on the methodology of the training of volleyball focused on the improvement of functional aspects, on the development of conditional abilities and energy mechanisms, and on optimization of the bio-mechanical aspects, undervaluing the function of bodily communication during the game through the gestures, the signs and the mimicking.

This trend produces a basic formation of sports operators providing skills on the theory of training, tactics and schemes of games, the knowledge of biomechanics and automatic technical-sport gestures, functional mechanisms to recruit energy, psychological bases that regulate the action team during phases of game, but doesn't deal with the function of the signs and the gesticulation in communication processes and in particular the "pragmatic" side of communication and the effects that it has on behavior (Watzlawick et. al., 1967).

Methodology and results

Starting from the observation of gesture, its analysis of meaning, its possible conditioning factors, its effects related to the various theoretical frameworks was conducted an empirical research with a female volleyball team affiliated with the Italian "Championship C Series" during the 2007-2008 season. It was established an observation protocol that involved a team of 3 experts observers who have observed 10 match. During these matches they have quantitatively registered the number of shares of game affected by non-verbal communication in the attack.

The study showed an average of 10%, crucial for approximately 90% of the sets of a match, showing the strategic role of body language and its ability on conditioning competitive performance and results.

The reason of this conditioning probably draws on two interdependent traditions of research: the first on the shapes of nonverbal communication in team sports, and the second one, on the neurobiological mechanisms that connect action and cognition.

Discussion

Volleyball is a sport where the use of body language is very frequent, is a sport with very narrow game space (81 square meters per team) and actions extremely rapid and dynamic, whose technical characteristics, tactics and logistics constantly favour nonverbal communication between the players on the court. The players through perceptive and intuitive

processing, decode the signs, gestures and facial expression of team-mates and / or of opponents in a few thousandths of a second through the anticipation and interpretation of the consequences of the actions, one's own or other, confirming the proactive role of the brain that is not restricted to acquire all sensory events of the world, while it interrogates the world according to its conditions in order to predict and anticipate behaviour, adjusting the sensitivity, combining messages, pre-specified values estimated, according to an internal simulation of the expected consequences of the action (Berthoz, 2002).

In particular, the decoding of signs or of facial expression is "functional" when it refers to the same team and when communication between the players is involved or that between the trainer and the athletes on the tactical intentions, strategies and the problems of the game. Decoding can be "diagnostic" when it is possible to recognize the diverse forms of nonverbal communication of the opposing team, through signs and elements that characterize the communication styles (M. Argyle 1986 - ET Hall 1966) of athletes and coach. The third form of decoding is "tactics" when the gesture or the action simulates a game intention to solicit a reaction of the adversary who helps their own team because, in the process of observation, the sensory information is encoded as motor acts and our motor system is activated as if we carry out actions that we observe, involving the simulation of the same and making it possible that 'reciprocity' of acts and intentions which is basic for the immediate recognition by us of the meaning of the gesture of others "as soon as we see someone to perform an act or a chain of acts, its movements, which it want to or not, get an immediate meaning for the observer. The system of mirror neurons and the selectivity of their answers determines a shared action space, where every act and every chain of acts, our's own or others, are immediately written and understood, without any express or deliberate learning process" (Rizzolatti, 2006, p. 127).

Conclusions

Therefore, it is necessary to provide an educational course for technicians and coaches that teaches and speaks about the following subjects:

- Neurobiological knowledge on the mechanisms of regulation of the various types and ways of imitation, learning, and gestural communication according to the research on mirror neurons (Rizzolatti, 2006)
- Knowledge of the mechanisms of perception and on the sense of movement or kinaesthesia which makes possible of simulations and anticipations of motor actions (Berthoz 1999);
- Knowledge of the mechanisms of imitation in the different phases of training;
- Acquaintance and meaning of non-verbal communication, of the interpersonal motor attitudes, of posture, of facial expressions, of contact, of walk and of the glance. (M. Argyle 1978).

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CROSSING A PHILOSOPHICAL FRONTIER: THE POTENTIAL OF INTERNATIONAL QUALITATIVE RESEARCH

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Research is one way we learn about sport and kinesiology. Research methodology in exercise and sport has too often focused on the philosophy of quantitative measures. Qualitative research is still new to the field of kin-anthropology, sport, and recreation. It is time to incorporate the philosophical perspective of a qualitative approach. Interviews and participant observation are useful scientific ways to gain information. This paper will outline how information was gained in international settings through the use of interviews and participant observation. Further this paper will explain the importance of developing new philosophy of sport and kinesiology through qualitative research. This paper exams four previous studies of the author in international settings. Findings indicate that interpretive or qualitative research not only helps to find new meanings, but it also leads to new philosophy.

Key words: *participant observer, interviews, international research, qualitative research, philosophy.*

Introduction

Today's global economy, internet, and travel are demanding that all academic disciplines also become global in their perspective. With the common use of English language and the access of computer information from the internet, information is readily available. Thus, we can no longer carry out research in the same traditions. It is time for other perspectives to be accepted, and that diverse ways of carrying out research are allowed in the mainstream of research centers. The purpose of this paper is to discuss the power of qualitative and interpretive research to produce new philosophy and new ideas.

Brockett and Hiemstra (1991) challenge researchers to expand the knowledge base through qualitative research. This "going beyond the iceberg" (p. 83), through participant observation, case study, and in-depth interviews encourages research in its natural setting. Qualitative research is an inductive process that attempts to understand the meaning of one's process or experience. This perspective allows for multiple realities and socially constructed context from the participants (Merriam & Simpson, 2000).

Houle (1961) calls on the investigative society to consider a different style of research that will focus on new paradigms by isolating the voice of the individual. Kuhn (1970) similarly invites the research community to transcend traditional means of research to consider alternative means of arriving at evidence. "The history of scientific investigation is littered with the wreckage of ideas that once seemed wholly logical…it is time to discover what they are doing." (Houle, 1961, p.34). In addition, "qualitative methods can be used to obtain the intricate details about phenomena such as feelings, thought processes, and emotions that are difficult to detect or learn about through more conventional research methods." (Strauss & Corbin, 1998, p. 11). Qualitative research has contributed new information and new philosophy, especially samples that have been overlooked in previous research. Qualitative research enables researchers to actively participate in problem finding, to clarify the complexity of difficult situations, and perhaps to develop new theory. This is the goodness of qualitative research (Peshkin, 1993).

Many scientists have expressed a belief that interpretive research may reveal the processes and meanings associated with free time that are difficult to capture in quantitative design. Also, interpretive research might produce information about how a program works as well as reveal complex and unexpected understandings that emerge. Qualitative researchers are usually sensitive to individualized meanings that often get hidden in broader generalizations. (Samdahl, 1999).

Method

This paper will highlight new information and philosophy gained in the following research papers: The Art and Science of Teaching Students to Ski: Andragogy on the Mountain (Roberson, 2008, Submitted to Schole), Zagreb: A City of Contrasts (Roberson, 2008), Learning Wellness (Roberson, 2007), and Remedy for modernity (Roberson and Babic, 2008). This research papers incorporated various phases of qualitative research in an international setting. We will highlight these processes and the new information and philosophical perspective that were gained as a result.

Various forms of qualitative research took place in these research papers:

1. Winter Camp: Participant Observation, note taking, reflecting, and interacting with instructor.
2. Zagreb Tourism: Inclusion of existing Tourism center for survey, trained two others to use survey in Croatian, interviews conducted during the process of tourism.
3. Water Exercise Class: Participant observation, interviews with instructors and managers, participant survey in Croatian (translation), one on one interviews for more detail, attending coffee time.
4. Walking and Hiking on Medvednica: Inclusion of local college, agreement on surveys, surveys in English and Croatian, analyze results separately and bring together. Train four students to participate, translation of results, and personal experience of walking and hiking in this area.

Results

I incorporated the perspective of participant observer in research 1, 2, 3, 4. I am a stranger in this country, and I do not speak the language fluently. This style of research allowed me to cross these difficult barriers yet make informed decisions. Every day I took notes and carefully wrote down what took place during this time. "Participant observation is an approach to qualitative research where the researcher spends prolonged periods of time in the subject's natural environment, unobtrusively collecting data. The researcher is simultaneously a participant and an observer" (Bogdan & Biklen, 2007, p. 274).

"Qualitative research in physical education, exercise science, and sport science is still relatively new" (Thomas, Nelson, & Silverman, 2005, p. 345). And adding to the complexity of this, international research across language barriers is not very common. My lack of ability to speak and understand the local language allowed for participant observation to be the most logical style of inquiry. This method of participant observation included informal discussions, direct observation, participation in the daily life of the group, and a self-analysis.

Participant observation is also defined "as a process in which a researcher established a many sided and long term relationship with individuals and groups in their natural setting for the purposes of developing a scientific understanding of those individuals and groups" (uk.geocities.com/balihar, 2007). I spent seven days with 220 people which I had no real affinity or friendships. I took steps to fit in with this group, and rather than coming across as an educational researcher, I simply tried to be with this group and to ski with them.

Similar to ideas of Glaser and Strauss (1967) there began to emerge several specific ideas from all of the entries I had made to my data. Since I lived in Zagreb, I could check my ideas and emerging findings with students as well as teachers. Adding to this, this paper was reviewed and read by two of the instructors. The advantage of the qualitative research, for the purpose of this study, was in its ability to contribute new information, especially from various samples that have been previously overlooked. A qualitative perspective also helped to capture the nuances of tourism and travel by welcoming anomalies in the discussion (Kuhn, 1970). In general, qualitative research enables scientists to actively participate in problem finding, to clarify the complexity of difficult situations, and to develop new theory.

The aim of this research was to understand the visitor's various experiences and to give voice to the ideas and feelings of tourists rather than typical consumer and market driven initiative which characterizes much tourism research (Westwood, 2005).The results were eventually presented to researchers at the Institute of Tourism.

This research was a basic qualitative design, which "seek[s] to discover and understand a phenomenon, a process, or the perspectives and world views of the people involved" (Merriam, 1998, p.11). Because of the lack of research with on-site walking, we interviewed participants as they are actually walking or hiking on Medvednica Mountain Park. All of the interviews took place on-site in various locations on the mountain called Medvednica Mountain Nature Park.

Discussion

In the first study, I observed a philosophy of experiential education (Lindeman 1928/1961), self-directed learning (Tough 1979, 1971), andragogy (Knowles, 1984), and communities of practice (Wenger, 1998).These students were learning by doing in an encouraging atmosphere of recreation while they were on the ski slopes. Those who learned to ski quickly became stimulators to their friends. Enclaves were obvious, such as the professors who skied together, the advanced student skiers, and the beginners.

In the second study I was able to discern 1. Healthy older adults are primarily motivated to improve their health. 2. Formal classes can create social situations where older adults help and teach one another. 3. Water exercise is an important way for older adults to continue to exercise. and 4. Informal meetings were an important way for these participants to connect and to transfer knowledge.

In the third study I was able to understand the responses that will help those who are interested to know what issues need to be addressed. The most frequent response to this theme concerns the physical structure of the city of Zagreb, specifically the buildings in the city center. The main statement was that these "old buildings need repair" and "some

buildings look like nobody cares about them". One respondent sad that the building were "ugly", while the other see it as "damaged houses, everything is grey".

In the fourth study, I was able to gain interesting insight about the experiences of hikers and walkers on Medvednica Mountain. The findings center around three main experiences including being in nature and outdoors, mental and physical benefits, and interacting with others and the self.

Conclusion

1. International research is a necessary for research and philosophy base to expand.
2. International research is possible through participant observation when language is a problem.
3. Translation is a necessary part of research. Some of the meaning is lost in translation.
4. Qualitative research drives and expands philosophy by introducing new paradigms overlooked in other research methods.

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ESTABLISHING DIFFERENCES OF SWIMMING COACHES BASED ON SOCI-CONATIVE CHARACTERISTICS QUESTIONNAIRE

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Abstract

The swimming coaches are "creators" who in their work combine intuition, compassion, creativeness, scientific and expert discoveries, and their experience. 71 Croatian swimming coaches (44 male and 27 female) participated in the research. Three questionnaires were used: Swimming Coaches Questionnaire, MOP2002 scale by Franceško, Mihić and Bala, and the Burns' Perfectionism Scale adjusted to the Croatian population (Ivanov, Penezić and Proroković, 1999). Our aim was to determine differences of demographic characteristics (gender and marital status) in coaches' attitudes towards different aspects of coaching work, motivation for achievement and tendencies towards perfectionism. It can be concluded that coaches differ significantly in gender and marital status relating to general variables directly linked to swimming and conative characteristics. The obtained differences reflect the attitudes of the society as a whole and the states of mind of individuals and clubs' managements.

Key words: *attitude, gender, marital status, ambition, perfectionism.*

Introduction

The coach is the individual who must have key knowledge in all aspects of the training process: physiological, biomechanical, nutritional and psychological. The goal is to develop the potential of every swimmer maximally and in doing so to be able to feel satisfaction. Authors of numerous works agree that the coach is a very important person for the development of athlete's sports career (Tušak and Tušak, 2001; Krevsel, 2001; Martens, 1990; Gummerson, 1992 in Sabock, 1985). There are many findings about planning and programming of the training session, anthropological and psychological status of the swimmer, but unfortunately little is known about the profile of the coach as an unavoidable link (Mraković, 1992). Rare are the researches based on the profile of coaches in individual swimming, on how swimming coaches differ in respect to the gender and their marital status, to their motivation and tendency towards perfectionism, to how experienced they are, to the number and category of swimmers they coach and to how long (if at all) they have been competitive swimmers themselves. The motivation for achievement is most frequently defined as dedication to highlight an individual in terms of their achievement in the eyes of others but also them self, persistency in the implementation of goals, implementation of goals as a source of satisfaction, as well as orientation towards planning (Franceško, Mihić and Bala, 2002). Striving for success and competitiveness are the most important factors which describe persons seeking their personal development. More and more often individual's success in the workplace is perceived as success in life, so the wish for success in work is used as a scale of motivation for achievements. Perfectionism represents a tendency towards achievement or an aspiration to very high standards. In research, perfectionism is usually equated with poor adjustment and achievement. Perfectionism becomes a problem when an individual has unrealistic expectations and is never satisfied with the performance (Hamachek, 1978, from Ivanov, Penezić and Proroković, 1999). In this research, perfectionism is viewed as a one-dimensional construction focused on personal cognition. That is how the Burns' scale of perfectionism emerged containing 10 particles measuring self-directed perfectionism (Burns, 1980, according to Calhoun and Accocela, 1990). The basic goal of the research is determination of the effect of differences in demographic characteristics (gender and marital status) on attitudes of the swimming coach towards different aspects of coaching work, as well as towards conative characteristics (the motive for achievement and tendencies towards perfectionism).

Methods

Respondent Sample

The research included 71 swimming coaches, (44 male and 27 female), from most Croatian clubs (23): Mladost, ZPK, Igra, Dubrava, Natator, Medveščak, Novi Zagreb (all from Zagreb), Barok (Varaždin), Olimp (Tuheljske Toplice), Sisak (Sisak), Osijek Žito (Osijek), Arena and Pula (Pula), Poreč (Poreč), Delfin (Rovinj), Primorje (Rijeka), Šibenik and

More (Šibenik), POŠK, Jadran, Grdelin, Mornar (all from Split), Jug (Dubrovnik), and Korčula (Korčula).The research was carried out on the relevant sample of swimming coaches, of different age, length of employment, level of educational qualification and age categories of swimmers with whom they work. Tests were carried out in the summer of 2007. Implementation of the questionnaire was individual, and the anonymity of answers guaranteed. The time for answering the questionnaire was not limited.

Variable sample

A total of 35 variables were deduced from questions of the Swimming Coaches Questionnaire. General demographic variables are gender and marital status. General variables directly related to swimming include: years of swimming, years of employment, constant employment in the club, categories and number of swimmers with whom they work. Variables which mark coaches' attitudes towards the work or the club are satisfaction with: the job, the monthly income in the club, activity schedule in the club, work distribution in the club, expert meetings schedule, flow of expert information, stimulating human relations, work of the management for the welfare of sport, swimmers' appreciation of your work, exploitation by the management and swimmers. Variables which mark coaches' attitudes towards swimmers are: existence of unpromising swimmers, unpromising work, commitment with unpromising swimmers, investment in and profitability of unpromising swimmers, preferring to work with troublesome but promising swimmers, preferring to work with polite but unpromising swimmers, opinion on whether seniors should stop swimming if they do not win medals on state championships. Variables which mark attitudes about "quality "coaches involve questions: could a coach be good without swimming experience, could a coach be good without the appropriate education. Variable which expresses self-evaluation of one's own work is: how one carries out the job of a coach. Variables which mark coaches' attitudes towards colleagues and the system of competitions are: whether your colleagues do their job well, whether the system of competition is stimulative for the development of swimmers.

Motivation for achievement was measured using the MOP2002 scale by Franceško, Mihić and Bala which consists of 55 particles (hereafter MOP). The scale is put together as a classic attitude scale of Likert type. The research used Burns' perfectionism scale (hereafter BSP) adjusted to the Croatian population (Ivanov, Penezić and Proroković, 1999).

Data analysis

In data processing, besides the descriptive statistic method, discriminative analysis and the Pearson's correlation coefficient were used. Results processing was made with the statistical package Statistica ver. 6.0. Standard statistical procedures were used to calculate the basic descriptive parameters of the variables, and the canonic discriminative analysis to determine differences among coaches. The following were calculated: characteristic values (λ), canonic correlations (R_c) Wilks's value ($\mathbf{W_\lambda}$), Bartlett's χ^2 test, structure matrix (the correlation) of the variables on the discriminative function. Reliability of Swimming Coaches' Questionnaire was confirmed by the Cronbach's alpha.

Results

The reliability of Swimming Coaches' Questionnaire was confirmed (Cronbach alpha amounts to 0.42). The canonic discriminative analysis showed the difference in a series of variables (general variables directly related to swimming and two conative variables) between male and female coaches in relation to GENDER (χ^2**=26.99**; **p< 0.00**), and MARITAL STATUS (χ^2**=30.65**; **p< 0.00**).

Table 1. Variable correlations with the discriminative function according to the GENDER criterion

gender	DF 1
GODPLI	-0.34
GODSTAZ	-0.26
RODNOS	-0.12
KATSKPL	0.43
KATKAD	-0.45
KATJUN	-0.59
KATSEN	-0.38
BROJPL	0.43
MOP	0.18
BSP	-0.18

Male coaches as a rule train the junior category (KATJUN), the cadet category (KATKAD) and the senior category (KATSEN), while the female coaches mostly train the swimming school category (KATSKPL). Also, male coaches competed in swimming (GODPLI), have the more years of employment (GODSTAZ) and male coaches are the ones who mostly have the status of permanent employees (RODNOS). Male coaches show greater tendency towards perfectionism (BSP), as opposed to female coaches who have greater ambition (MOP). Female coaches train bigger number of swimmers (BROJPL).

Table 2. Variable correlations with the discriminative function according to the MARRITAL STATUS criterion

marital status	DF 1
GODPLI	-0.32
GODSTAZ	0.75
RODNOS	0.26
KATSKPL	0.09
KATKAD	0.17
KATJUN	-0.08
KATSEN	0.15
BROJPL	0.13
MOP	0.16
BSP	0.09

Single swimming coaches have more experience as swimmers / competitors (GODPLI). Married swimming coaches have more years of employment (GODSTAZ) and mostly permanent employment with the club (RODNOS). Married coaches most often work with cadets (KATKAD). They show greater ambition and wish for success at work (MOP) and they are mostly coaches of the most elite category (KATSEN). Also, married coaches train a large number of swimmers (BROJPL), given that among other things they train begginer swimmers (KATSKPL).

Discussion

The relatively low reliability of the questionnaire was expected, because it was not constructed according to kinesiometric i.e. psychometric principles but as an insight in the coaches' attitudes, with the purpose of undertaking measures for the improvement of coaches' practical work. Reasons why female coaches mostly work with the beginner swimmers while male coaches work with older categories and top swimmers lie in the conventional thinking that coaching is essentially "male job", and that male coaches more easily work in shifts, on weekends and have no problem traveling to competitions as opposed to female coaches (only two female coaches in Croatia work with the senior category). That is also the reason of the more frequent permanent employments of male coaches, and consequently of more years of employment. Furthermore, female coaches train bigger numbers of swimmers which is logical given that they mostly work with the swimming school category which is the biggest category in the hierarchy of swimming clubs (e.g. PK Mladost has 614 swimmers of which 389 beginner swimmers, 100 junior cadets and cadets, 35 juniors, 21 seniors). The research also confirmed already known trend that female swimmers give up competitive swimming sooner. Male coaches show greater tendency towards perfectionism while the female coaches have bigger ambition. The resulting difference can be attributed to the "privileged" status of the male in comparison to female coaches in clubs. Since female coaches are unjustly neglected in working with juniors and seniors it is logical that they wish for older swimming categories, while incline towards perfectionism because their status is already ensured. Single swimming coaches spent more time as competitive swimmers but priorities change with marriage. Reasons can be: lack of time for everyday long training sessions, as well as the fact that swimming is an amateur sport and that means that the money earned competing is insufficient (if not among Europe or world best). As a result married swimming coaches earlier obtained permanent employment, thus having more years of employment. They also train larger numbers of swimmers. Married coaches train the beginner, cadet and senior category. The reason why they lead more categories is lower number of seniors in clubs (Croatian Swimming Organization-HPS- and has registered 221 senior and 1500 beginner swimmers of A and B categories, therefore swimming school). In such cases, club management does not want permanent employees to have less working hours and a smaller number of swimmers. Also, married coaches show greater tendency towards perfectionism and show bigger ambition and wish for success at work. The reason probably lies in the satisfaction with their coaching status in their club which channels their energy into more quality work with the swimmers. Success at the workplace is more frequently identified with success in life.

CONCLUSIONThe obtained differences reflect the conventional attitudes of the society as a whole, individuals' states of mind and that of the clubs' managements. Male coaches mostly train older categories of swimmers and have shown larger tendency towards perfectionism while female coaches have shown larger motivation for achievement. Furthermore, married coaches show larger tendency towards perfectionism and larger ambition.

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Sport for All: Fitness and Health-related Activities

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PROMOTING PARTICIPATION IN PHYSICAL ACTIVITY, SPORTS AND EXERCISE: A PUBLIC HEALTH PERSPECTIVE

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Abstract

Promoting participation in physical activity, exercise and sports can make an important contribution to the prevention of disease, promotion of health and community well being. Physical inactivity is a central risk factor for many of the most common chronic diseases, notably heart disease, stroke, cancers, type 2 diabetes and mental health. Inactivity is an independent risk factor for these health outcomes and physical activity an important contributor to prevention and treatment of hypertension, blood cholesterol and obesity.

In summary, increasing participation in physical activity is a major population health challenge for most countries. It is a relatively new agenda and progress to-date has been slow but there is great potential for approaches that focus on health enhancing physical activity. Systematic reviews provide an indication of current knowledge of what interventions work but there are notable gaps which provide opportunities for the research community. Nonetheless, on the basis of what we do know, there is a clear mandate to implement a population based approach to increase participation and improve health and community wellbeing. The WHO Global Strategy and supporting documents provide us with clear guidance and direction and call for all countries to respond.

Key words: *participation in physical activity, promotion of health well being*

Promoting participation in physical activity, exercise and sports can make an important contribution to the prevention of disease, promotion of health and community well being. Physical inactivity is a central risk factor for many of the most common chronic diseases, notably heart disease, stroke, cancers, type 2 diabetes and mental health. Inactivity is an independent risk factor for these health outcomes and physical activity an important contributor to prevention and treatment of hypertension, blood cholesterol and obesity (WHO, 2004; Bouchard et al., 2006). Moreover, an active lifestyle can reduce the risk of depression, prevent falls in the elderly, may enhance cognitive function and improve academic performance in children (Katzmarzyk and Janssen, 2004). For most of these conditions, accumulating half an hour of at least moderate-intensity physical activity on most days of the week is sufficient to achieve these preventive benefits (US DHHS 1996).

Although much of the current evidence on the health benefits of physical activity was in place over a decade ago, it can take decades to translate an evidence base into public health policy and action. Thus in many countries physical activity promotion is still in its early development (Bauman et al., 2006). One major development in recent years has been the increased recognition of the need for a broader focus of physical activity, in Europe this is often known as health-enhancing physical activity (HEPA). This has opened up scope for interventions beyond only leisure-time physical activity, sports and recreation and includes the promotion of active transportation (such as walking or cycling for all or part of travel trips) and interventions to maintain active participation in cultural activities and settings. This wider agenda may be particularly useful for developing countries, where effective population based interventions might focus on maintaining and preventing the decline in activities such as cycling and walking for transport which are currently more prevalent than in many developed countries. Associated with HEPA is the increased range of settings for promotion of physical activity, and thus the potential for wider collaborations beyond working the health and sport sector. Partnership with other agencies and disciplines needs to be developed, including links to education, transport, and urban planning sectors.

A public health approach to the promotion of physical activity seeks to increase population levels of physical activity by influencing personal, educational, social and environmental factors that contribute to physical activity behaviour (Bull et al., 2006). However, to-date, few studies have evaluated true multi-level and multi-strategy interventions using broader socio-ecological theoretical principles (Shilton et al., 2007). In reality, much of the published research on interventions has been more narrowly focused, using selected (often single) intervention approaches, in defined settings with volunteer samples. The challenge for researchers in the future is to move beyond this approach.

The current level of interest in physical activity has stimulated several national level efforts to review the intervention literature to identify what works. For example in the USA the Taskforce on Community Preventive Services reviewed and

made recommendations on implementation based on the level and quality of evidence available (www.thecommunityguide .org/pa/). Eight categories of interventions have been classified in recent years as having a 'strong' or 'sufficient' evidence of effectiveness(Khan et al., 2002; Heath et al., 2006).. These recommendations are a starting point for interventions in developed and developing countries while accounting for their local needs and capabilities.

In the UK the National Institute for Health and Clinical Excellence (NICE) has commissioned reviews of evidence for the effectiveness of interventions promoting physical activity. Work commenced on physical activity in 2005 with a review of effectiveness of 4 behavioural-based interventions: pedometer interventions, community-based walking and cycling programmes, brief advice from primary care providers and exercise referral programmes (NICE, 2006). Recent work has addressed environmental interventions across five key areas: transport, urban planning and design, natural environment (urban and rural), building design and policy (NICE, 2008) and current work underway focuses on physical activity interventions aimed at young people. Again one of the emerging limitations across these reviews is that much of the published evidence provides little insight into the effectiveness of implementation and dissemination at the community-wide, population level. Yet this is the question that challenges health promotion practitioners and decision makers on a daily basis!

Another gap in the current evidence base on intervention to promote physical activity is the limited evidence on transferability of findings to developing countries. It is only more recently that attempts have been made to specifically identify and integrate evidence from developing countries. For example, recent efforts in 2005 have developed a framework to describe 'good examples' of physical activity health promotion, describing principles for assessing the effectiveness of national level programs (WHO, 2005). The evaluation of physical activity programs in developing countries needs to take account of differences in the physical activity domains, the socio-economic and socio-cultural characteristics, and different issues related to the built environment infrastructure and climate, and their impact on everyday 'active living' (Gomez et al., 2005). The rapid urbanization in developing country cities provides a unique opportunity to evaluate the effects of 'natural experiments' in these environments.

At a global level the World Health Organisation provides leadership to this agenda through the Global Strategy on Diet, Physical Activity and Health [DPAS] (WHO, 2004). This is supported by guidance on how to implement a population based approach (WHO, 2006a) and principles by which to assess progress towards the implementation of DPAS (WHO, 2006b). One of the key principles that emanates from DPAS is the need for population-level interventions, and the need to move beyond high-risk screening, detection of risk and brief advice; such approaches are not effective in the long term to promote physical activity, and reach only a selected few in the community. The criteria for a population based approach is summarised in Table 1.

Countries interested in implementation of DPAS and population-based approaches to physical activity face several challenges. Firstly, action to promote physical activity is not resourced commensurate with its potential to promote health and community wellbeing. This calls for ongoing advocacy efforts within and outside of government to foster political commitment and policy development (Shilton, 2006).

Table 1. Eleven criteria for good practice in physical activity promotion

1. ***Consultation*** with relevant stakeholders during development of physical activity policy and action plans
2. Adoption of a comprehensive approach to physical activity promotion using ***multiple strategies*** (e.g., individual-oriented as well as environmental focused interventions) targeting different population groups (e.g. children, adolescents, women, older adults, disabled people, indigenous people)
3. Working at ***different levels*** (local, state and national as well as individual, whole community and physical environmental level)
4. Development and implementation of the policy and action plan across multiple agencies and settings by ***working through coalitions, alliances and partnerships*** (e.g. involving cross government, non government as well as relevant private sector partners)
5. ***Integration*** of physical activity policy within other health and non-health related agendas (e.g. in the field of health, nutrition, transport, environment)
6. ***Stable base of support*** and resources to implement the policy and action plan (e.g. from politicians and government with or without support from other supporting organisations)
7. Development of an ***Identity*** for the physical activity program by means of a logo, branding and/or slogan. This may include identifying and cultivating a spokesperson or 'champion' for the initiatives as well as an advocacy / communication plan;
8. A clear statement of the ***Timeframe for*** implementation of the physical activity plan;
9. Specific plans and resources for ***Evaluation*** of the efforts to promote physical activity
10. Development and/or maintenance of physical activity ***Surveillance or Monitoring Systems*** which includes suitable population-level measures of levels of physical (in)activity and related factors;
11. Statement of recognition of existing ***National guidelines / recommendations on physical activity*** or intent to develop them.

A second challenge is that the promotion of physical activity requires actions and approaches from both within and outside the health sector, and requires interagency partnerships, co-funding and joint planning. These are slow to establish and often represent very different ways to working and thus require institutional change. These issues are particularly

difficult in developing and rapidly urbanizing countries. Those who plan and build our expanding urban environments and transport systems are critical future partners in addressing physical inactivity. So too are policy makers in key settings such as schools, workplaces and local Government as they preside over policy decisions which have a significant impact on physical activity opportunities and access.

A third challenge is that the building of good evidence and the evaluation of complex multi-component interventions requires cross-disciplinary work but this in turn presents methodological and practical challenges, including how to engage with researchers, policy makers and practitioners outside the health sector (Nutbeam & Bauman 2006). This calls for working in different ways and with different paradigms.

In summary, increasing participation in physical activity is a major population health challenge for most countries. It is a relatively new agenda and progress to-date has been slow but there is great potential for approaches that focus on health enhancing physical activity. Systematic reviews provide an indication of current knowledge of what interventions work but there are notable gaps which provide opportunities for the research community. Nonetheless, on the basis of what we do know, there is a clear mandate to implement a population based approach to increase participation and improve health and community wellbeing. The WHO Global Strategy and supporting documents provide us with clear guidance and direction and call for all countries to respond.

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WALKING OUTDOORS: VOICES FROM MEDVEDNICA

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Abstract

It is well known that people want to know how to improve personal health. Many are interested in simple exercises that can last a lifetime. The benefits, mental and physical, of exercise are well documented, yet, many choose to remain inactive. There is a need for more research concerning those who continue to exercise.

The purpose of this study was to understand more about the experience of those who are hiking and walking on Medvednica Mountain Nature Park near Zagreb, Croatia. 122 hikers and walkers on-site were interviewed with general questions about the walking experience on Medvednica. The interviewers made written records of responses during the interview, on which qualitative analysis were carried out.

The findings center around three main experiences: 1. Nature and outdoors, 2. Benefits – Mental and Physical, 3. Interaction with others, and the self.

There are specific benefits, mental and physical for walking on a daily basis. Second, if the person can walk outside in a natural setting this will add to the exercise by bringing the individual close to the natural world. These people have found a simple way to negate the impact of living in modern society. This research suggests that civic organizations should promote walking as a way of life. There were many people who avoided us; and for some it was obvious we were becoming a constraint to their walking experience.

Key words: *walking, hiking, leisure, nature, qualitative research*

Introduction

The physical and psychological benefits of physical activity are substantial and have been well documented: 57% of Canadians aged 18 and older, one third of the American population age 50 and over, and 66% of adults in the UK are considered insufficiently active for optimal health benefit (Wesch, Milne, Burke and Hall, 2006). Because of this, there is a need to learn more about the experience of people who exercise as a way of life. Therefore the purpose of this study is to find people who are exercising in this way and learn more about their experience.

This research brings together several dynamics - leisure and recreation, walking or hiking, being with others, as well as geography. The mountain is within the city limits of the city of Zagreb and easily accessible to a population of one million people. Walking is the number one choice of exercise for many people, and one of the simplest and most natural forms of recreation and exercise. The dynamic of being with others during walking or hiking adds a significant social aspect to their leisure time.

Walking and hiking is more than merely taking steps. Authors suggest that people should consider that walking not only promotes health, but also is a preventative for poor health; moving of the body through nature also allows for the mind to interact with its environment. They write about the importance of shared experience (talking and walking or narrating: Adaval and Wyer, 1998) with friends and family during leisure time.

The subjects in this study have chosen to utilize their leisure time to improve their health in a natural and simple way. This on-site research provides a needed voice in recreation and leisure research, because during our investigation we could not find other on-site interviews with walkers or hikers. Also, this is the first qualitative study of exercise that has taken place with participants from Croatia.

Methods

This research was a basic qualitative design, which "seek[s] to discover and understand a phenomenon, a process, or the perspectives and world views of the people involved" (Merriam, 1998, p.11). The main topics addressed were topics: hiking/walking experience, enjoyable factors in hiking/walking at Medvednica. We started the interviews in November of 2006 and concluded in February of 2007. All of the interviews took place on-site in various locations on the mountain. The authors conducted 102 interviews, with a further 20 undertaken by trained volunteers. Adult walkers and hiker,

from 20 to 88 years old, male and female, were approached and invited to participate in the study. The interviewers made written records of responses during the interview which were later transferred to a more permanent record along with any further detail added by the researcher immediately following the interview concerning the discussion. The interview records were subsequently translated in English for analysis by both authors.

Our interviews were an informal conversational interview (Patton, 1990). This natural flow from the immediate surroundings permits an informal interview that takes advantage of the context of the moment. This also allows for observation as well as flexibility so the interviewer can adapt the interview to the individual. A blend of an interview guide and informal conversational interview was incorporated. Similar to the advice of Bogdan and Biklen (1992) we intensely listened during the interview and wrote comments "Treat every word as having the potential of unlocking the mystery of the subject's way of viewing the world" (p. 98). Also, we tried to create an environment where the person felt at ease. Both researchers read through the findings several times, conducted an independent analysis, and then collaborated on the final account.

Results

The purpose of this study was to understand more about the experiences of hikers and walkers on Medvednica Mountain. There are five main findings (Table 1). Each finding has the three top experiences under that category also listed. The findings center around three main experiences including being in nature and outdoors, mental and physical benefits, and interacting with others and the self (Table 1). The number refers to how many participants discussed this experience and the numbers in this table represent how often the participants referred to this particular experience.

Nature and Being Outdoors 65	
Fresh Air	22
Quiet	15
Woods	16

Mental Benefits 88	
Good for me	36
Stress Relief	31
Relaxing	37

Interacting with Others 52	
Family	27
Friends	44
Others/Huts	14

Physical Benefits 84	
Exercise	40
Health	30
Recreation	10

Interaction with self 31	
Thinking	23
Looking/Watching	12
Memories	23

Discussion and conclusion

Participants discussed the experience of being in nature and the outdoors while walking. This centered on an appreciation for the "forest, trees, and woods," the experience of breathing fresh/clean air, and the quiet. Also mentioned were the colors of nature, the various aspects of the mountain, sounds in nature, and searching for and picking mushrooms. They are talking about connection with earth, about the nature, the wood, peace, quiet, health, well-being and a different energy here on the mountain. "Some hikers expressed: "Everything that is negative is just going out; here is better air, breathing is better quality, and it is good relaxation; for me it is escape from city, enjoying in nature and I never smoke when I'm here."

The hikers seemed to really enjoy the quiet, the beauty of the trees, the hills, valleys, and the air. Concerning quiet, other words that were used were "silence, tranquil, and peaceful." They made the connection between nature and relaxation: "Nature relaxes me, makes me feel better, we always have some good tempo of walking; It is important for us, and I think it is the best way of relaxation; Hiking gives me better vitality, condition for life, and for living; Nothing can't make any problem for me, everything is easier."

The main experience discussed by the participants concerned mental and physical benefits. They were convinced that this walking and hiking was "good for me," others said "I feel great," "it gives me energy," "I am ready for work," and "my mood is better." This personal mental benefit is described: "…We feel good physically and psychologically, I sleep well and healthy; it is pleasure, it is chance to see my friends and be with them, for me is very important knowledge

that I do something for myself." The walkers and hikers often mentioned stress relief, relaxation, positive experience, and a sense of escape. This mental benefit was also described as "filling up my batteries." Adding to this another said: "I keep doing that (walking) because it makes me feel good, I fuel my battery for the rest of the next week, I'm happy here because the people and their activities and habits are so normal, food is normal – domestic (homemade)…here is everything normal, health for environment ... This can help me to deal with stress"

There were several hikers who emphasized that hiking on Medvednica was something similar to psychology. Observe what one hiker said: "I use this hiking instead of a psychiatrist. In one way I am tired when I finish, yet full of energy. I am full of energy, it is filling me." This is like a balance between the physical and the spiritual.

One hiker stated: "For me hiking means health and conditioning. I enjoy in walking. I didn't visit doctor since 1991." Similar to exercise, many participants discuss an experience of health renewal. One woman stated: "I know this is healthy, especially for bones, against osteoporosis. When I am doing this I am younger, because I can go. This helps me to be in good condition for work." One man said: "For me hiking is health, physical and physiological relaxation, joy, during hiking I forget all problems." Two ladies walking together and carrying umbrellas shared the following: "This is a need for us to come here. We want to breathe. We feel healthy and happy when we are here. We are calm because we are doing this walking up Medvednica." And adding to this one hiker stated: "Hiking is healthy, convenient and useful for soul, eyes, body."

Many discussed the interaction and connection that is made with others during hiking and walking. This includes those they are hiking with, usually friends or family, and may involve singing, eating, and drinking. However, the dominant part of this is simply being with someone and walking together in the nature – walking and talking. This idea of "walking and talking" was expressed in various ways. One hiker stated: "I like to walk and to talk. We talk about business; about the nature…I am here every weekend. This is a stress relief from a stressful week. And I am trying to teach my son to get with the nature … When we are walking we are talking about our lives.''

Other aspects of interacting with others include people they meet or pass during hiking, as well as going to various mountain huts, especially for well known local food. Very similar to interacting with others, yet somewhat different, is the interaction and connection the walker and hiker has within himself/herself. This is a personal, internal experience within the individual as he/she interacts with that which is around them especially nature and people. For example, some participants discussed thinking, clearing their mind, looking and watching the nature, something spiritual such as praying, and reliving past memories of walking with friends and family. Many participants discussed how during this hike on Medvednica they would forget themselves, or their concerns, or problems: "For me hiking is health, physical and physiological relaxation, joy, during hiking I forget all problems." Going to another level another walker stated: "I heal my depression here. It provides me with internal pleasure and balance." Explaining this internal chemistry one walker stated: "When I do hiking I've got more energy, I feel better, it is easier to do other things, easier to solve problems. Hiking means to me realising of stress, health, physiological and physical well being." Although initially coming for exercise, these walkers realized that during this process of walking in nature, they are also involved in an internal psychological and mental healing. Similar to this, another said: "I can think about all my life and all the things in my life." Another hiker remembered: "When you are here you leave behind yourself, all of your worries, and just everything." Adding to this another hiker said: "during hiking I forget all problems."

The modern world seems to separate the individual from natural ways to exercise such as walking or an agrarian lifestyle (Kirk, 1998; Rudner, 1996). Sensing that leisure time is compromised in our busy life, some are looking for simple ways to participate in exercise or activities that can promote health (Jermanok, 2006). In today's society people spend long hours sitting while at work, during transportation, and in school or various meetings. This research has found walking and hiking as a natural, simple, and healthy choice for the problems of modern life. Also, hiking on an elevation such as hills or mountains adds to the intensity of this exercise and promotes more benefits. Similarly to some previous research (Fisher & Li, 2004; Larkin, 1999; Neis & Partridge, 2006; Stanish, Temple, & Frey, 2006; Ward, 2006) this research has confirmed these mental and physical benefits of walking and hiking. Among those discussed in interviews were weight control, stronger bones, higher quality of life, and better circulatory system. Close to the benefits that Williams and Strean (2006) describe, these participants emphasize mental benefits – especially less stress, less worry, and positive mental energy as a result of walking in nature.

The participants in this study were continually discussing how much they enjoyed hiking and walking in undisturbed nature also reflecting ideas of Evans (1933), Caulking, White, and Russell (2006), and Palmberg and Kurer (2000). Perhaps this is a modern example of Russell and Phillips-Miller's (2002) discussion of wilderness therapy; these participants discussed "walking and talking" as if they were involved in their own personal self-help therapy.

The implications for this work are that walking as a way of life should be promoted as policy among local governments and various civic institutions. More research in the area of walking around the world, as well as Nordic walking would add to this research. There is a need for communities around the world to promote walking and hiking by providing pathways within local communities as well as education concerning wellness (Vong, 2005). Similarly, Larkin (1999) and Pagano et al.'s (2006) discussion on a convenient place for walking and hiking was also an important concern for these hikers. Many of the participants live within a radius of five kilometers of Medvednica Mountain.

This research has shown that walking should be promoted as a way of life. The implications of this are widespread and can affect every home, business, and community. For example, walking paths should be made available for everyone, and walking for a minimum of 30 minutes a day should be encouraged in various ways. Crowded cities have a responsibility to provide access for opportunities of leisure, such as walking trails and biking paths.

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PHYSICAL ACTIVITY AND BODY DISSATISFACTION IN FEMALE UNIVERSITY STUDENTS

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Abstract

The study was conducted on a sample of female students of the University of Zagreb aged 18-20. It aimed at examining students' body satisfaction in relation to their physical activity and eating habits. This is the first research among Zagreb female students on their self-image as related to their comparison with top models resulting from a growing sociocultural pressure among young women. The results revealed that most of the students were satisfied with their appearance, whereas some of them claimed having "unhealthy" habits, such as insufficient physical activity or increased food intake during a single meal, which affect their physical appearance, and result in a certain level of dissatisfaction. In addition, women experience some negative emotions when comparing themselves with top models presented through the media.

Key words: *body dissatisfaction, sociocultural pressure, eating disorders.*

Introduction

In today's world growing sociocultural pressure makes women feel they are not slim enough. Prospective studies have found that body dissatisfaction predicts future increases in eating disorder symptoms and the onset of eating pathology among young women (Levine, Smolak, 1996; according to Krones et al 2005, Wertheim *et al* 2001.). Preoccupation with body image is highly prevalent among adolescents and young adults, increasing a real threat of possible eating disorders among them, such as bulimia and anorexia. Eating disorders are risky and dangerous behavioral disorders resulting from a combination of different factors, including emotional disorder, personality disorder, family pressure, genetic and biological predisposition, the availability of abundant food, and obsession with slimness. Many young women perceive themselves as being fat, although they have an ideal body mass, and they use different healthy and unhealthy methods in order to lose weight.

Physical activity and exercise can be related to a person's health, especially its psychological component, in different ways. Physical activity is extremely important in body shaping, as well as in preventing excessive body mass, having beneficial effects on a person's health and well being (Both, 2002, Calfas *et al* 2000, Keating *et al* 2005; Sparling and Snow, 2002, Fish and Nies, 1996). The research conducted by Thome i Espelage (2004) evaluated the role of physical activity among female students, as an indicator of a healthy lifestyle, in relation to their diet and mental health. Their research revealed that for women who scored high in Eating Attitudes Test (EAT) exercising was closely related to severe depression and anxiety. Women who scored low in EAT associated exercising with beneficial effects.

There have been few studies on physical activity, eating habits, and body satisfaction among students in Croatia. A research on physical activity looked at students' preferences and attitudes towards exercise, using K1 and K2 scale (Bosnar, Prot, 1993, 1995, 1999, Caput-Jogunica, 1999, Fučkar and Dijaković, 2001, Prot *et al* 2001 in Caput-Jogunica and Ćurković, 2007).

Andrijašević and his team of researchers (2004) conducted a study on kinesiological activities and subjective health status assessment based on a sample of 449 students. According to the results, male students reported their health status to be better, while female students assessed their health status to be poor, indicating they had numerous health problems, such as general fatigue, which is related to a number of psychosomatic disturbances (tension, nervousness, back pain, etc).

In 2004 Šatalić and his team carried out a survey among 2433 students looking at the students' eating habits and diet quality according to their sex, religion, and risk factors. The results showed that female students had more adequate eating habits and nutrient intake. The survey found that students who were more physically active, who didn't smoke or drink alcohol, had more adequate eating habits.

To our knowledge, there are no studies among Croatian students focusing exclusively on body satisfaction. There is lack of research on the relation between physical activity and body satisfaction. This research aims at: 1. determining the degree of students' physical activity, 2. examining students' personal body satisfaction, as well as their satisfaction with life in general, 3. looking at the way students compare themselves with top models, 4. determining whether there is a significant, statistically-backed, difference between body satisfaction and physical activity, 5. determining whether there

is a significant, statistically-backed, difference between body satisfaction and the need to take a large quantity of food during a single meal, 6. examining the emotions students experience when comparing themselves with top models.

Methods

The research was conducted on a sample of 368 female students of the University of Zagreb aged 18-20. They were given an anonymous 30-item questionnaire on their physical activities and self-assessment of body satisfaction and satisfaction with themselves in general. The questionnaire was divided in several subscales: physical activity (2 variables), satisfaction with certain body parts (14 variables), weight issues (5 variables), comparing oneself with top models (6 variables), satisfaction with one's life (1 variable), and demographic variable (2 variables). The research was conducted in the year 2006/07, within physical education classes among first and second year female students.

The data were processed by descriptive analysis and the analysis of proportion (%). Differences in answers to particular questions were tested using the $\chi 2$ test for each variable. Program package STATISTICA 7.1 and Microsoft Excel were used.

Results

Previous studies suggest that internalized self-image, as a personal view of ideal beauty, is the source of body dissatisfaction, which consequentially makes many young women use some restrictive diet methods (Levine, Smolak, 1996, Strigel-Moore, 1986, according to Krones *et al* 2005).

Table 1. Frequency and percentage related to the answers on body satisfaction

How satisfied are you with particular parts of your body?										
Category	Completely dissatisfied		Mostly dissatisfied		Neither satisfied, nor dissatisfied		Mostly satisfied		Completely satisfied	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Hair	4	1,08	17	4,61	42	11,41	191	**51,90**	114	30,97
Eyes	3	0,81	4	1,08	13	3,53	95	25,81	253	**68,75**
Ears	10	2,71	11	2,98	38	10,32	92	25,00	217	**58,96**
Nose	12	3,96	33	8,96	74	20,10	125	**33,96**	124	33,69
Mouth	3	0,81	11	2,98	44	11,95	145	39,40	165	**44,83**
Teeth	7	1,90	51	13,85	80	21,73	137	**37,22**	93	25,27
Voice	6	1,63	12	3,26	79	21,46	123	33,42	148	**40,21**
Bosom	8	2,17	42	11,41	89	24,18	130	35,32	99	26,90
Abdomen	29	7,88	88	23,91	95	25,81	107	29,07	49	13,31
Hips	22	5,97	46	12,50	88	23,91	135	36,68	77	20,92
Thighs	34	9,32	70	19,02	86	23,36	122	33,15	56	15,21
Bottom	21	5,07	63	17,11	77	20,92	131	35,59	76	20,65
Knees	20	5,43	28	7,60	94	25,54	137	37,22	89	24,18
Legs	22	5,97	49	13,31	82	22,28	136	36,95	79	21,46

Students reported being "mostly" or "completely satisfied" with different parts of their body. They are most satisfied with eyes, hair, and ears. It is interesting that 20-25% indicated being "neither satisfied, nor dissatisfied" with some parts of their body, such as bosom, abdomen, hips, thighs, bottom, knees, and legs. 20-30% students reported being "partly" or "completely dissatisfied" with their abdomen, thighs, and bottom.

Table 2. Resusts related to phyicisal activity during the month before the study

How often did you engage in some sports or recreational activity **over the last 30 days**?			
		F	**%**
1.	Not once	44	11,95
2.	2-5 times	198	53,80
3.	6-12 times	68	18,47
4.	13-20 times	30	8,15
5.	21-28 times	13	3,53
6.	Every day	15	4,07
TOTAL		**368**	**100%**

Table 3. Results related to physical activity per week

How often did you engage in sports or recreational activity lasting for at least 30 minutes **over the last 7 days**?			
		F	**%**
1.	Not once	58	15,76
2.	One day	140	38,04
3.	Two days	87	23,64
4.	Three days	45	12,22
5.	Four days	21	5,70
6.	Five or more days	17	4,61
TOTAL		**368**	**100%**

Tables 2 and 3 show the levels of students' physical activity during the month and the week prior to the study. The results revealed that over those 30 days only 4,07% of the students exercised regularly, while 38,04% of the them exercised only once over the 7 days. More than half of them did some exercises 2-5 times during the last 30 days. These results suggest that female students of the University of Zagreb were not sufficiently physically active, which could result in certain health problems in the future.

Comparison of the variable related to students' satisfaction with a particular part of their body with that related to their physical activity shows that there are some statistically significant differences when it comes to the lower body parts: satisfaction with the thighs compared to the physical activity over the last 7 days (χ^2 37,5320, df=20, p=0,010106), and satisfaction with the bottom compared to the physical activity over the last 7 days (χ^2 31,4266, df=20, p=0,49830).

It didn't come as a surprise that female students were more sensitive to and critical of these body parts since they are characteristic of a typically female body shape. Students with lower level of physical activity reported being more dissatisfied with these body parts, which is again not surprising since physical activity has a key role in shaping these parts.

Some studies (Cooley, Toray, 2001, Stice 2003, Krones 2005) emphasize that strong body dissatisfaction among girls is an important precondition for bulimia. As regards Croatian female students, 55,43% of them reported having the need to take large quantity of food during a single meal occasionally, while 9,78% of the students reported having the same need often or very often. The analysis of the satisfaction with a particular body part and the need to take large quantity of food during a single meal revealed there was significant difference between the satisfaction with thighs and the need to take large quantity of food during a single meal (χ^2 25,8688, df=16, p=0,055924, significant level 5,6%), and that between the satisfaction with the bottom and the need to take large quantity of food during a single meal (χ^2 25,9128, df=16, p=0,055289, significant level 5,5%), which again indicates students' dissatisfaction with the lower part of their body. In other variables there was no statistically significant difference.

Social comparison is a process in which our personal characteristics are put into relation with others (Stice, 2003). When we compare ourselves with others, sociocultural pressure affects general emphasis on our agreeable appearance and distorts our positive body image.

Most studies support the theory according to which sociocultural pressure of the internalized self-image "feeds" body dissatisfaction and contributes to eating disorder. Prospective studies have found that female adolescents who are trying to achieve the current media ideal for women become more focused on their weight than their peers (Krones *et al* 2005). Experimental studies have revealed that women who are exposed to images of ultra-thin models experience various negative emotions, including depression, stress, guilt, shame, insecurity, and body dissatisfaction (Heinberg, Thompson, 1995, Irving, 1990, Stice, Shaw, 1994, Groesz 2002, according to Cash 2004). This prompted us to examine the emotions Croatian female students experience while comparing themselves with top models.

As shown in table 4, most of the students claimed they were not burdened by the looks of top models. Still, it is worth mentioning that some students confirmed they did experience emotions such as discomfort (30,70%), insecurity (30,16%), depression (29,34%), guilt (11,95%), and shame (10,86%).

It is alarming that some students feel depressed due to both, body dissatisfaction (8,96%), and insecurity (6,79%).

Table 4.

	never	sometimes	often	always
The need to take large quantity of food during a single meal	34,78%	55,43%	7,88%	1,90%

Feelings resulting from comparison with top models	completely incorrect	partly correct	completely correct
discomfort	65,76%	30,70%	3,53%
shame	86,14%	10,86%	2,98%
guilt	84,51%	11,95%	3,53%
insecurity	63,04%	30,16%	6,79%
depression	61,68%	29,34%	8,96%
stress	87,22%	9,78%	2,98%

	completely dissatisfied	partly dissatisfied	neither satisfied, nor dissatisfied	partly satisfied	completely satisfied
life satisfaction	1,08%	7,60%	12,77%	47,28%	31,25%

Results have revealed an alarming inclination of students who are particularly dissatisfied with their body to experiencing negative emotions and to developing eating disorders, as well as other disorders that have negative effect on their health. This inclination could be explained in terms of longitudinal studies which have found that body dissatisfaction, as well as general feeling of dissatisfaction, predicts future increase in depression symptoms (Cole, Martin, Peeke, Serozynski, Hofman, 1998, Stice 2003), as well as the beginning stage of depression (Rierdan, Koff, Stubbs, 1989, Stice, Hayward, Cameron, Killen, Taylor, 2000, according to Thome and Espelage, 2004).

Conclusion

The results of this research have revealed that some students feel dissatisfied with a particular part of their body, especially with abdomen, hips, thighs, and bottom. These body parts are also the ones that are most susceptible to fat accumulation, especially among the students who are not physically active or have the need to take large quantity of food during a single meal. It is exactly the unhealthy lifestyle (moderate kinesiological activities on daily basis, lack of healthy diet or meal planning) that makes some students feel dissatisfied, while their personal aesthetic criteria on body dissatisfaction is the source of their dissatisfaction, inducing various negative emotions (insecurity, discomfort, guilt, and depression). The results of this study are in accordance with the results of previous studies conducted among female students. The study points to the importance of introducing educative measures within the education system with the purpose of providing information on healthy lifestyle and preventing negative consequences of the "efficient" (unhealthy) diet methods presented through the media. The educative measures would also help identify the factors which contribute to body dissatisfaction, as well as the feeling of general dissatisfaction. Attention should be paid to social values which favor differences and individual advantages, rather than stereotypes and imposed styles. One's sense of self-worth includes all personality factors, along with aesthetic ones, which should present an advantage, thus contributing to the feeling of emotional satisfaction. This is largely the responsibility of the media, which often present questionable values and standards of life.

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THE FUNCTION OF QI GONG AND ITS RELATIONSHIP WITH GYMNASTICS AND SPORT IN HEALTH PROMOTION

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Abstract

The main purpose of Qi Gong is to reproduce and reformulate those patterns which, through body exercises, postures and different forms of movement enable to regain an instinctive reactivity obtaining the rebalance of the vital energy, activating the single energetic and psychic, material and mechanic components. The big differences existing between the western and eastern societies reflect the single countries' cultures, which have developed starting from very different historical background. They tackle different issues, but the purpose is the same: man's health (Maciocia, 1996). One of the main differences is the way human being is examined; the Chinese way, different form the western one, always takes into account the person as a whole and is a less palpable way, which means that it is not based on quantitative data which can be precisely measured, but on general concepts and empirical observations. The study of the movement, too, analyzed in connection with education and sport issues, is affected by such a distance between psychological and somatic concepts, and is not easy to imagine it as an integrated phenomenon, even though it probably represents one of the best exemplification of the wholeness which is characteristic of the human being.

Key words: *Qi Gong, health, dialectic culture, education, sport, chinese gymnastic*

Introduction

Chinese traditional philosophy dates back to 5000 years ago its history is recorded in classical books which include both theoretical and practical aspects, and been translated, revisited and popularized all over the world. Such books represent the basic corpus to which we still refer today to understand all the different branches of this field: "Huangdi Neijing, IV century b.C. is divided in two parts: Su Wen and Ling Shu; Nan Jing, III century b.C.; Shennong Bencao Jing I century A.D.; Shang Han Za Bin Lun, I century A.D." Besides, we also must take into account the tradition related to the teaching of the physician Hua Tuo; he did not leave any written account, but his teaching has been transmitted through several records. One of the most interesting record related to the origins of the gymnastics for health, Qi gong, is a silk roll made of three texts and a plate. Such table called Daoyin tu represents women and men while doing Qi Gong exercises in the same postures still used today. The spreading and the application of the theories has been very slow, since there was the tendency to hand down one's knowledge from father to son, so the spreading and the transmission of such a knowledge was very limited and it caused a sparse knowledge of such theories. We must include in the Chinese tradition a very rich practical experience achieved during the years, from which the efficiency of methodology derives. The most famous branches in the world which better express the criteria of the philosophy considering the man's health as the main purpose are: Acupuncture, Qigong and Taijiquan (gymnastic – meditation), Tuina-Anmo (Chinese massage), chinese phytoterapy and special diets. "The main features of Chinese philosophy are to be found in the dialectical method, in the organicistic concept of the human being and the world, as well as in the relationships between human being and the nature. This is the main difference between the eastern and western world way of thinking" (Yan Chong Wen, 2001).

The tradition

The traditional theory is deeply rooted in the philosophical bases of Naturalism which in China, since the ancient times, are expressed in a dialectical conception of reality as well as in the philosophy of wu wei. The general view of nature has built on during the time, assuming the form of Yin Yang and of the five natural elements (Water, Fire, Earth, Metal and Wood).

The position of man in the natural world is then interpreted on the base of a system of dialectical relationships between the five elements constituting the natural world and the five main organs of human body: the five Zangfu, as well as the energetic channels system (or Meridians Jingluo). The organicistic view, which is typical of the Chinese thought, is well expressed in two distinctive traits of this philosophy: the unitary view (holistic) of human body phenomena and the approach to pathological systems; such systems are grouped in a system of groups which are apparently not homogeneous and not collateral, but they are actually controlled by a dialectical and not mechanicistic definition of their causes and interrelationships.

The unitary and systemic view of the body and its organic apparatus enabled to work out an interactive interpretation of the life phenomenon, as well as its endless transformation and movement, giving it a rational and systemic nature.

The correspondence between human body and nature can represent the explanation of the state of health or illness. (Maciocia, 1996).

West and East

The Human being is settled in the natural world through a system of mutual relationships and influences which are organized according two specific fields:

- The relation between the human body and the five elements or elements constituting the natural world (water, fire, wood, earth, metal);
- The explanation of human life phenomena according the two opposite aspects internal/external and their mutual relationships (Su Wen, 1993).

Trough the application of the above mentioned theories the Chinese science has acquired the ability to interpret in a systematic way the phenomenon of life from an unitary point of view. The body is seen as a living organism, which is constantly changing, and its physiological changes explanation are rationally connected to changes occurring in the environment he lives in. Besides, the body learns how to respect the laws of the nature and how to benefit from it, without trying to control and subjugate it (just the reverse of the modern Western science) (Maciocia, 1996). In particular, assessing the condition of an organism always represents a process of interpretation of the symptoms which manifest through the historical and contextual investigation of the person; such investigation is carried out applying a dialectical methodology, a methodology which in charge of understanding the complexity of life phenomenon; man's health is one of these phenomena.

The western culture observes the body through a dualistic view of the human being, so, what is previously split is then difficult to put together. In fact, although we often try to put together the body and the psyche, "…no psychosomatic medicine could arrange the threads of two weaves made of such two different woofs and to put together what had been thought as separated at its beginning" (Sotte-Pippa, 2001).

The innovations

The future view of the research of health will have to satisfy needs emerging from the developing of the modern society and the new life styles.

The life rhythm is getting faster and the ante is higher and higher. The consequences of a man's nought are more and more dramatic, people's careers go forward and backward more rapidly than in the past, the psycho-physical breakdown has often severe consequences and it is starting appearing in younger and younger people. Therefore, great attention is paid to all the methods which can promote a general health condition, necessary to have higher possibilities of success (Garratt T., 2004).

On subject, in the West different theories, such as some psychological theories have been investigated and applied too (NPL) (Bandler R. - Grinder J., 2004). Great attention was paid to nutrition and to some techniques useful for physical and mental recovery (meditation), in order to improve the condition of attention and participation of a person. They have a positive outcome in the field of education and/or to optimize the sport and work performances. It is then necessary to understand the relation between the organic and the somatic difficulties, the psychological sphere and the social issues. In this sense the progress should occur mostly in a context of integration between the genetic, somatic and environmental aspects of such issue.

Since the ancient times, the Chinese employed some techniques to reach the health state which were perfectly integrated with the unitary vision of the human being: "The corporeity is the Yin expression (material) of the mental Yang, the harmony of the body movement represents the expression of a correct balance, which is to say that turning away from such unity is the first sign of a man's disease". (Sotte L., Pippa L., 2001).

Qi Gong and Taijiquan have the basic purpose to reproduce and reformulate the models that through body exercises, postures and forms imitating animals and atmospheric agents, enable to regain an instinctive reactivity by achieving the single energetic and psychic, material and mechanical components.

From an historical point of view, four different models of medicine have developed, and in such models Qi Gong can have an important function.

1. Therapeutic Medicine. In fact, Qi Gong promotes the principle with which for the first time we deal with the treatment of a disease. The exercises of such method support the recovery of the deficient body functions, help to obtain the balance that, in turn, promotes the improving of our energy circulation; The faster our energy goes, the less we can be attacked by the outside forces. Qi must flow along the channels following their right course. Our physiological Qi is called Zheng Qi. When an internal or external excess, a pathogenic energy attack, an imbalance or a deficiency

disturb the body our Qi cannot flow regularly, but it will turn aside and change its speed; in other words Qigong is the way to help Qi flowing regularly and more rapidly, causing an improvement of our immune defence system.

2. Preventive medicine. It consists of a constant observation of one's psycho-physical condition so to be able to intervene by activating circulation of Qi when the first signs of imbalance appear: this is a particular attention one gives to one's lifestyle so to avoid to get ill.
3. Rehabilitative Medicine. It is intended not only to heal disease through Qi, but also to recover a fine form after convalescence.
4. Mind Medicine. The aim is to activate consciously all our resources.

Our organism, seen as an organic whole, which includes all these elements, needs a corresponding whole of practices and "gymnastics" which can stimulate and control the physical (body and breath), mental, energetic and spiritual health.

In the West the hiatus psiche-soma attributes to the left cerebral hemisphere the understanding of the conscious organization, which is mechanical and scientific, and of the motion, while it attributes to the right hemisphere the aesthetic, artistic perception ability of the same phenomenon.

"In the East the correct practice of a Qi Gong exercise corresponds to the beauty of the gestures of such exercises, thus activating the so called internal unions: the Hearth Xin and the Idea/Thought Yi, the Idea YI and the Energy Qi and, finally, the Energy Qi and the Strenght Li.

When we learn a movement we experiment different phases: the hearth, prince of Psychism, generates the idea of movement (first union); the idea of movement generates Energy (second union); the Energy translates into Strenght, which materializes through the final act. The movement generated (third union) will be the result f the perfect expression of the psychosomatic integration, and for this reason it will have to be aesthetically beautiful" (Sotte L., Pippa L.,2001).

Considering this eastern world view, our scientific approach means to deepen those theories which, if applied daily, can promote an health condition so to improve the cognitive and performance conditions of the person. In such a sense Qi Gong can be intended in the service of education and sport, too.

"Qi Gong has some movement sequences which have the purpose to open the orifices of cephalic region (eye, nose, mouth-tongue, ear), some important acupoints directly or indirectly connected with the inner part of the body; through these points is possible to reactivate the balancing of the corresponding internal organs according to the Chinese medicine" (Sotte-Pippa, 2001). Planning a methodology which can improve the energetic activities of the senses means to create the conditions to achieve a health state, which is useful to strengthen the use of body multisensoriality (Gamelli, 2001) in order to support the training processes of the students.

So, is licit to reflect on the possibility that Qi Gong can nourish the improvement of the cognitive skills of the subject. In fact, some authors think that the use of the senses alternative to the school traditional canonicity can be an emotionally involving information gathering modality, which is the essential condition for a forced learning and memorizing process. (Le Doux, 2002). Therefore, through the exercises aiming at the person's energetic rebalancing, together with the meeting, the exchange, the relation with other particularly stimulating training contexts which are different from corporeal point of view, the student learns how to enhance the learning itself and feels a sense of gratification for the building of the knowledge and of its skills. In the same way the athlete, through the integration of the medical gymnastics can physically recover that harmony with the nature balance, that "enable us to achieve that internal silence which harmonize ourselves with the cosmos/universe" (Sotte-Pippa, 2001).

The author states that, by activating the functions of muscles, tendons, joints of the whole body and marrow (brain and spinal marrow in T.C.M.) and the energy circulation within the primary and secondary channels, the blood and body fluids circulation is promoted, too; besides, all the structures of locomotor system get stronger and more flexible, so the blood production and the immune system are stimulated, too. Through the brain, the hypophysis and the spinal marrow there is also an action on the psycho-neuro-immune-endocrine system, through the mental visualization of movements the Shen, the mental aspect become more peaceful and more stable. Finally, everyone will have to optimize this silence in order to realize one's truth.

Conclusions

The western sport was born, since the first games in Olimpia, together with the concept of competitiveness: the contest with an "enemy" to bat seems the sine qua non category of the sport practice, and it gets more evident in team sports.

Competitiveness of the contenders generated the funs' shouting, and they have become now a social category which, for better or for worse makes the stadium coloured and lively, as well as the Monday morning discussions. In this field the Chinese gymnastics are different, too, and western people wander about some issues. It is true that some of these gymnastics are considered a part of martial arts (e.g. Gongfu) or personal defense tecniques, therefore they include the aspect of competitiveness, while other gymnastics such as Qigong and Taiji, not only did not generate in an competitive

fields, but they never, during their long evolution have considered the concept of a contest with a contender. We could say that they fight against only one contender: ourselves and our energy balance. The competitive part of a Qigong exercise consists of overcoming our weaknesses, to harmonize our disharmony and to tune the coherence of our mental and physical manifestation in the Unity of the Body" (Sotte-Pippa, 2001).

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RELATIONSHIP BETWEEN EXERCISE FREQUENCY AND SELF-PERCEIVED MENTAL HEALTH

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Abstract

Authorities in interdisciplinary fields agree that physical activity is an important element of a healthy life-style. Therefore, the aim of our study was to examine the relationship between exercise frequency and self-perceived mental health. An additional aim was to determine the reliability of exercise frequency scale and mental health summary score. The results showed that, compared with their inactive counterparts, people who exercise three and more times per week reported higher levels of self-perceived mental health.

Key words: *physical activity, psychological well-being, population-based study, SF-36, Croatian population*

Introduction

If exercise could be packed into a pill, it would be the single most widely prescribed and beneficial medicine (Hales, 2005). Authorities in interdisciplinary fields agree that physical activity is an important element of a healthy life-style. The positive role of physical exercise in the prevention and treatment of a range of medical conditions has recived a great deal of attention over the recent years. A large body of research shows that regular exercise provides a long term protection against obesity (Hill & Wyatt, 2005), coronary heart disease (Berlin & Colditz, 1990), diabetes (Eriksson & Lindgarde, 1991), osteoporosis (Ernest, 1989), and even malignant diseases (Colditz et al., 1997).

Although it has been shown that physical activity can indirectly improve subjective well-being and life quality by reducing the risk for different deseases (Fox, 1999), the direct relationship between exercise and aspects of mental health has only recently become the subject of extensive research. Unfortunalely, while the relationship between exercise and physical health is well documented, there is not so much evidence on the relation between exercise and psychological well-being (Scully et al., 1998). One of the greatest psychosocial benefits of physical activity is its effect in the prevention and treatment of depression and anxiety. According to Dishman et al. (2004), about 30 population-based studies on exercise and depression have been conducted around the world since the first one in 1988. Nearly all of them showed that people who report little or no leisure time physical activity are more prone to symptoms of depression, but about half of the results were not significant. A critical review (Scully et all., 1998) has shown that regardless of the type of exercise or anxiety measures included, there is a constant association between exercise and anxiety reduction. Besides individuals with clinically diagnosed mental illness, there are many individuals who suffer from low self-esteem, emotional distress, lethargy, sense of hopelessness, and irritability or chronic stress. These symptoms reflect low levels of self-perceived mental health and often have a significant role in a variety of personal problems and risk behaviors.

Qualitative research has shown that people involved in exercise programs associate exercise with psychosocial benefits, such as relaxation, increased social contact, promotion of self care, and self esteem (Smith et al., 1996). On the other hand, because of inconsistent procedural methods and different psychological functions evaluated across studies, reviews of quantitative studies often do not reach a final conclousion. This especially refers to practical recommendations on how exercising could be used in order to reduce particular symptoms or wich type of exercising is most helpful in diferent circumstances. Consequently, the literature still remains inconclusive with regard to the relationship between physical exercise and general mental health (Scully, et al., 1998). Although some studies provide evidence for an association between exercise and mental health (for review, see Biddle, 2000), the complexity of the field requires additional investigations about description, as well as prescription of exercise in relation to mental health.

Therefore, the aim of our population-based study was to examine the relationship between exercise frequency and self-percived mental health. An additional aim was to determine the reliability of exercise frequency scale and mental health summary score.

Methods

This population-based study was conducted in November, 2007 on a random sample of Croatian inhabitants aged 15 years or more who live in private households. The sample did not include people who live in institutions (hospitals,

nursing homes, etc.), Croatian citizens living abroad, and foreign citizens living in Croatia. The latest official Croatian Census (2001) was used as a data-base for the selection of participants. The survey was conducted on a total of 1,032 individuals (51.6% women and 48.4% men). Study results were representative of the regional, sex, and age structure of Croatian adult population. All participants had given their written consent for participating in the research before they were interviewed.

The Croatian version of the SF-36 survey (Maslić Seršić and Vuletić, 2005) and additional questions about exercise frequency were administered in face-to-face interviews conducted by trained interviewers. The SF-36 is a multi-purpose, short-form health survey with 36 questions. It represents a theoretically based (Ware et al., 1993) and empirically verified operationalization (Ware and Gandek, 1998) of two general health concepts – physical and psychological. It yields an 8-scale profile of functional health, well-being scores, as well as psychometrically based physical and mental health summary measures (Ware, 2008). For the purpose of this study, mental health summary measure was used. Mental health summary measure encompasses four scales (vitality, social functioning, role-emotional, and mental health). An extremely low result on this summary measure suggests a considerable amount of psychological pain and distress and indicates the presence of psychological problems which impair normal social functioning. On the other hand, a high result indicates a positive emotional state, characterized by a strong feeling of happiness and life-satisfaction. A person with a high result on this summary measure has no emotional impairments in social functioning. Three point scale was used to assess exercise frequency (I never exercise; I exercise 1-2 times per week; I exercise 3 or more times per week).

The reliability of the variables was determined by test-retest method with a 30-day window between the first and the last measurement on a random sample of 122 Croatian inhabitants. Pearson correlation coefficient and corresponding confidence interval were calculated to estimate the reliability of mental health summary score. The observed proportion of agreement and corresponding confidence interval were used to estimate the reliability of exercise frequency scale. Relative frequency and descriptive parameters (mean, standard deviation, minimum, maximum, skewness, and kurtosis) were calculated for each exercise frequency group.

In order to determine the differences between the groups in the relation between exercise and self-perceived mental health, ANOVA and Sheffé's post-hoc test were performed. Statistical analyses were performed by STATISTICA 7.1 (StatSoft, Inc. 2005).

Results

Reliability of summary mental score was 0.71 with 95% confidence interval from 0.62 to 0.79. The observed proportion of agreement for three-point exercise frequency scale was 0.79 with 95% confidence interval from 0.68 to 0.87.

Table 1. Relative frequencies and descriptive statistics of self perceived mental health for exercise frequency groups

	rf (%)	Mean	Std.Dev.	Skewnes	Kurtosis
0	59.15	49.40	9.28	-0.73	0.73
1-2	25.30	50.36	9.38	-1.16	1.84
3 or more	15.55	52.45	8.72	-0.92	1.30
Overall	100.00	50.04	9.20	-0.84	1.02

According to the frequency of exercise, the participants were divided into three groups. (Table 1). The highest proportion of participants reported that they did not exercise at all (59%), followed by those who exercised at least one to two times per week (25%), while the lowest proportion exercised 3 or more times per week (16%).

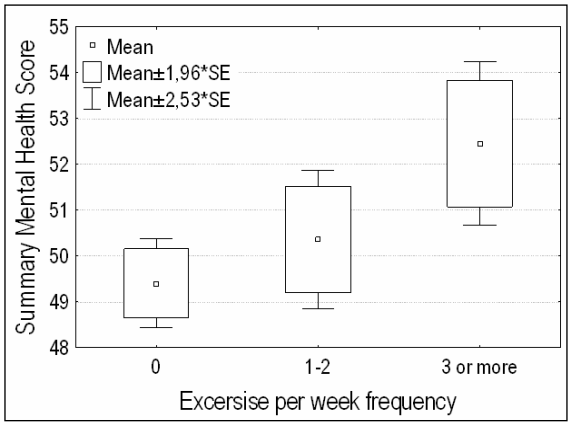

Figure1. Differences between exercise frequency groups in summary mental health score - Box-Whisker plot

Table 2. Differences between exercise frequency groups in summary mental health score - Analysis of variance and Sheffe post-hoc test results

ANOVA				Scheffé's test	
df Effect	df Error	F	p	groups	p
2	981	6.74	0.00	0 vs. 1-2	0.39
				1-2 vs. 3 or more	0.09
				0 vs. 3 or more	0.00

The ANOVA showed a significant diference between exercise frequency groups ($p<0.01$). Furthermore, Sheffé's test revealed significantly higher mean of self perceived mental health for participants exercising 3 or more times per week, compared with participants who do not exercise at all (52.45 vs. 49.40).

Discusion and conclusion

Regular physical exercise has been characterized as a form of positive health behaviour, having both physiological and psychological benefits. Our results showed an increase in self-perceived mental health with an increased frequency of exercise, with persons who exercise three or more times per week reporting significantly better self-perceived health than persons who do not exercise.

These findings are in accordance with the findings of other studies which suggest that individuals who exercise at least two to three times a week experienced significantly less depression, anger, cynical distrust, and stress than those exercising less frequently or not at all (Hassmén et al., 2000). Despite numerous warnings on negative effects of sedentary life-style, the prevalence of inactivity is very high. We showed that 16 % of participants exercised three times per week, 25 % exercised 1-2 times, and 59 % did not exercise at all. These data, especially since they are obtained on a representative sample, point to the need of a greater promotion of physical activity within the framework of national health-promotion strategies.

There have been several hypotheses explaining how exercise improves general mental health. Mediators underlying this association can be classified into two broad categories – physiological and psychological factors. One of the proposed mechanisms for the antidepressant effect of exercise is that higher levels of endorphin following exercise produce improvements in mood (Dishman et al., 2004). According to monoamine hypothesis, acute exercise results in increased release of norepinephrine, dopamine, and serotonin in the brain and elevation of level of these neurotransmitors is also provoked by drugs in antidepresion drug therapy (Chaouloff, 1989). Furthermore, it has also been suggested that increased body core temperature during acute exercise leads to increased relaxation and better mood state (Fox, 1999). Other studies have showed that increase in cerebral blood flow, reduction in muscle tension, and increase in maximal oxygen consumption and delivery of oxygen to cerebral tissues may also account for the positive effect of exercise on psychological well-being (Weinberg and Gould, 2007). Also, since insomnia is related to many quality-of-life impairments (Zammit, at al., 1999), the observed improvement in the quality of sleep following daylight exercise may in part account for the positive mental health effects of exercise (Stathopoulou at al., 2006).

Psychological studies have hypothesized the following mediators between exercise and mental health: feelings of competency and self-efficacy, self-concept and self-esteem, the interruption of negative thoughts, positive social interactions, and opportunities for fun and enjoyment. Fox (1999) stated that regular exercise can foster perceptions of competence and self-efficacy or confidence about one's body and its capabilities, which affects overall self-esteem and other elements of well-being. Exercise can also distract attention from anxiety-provoking thoughts and provide a time-out from cares and worries (Bahrke and Morgan 1978). The social interaction through sport participation can provide social support for improving self-esteem and life satisfaction (Fox, 1999). Sports activities were found to stimulate the process of socialization in children and adolescents (Vikjalmsson and Thorlindsson, 1992), and increase mobility and independence in elderly people (Fox, 1999). However, none of the mentioned theories or hypotheses offers a complete explanation of this complex relationship. In fact, it seems that positive changes in psychological well being are a result of interaction of all the described mechanisms (Scully et al., 1998). At the moment, there is still a lack of empirical data on the optimal dose (activity type, frequency, intensity and duration) of exercise and possible relation between exercise and psychosocial outcomes. According to our results, benefits of exercise on mental health can be obtained by exercising three or more times per week.

To conclude, a significantly better self-perceived mental health was found in participants who exercise three and more time per week, as opposed to inactive participants. The cross-sectional design of this study prevents us from drawing any definite causal inferences, so the obtained results certainly require further research.

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THE ANALYSIS OF SKIER'S ACTIVITIES DURING THEIR FREE TIME

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Abstract

The elite skiers spend about 250 days on snow, so it is interesting to find out what are their occupations during active vacation when they come home. Thus, the aim of this research is to determine how top class skiers spend their free time and what they hobbies are. The sample consist 40 man and 34 woman skiers who were participants of World cup during their career. The variables were age, profession, knowledge of foreign language, sport activities and hobbies. The obtained data were analyzed by Statistic for Windows 7.0. using "Descriptive statistic" and "Frequency tables". From obtained results it can be concluded that for the most skiers a professional job is skiing. The majority knows some foreign languages. The most attractive sports activities are indoor sports with ball (tennis, soccer, volleyball) and sports on open air, in nature (golf, cycling, hiking, motor cross). A free time they use for listening music, reading books and going to cinema.

Key words: *alpine skiing, active vacation, hobbies*

Introduction

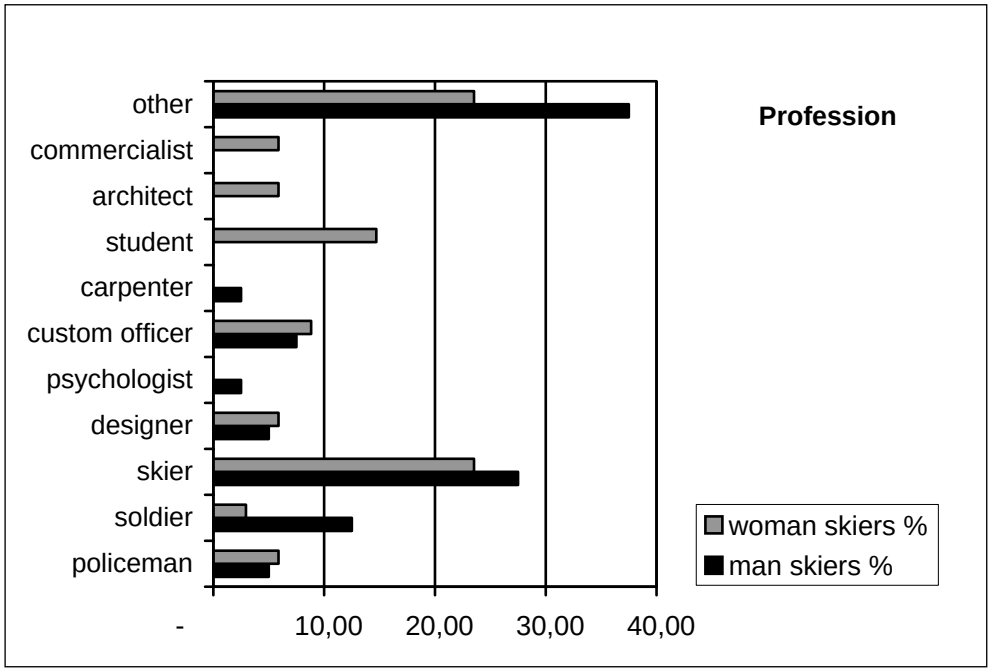
A modern way of skiing demands from elite skiers commitment to every day extensive training and maximal physicals and mental effort. Also, demand giving up from every day life situation. Skiing is sport which is executing in specific terms, in the mountains on snow and coldness, far away from big cities. During whole year, for the period of competition which last from December to April, and for the training period, skiers are forced to spend the most of their time far away from home. Usually they are situated in small villages in the mountains which are surrounded with beautiful nature but without sport centers, social-cultural and fun contents…So, the question is how elite skiers, even they do not have too much time and space for pleasure, succeed to make up their needs for fun and friendship. The elite skiers spend about 250 days on snow, so it is interesting to find out what are their occupations during active vacation when they come home. Therefore, the aim of this research is to determine how top class skiers spend their free time and what they hobbies are.

Methods

The representative sample of this study was 40 man and 34 woman elite skiers from all parts of the world who were participants of World cup during their career. The ages of subjects were from 24 to 38 for man population and from 21 to 34 for woman population. The variables included in this analysis were age, profession, knowledge of foreign language, sport activities and hobbies (Štihec, Strel, 1998). All data were collected from skier's bibliographies which were announced on official Internet sites of Eurosport (www.Eurosport.com) (Čepulenas, 2007). The obtained data were analyzed by *Statistic for Windows 7.0.* For the needs of this investigation a "Descriptive statistic" and "Frequency tables" was used (Jurakić, Andrijašević, 2005).

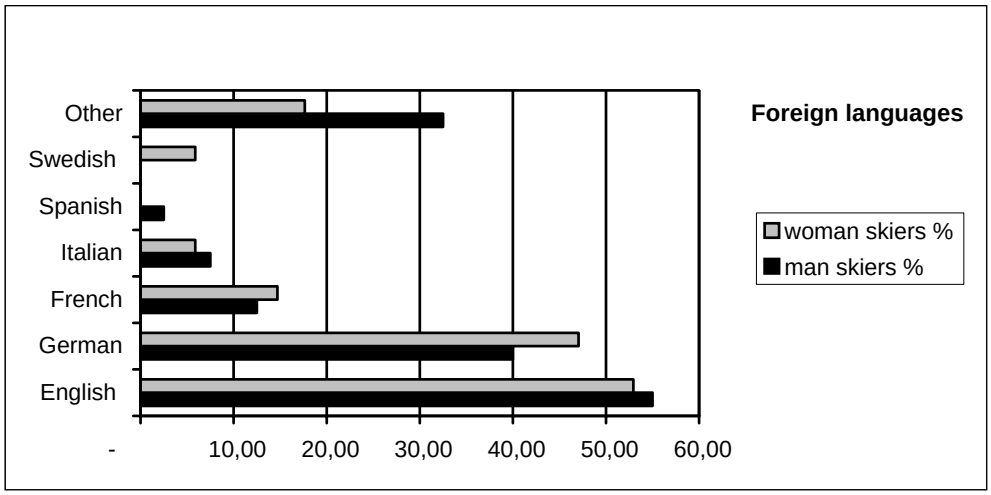
Results

From the answers on the questions how elite skiers spend their free time, what are they hobbies, which is their profession and did they speak some foreign languages, some interesting results were obtained. From graph 1. it can bee seen that for the most man subjects the skiing is a professional job, then follows jobs such as soldier and customs officer. The woman subjects are also mostly a professional skier. On second place is customs officer, and then follows designer, architect and commercialist while many of them were still students.



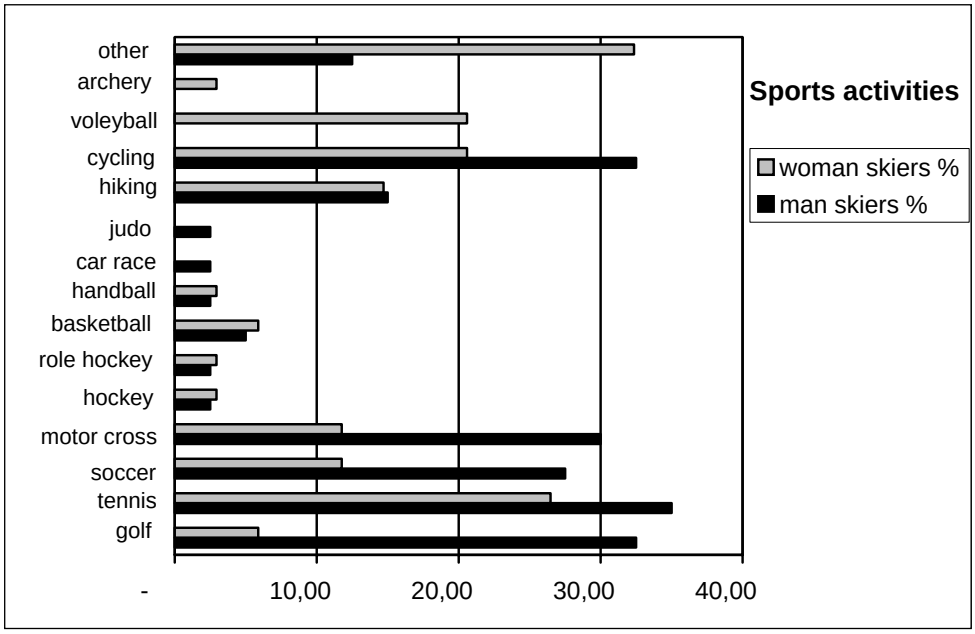
Graph 1. Professionl occupation of elite man and woman skiers

From graph 2. it is obvious that the majority of a man and woman skiers know English and German languages. Other languages which are also well known are Italian and French.



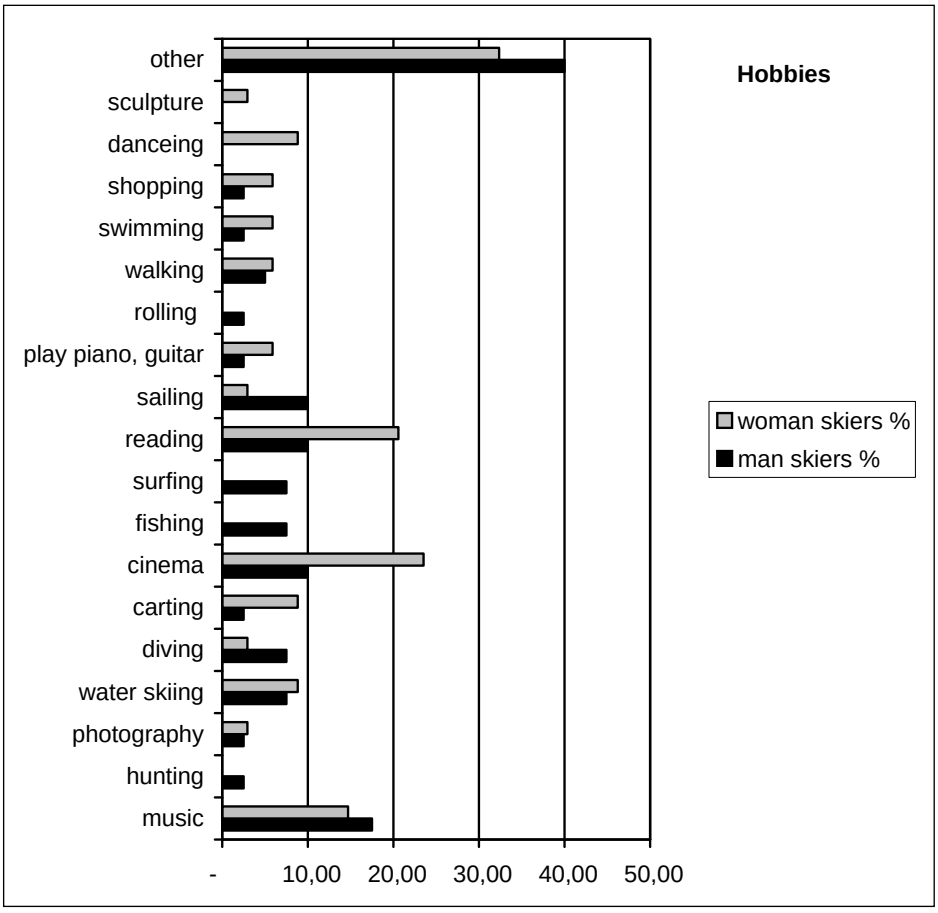
Graph 2. The knowledge of foreign languages of elite man and woman skiers

In graph 3. are presented the most attractive sports activities that elite skiers do at the time when they are not on snow. From obtained data it can be concluded that man skiers mostly pick tennis, cycling, golf, motor cross and soccer for sports activities, while woman skiers prefer tennis and then follows volleyball, cycling and hiking.



Graph 3. Sports activities of elite man and women skiers during their free time

The answers on the question what are the hobbies of elite skiers are shown in graph 4. On the base of collected data it can be seen that man skiers like the most listening a music, reading and going to cinema, but many of them also like activities on water such as sailing, surfing, fishing, diving and water skiing. A woman skiers also like go to cinema, reading and listening music, but for a different of man skiers they as well prefer water skiing, carting, dancing, playing piano or guitar and shopping.



Graph 4. The hobbies of elite man and woman skiers

Discussion and conclusion

From results obtained in this research it can be concluded that for the most of a top class man and woman skiers skiing is a professional occupation. That is understandable because skiing is sport which is executing in specific terms, far away from schools and colleges, so many of them are not in position to educate for some different profession and skiing is their life. Also, the majority of subjects are still active competitors so some other occupations are not priority for them. Further, skiing is sport whose competitions are executing in various parts of the world and in many different countries so it is explainable that subjects knows some foreign languages. From sports activities, that elite skiers like to choose for pleasure when they are not on snow, the most attractive are indoor sports with ball (tennis, soccer, volleyball) and sports on open air, in nature (golf, cycling). That can be explained with possibilities to enjoy in those sports in cities with sports centers and also with needs to do something witch is not connected with skiing. It is interesting to conclude that many of subjects like extremes sports such as hiking, motor cross, carting. The reasons for that can be related with skiing and missing of challenges during active vacation. At the end, it can be said that man and woman skiers like to use their free time for a good rest and enjoy in music, reading and going to cinema. That is also understandable because after a hard period of training and competitions everybody need a rest to gather energy for achieving new goals.

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PHYSICAL ACTIVITY PREFERENCES IN CROATIA

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Abstract

Assessing physical activity preferences (PA) is one of important steps in developing interventions for the promotion of PA. The main goal of this study was to assess PA preferences in the Croatian population. The second goal was to determine gender differences in PA preferences. The study was conducted on a random sample of 1,032 participants. In order to estimate PA preferences, the IZSRP-2007 was used. In order to determine gender differences in preferences, means and standard deviations were calculated and Student's t-test was performed for each activity. The most preferred activities in women were Walking, Swimming, and Dance; and Team sports, Swimming, and Fitness (weight training) in men. Significant gender differences were observed for the majority of activities. Results of this study could be valuable for researches interested in developing PA interventions in Croatia.

Key words: *exercise attitudes, physical activity interventions, health promotion*

Introduction

In last two decades it has been shown that participation in a regular physical activity offers substantial physiological (Hurley et.al., 2003; Smith et.al., 2006) and psychological (Andrijašević et.al., 2005; Abu-Omar et.al., 2004; Carron, et.al., 2003) benefits. Therefore, the promotion of regular exercise among adult population is considered a crucial step in the prevention of a wide range of chronic diseases, such as diabetes, osteoporosis, and coronary heart disease (US Department of Health and Human Services, 1996; Schnohr et.al., 2006). The World Health Organisation through its "Global Strategy on Diet, Physical Activity and Health" recommended that greater attention should be given to increasing physical activity on the population level (WHA, 2004). In order to increase the physical activity level, physical activity strategies and interventions have been created in many countries. Assessing physical activity preferences of the targeted group is one of important steps in developing interventions for the promotion of physical activity. Preferences can include many general attributes, such as the type of exercise, surrounding environment (individual or group exercise), timing, and general setting (Cohen-Mansfield et.al., 2004). It has been suggested that physical activity interventions are most beneficial when they are tailored to individual preferences and that a better understanding of these preferences could lead to an increased adherence to exercise programs (Ruland & Moore, 2001; Wilcox et.al., 1999). Also, efforts to promote participation in physical activity are likely to be most effective if they address the needs and interests of particular target groups (Booth et.al., 1997).

To our knowledge, there have been no reports on preferred activities in Croatia based on a representative sample of participants, so this study is the first report of that kind. The main goal of this study was to assess physical activity preferences in the Croatian population. The second goal was to determine gender differences in physical activity preferences.

Methods

The study was conducted on a random sample of participants aged 15 years or more who live in private households. The sample did not include participants who live in institutions (hospitals, nursing-homes, etc.), Croatian citizens living abroad, and foreign citizens living in Croatia. The latest official 2001 census was used as a data base for the selection of participants. The survey was conducted on a total number of 1,032 individuals. All participants had given their written consent for participating in the research before they were interviewed.

In order to estimate the physical activity preferences of participants, the IZSRP-2007 was used. The IZSRP-2007 is a check-list consisting of 14 activities, which can be divided in several groups as follows: Group exercise programs, Aerobic exercises, Team sports, Racquet sports, Dance, Hiking, and Martial arts. Participants were asked to evaluate each of the 14 activities on a scale from 1 to 5, where 1 indicated "I would never participate in this activity" and 5 indicated "I would like to participate in this activity for sure".

Statistical analyses were performed by STATISTICA 7.1 (StatSoft, Inc. 2005). In order to determine gender differences in preferences, means and standard deviations were calculated and Student's t-test was performed for each activity. The percentage of participants within each category from 1 ("I would never participate in this activity") to 5 ("I would like to participate in this activity for sure") was calculated for men and women separately.

Results

The sample included a total number of 1,032 participants (48.4 % men and 51.6 % women).

Table 1. Differences between genders - descriptive statistics and results of Student's t-test

	mean±sd		t-value	Df	p
	women	men			
Pilates	2.35 ± 1.43	1.20 ± 0.60	16.68	1024	0.000
Aerobic	2.53 ± 1.52	1.20 ± 0.57	18.28	1024	0.000
Cardio fitness in gym	2.18 ± 1.31	1.89 ± 1.24	3.59	1020	0.000
Fitness (weight training)	2.04 ± 1.34	2.57 ± 1.52	-5.96	1023	0.000
Spine exercises	1.98 ± 1.29	1.37 ± 0.79	9.06	1024	0.000
Yoga	2.01 ± 1.36	1.41 ± 0.87	8.34	1024	0.000
Swimming	2.75 ± 1.55	2.72 ± 1.56	0.38	1022	0.702
Racquet sports	2.06 ± 1.31	2.12 ± 1.42	-0.76	1023	0.447
Dance	2.55 ± 1.53	1.64 ± 1.14	10.83	1023	0.000
Martial arts	1.53 ± 1.04	1.88 ± 1.29	-4.75	1024	0.000
Team sports	1.89 ± 1.28	3.04 ± 1.63	-12.67	1025	0.000
Hiking	2.23 ± 1.42	2.13 ± 1.38	1.13	1024	0.260
Walking	2.82 ± 1.48	2.33 ± 1.44	5.41	1025	0.000
Running, cycling, rollerblading	2.47 ± 1.47	2.34 ± 1.46	1.40	1018	0.162

Table 2. Prefered activities among female participants

	rf (%)				
	1	2	3	4	5
Walking	29.38	13.75	19.40	19.96	17.51
Swimming	34.22	12.67	16.82	16.26	20.04
Dance	39.81	12.64	16.04	15.28	16.23
Aerobic	41.43	9.98	18.08	14.88	15.63
Running. cycling. rollerblading	40.53	14.39	16.29	15.53	13.26
Pilates	44.26	10.55	22.22	11.49	11.49
Hiking	47.46	15.25	14.88	11.68	10.73
Cardio fitness in gym	45.94	15.69	19.47	12.10	6.81
Racquet sports	52.45	13.21	16.23	12.26	5.85
Fitness (weight training)	53.58	15.66	12.83	9.43	8.49
Yoga	56.50	12.24	13.75	8.66	8.85
Spine exercises	54.43	15.82	13.94	8.85	6.97
Team sports	58.57	15.07	12.62	6.21	7.53
Martial arts	73.07	11.86	7.53	3.77	3.77

rf (%) - percentage of participants within each category where 1 indicated "I would never participate in this activity" and 5 indicated "I would like to participate in this activity for sure".

Table 3. Prefered activities among male participants

	rf (%)				
	1	2	3	4	5
Team sports	31.25	8.47	13.10	18.95	28.23
Swimming	36.77	10.71	15.15	18.99	18.38
Fitness (weight training)	39.60	12.32	14.55	18.59	14.95
Running. cycling. rollerblading	45.12	13.62	15.45	14.02	11.79
Walking	44.35	14.92	15.93	12.90	11.90
Hiking	51.11	14.14	13.33	13.33	8.08
Racquet sports	52.73	13.74	12.93	9.70	10.91
Cardio fitness in gym	58.22	12.98	15.21	8.32	5.27
Martial arts	60.81	12.93	9.90	10.30	6.06
Dance	69.49	12.53	7.47	5.66	4.85
Yoga	75.96	13.33	6.26	2.42	2.02
Spine exercises	77.37	12.73	6.46	2.42	1.01
Aerobic	86.06	8.69	4.24	0.81	0.20
Pilates	87.88	6.67	3.64	1.41	0.40

rf (%) - percentage of participants within each category where 1 indicated “I would never participate in this activity” and 5 indicated “I would like to participate in this activity for sure”.

Results of Student’s t-test showed significant gender differences in preferences for each group of activities, except Swimming, Racquet sports, Hiking, and Running, cycling, and rollerblading (Table 1).

The most preferred activities among women were (Table 2) Walking, Swimming, Dance, Aerobic, and Running, cycling and rollerblading. Walking received the highest grades (4 and 5) from 37.47 % of female participants. Similar as for men, swimming received the highest grades from 36.30 % of women. The most unattractive activities for female participants were Martial arts and Team sports.

As presented in table 3, the most preferred activities among men were Team sports, Swimming, Fitness (weight training), Running, cycling, and rollerblading, and Walking. Team sports received the highest grades from 47.18 % of male participants, while Swimming and Fitness (weight training) received the highest grades from 37.37 % and 33.54 % of male participants, respectively. The most unattractive activities for male participants were Pilates and Aerobics.

Discussion

The main goal of this study was to assess physical activity preferences in the Croatian population. Team sports were most preferred activities among male participants. We consider that there are several explanations for this phenomenon. Firstly, team sports such as football, handball, basketball, and volleyball are the most represented sports in the mass media due to traditionally great accomplishments of Croatian national teams in these sports. Secondly, the majority of free-of-charge sport courts and school sport facilities are suitable for these sports. Thirdly, team sports are most often a part of physical education in primary and secondary schools, as well as at the universities. The most preferred activity among women was walking. Given this finding and the well-supported evidence that regular walking of about 30 minutes per day (Hamer & Chida, 2008; Keller, Trevino, 2001;) provides cardiovascular health benefits, it is clear that physical activity strategies for public health promotion should focus on walking. Furthermore, it is important to emphasise that walking is not only easily attainable for most of the people but that it is also costless.

It is interesting that among both men and women, Swimming, Running, cycling, and rollerblading, and Walking were ranked among the top five preferred activities. This finding is consistent with previous research, which suggested that individuals tend to dislike activities in structural or formal settings (Burke et.al. 2006; Wilcox et.al., 1999). The finding indicates that physical activity interventions should include not only structured gym-based exercise programs but also should encourage involvement in unstructured exercise programs. This kind of intervention should be based on education of potential participants, which would encompass education about potential health benefits of exercise, as well as specific information about physical activity and exercise (when to exercise, how to exercise, how much to exercise).

The significant gender differences were observed for the majority of activities. This was expected, since previous studies obtained similar results (Burke et.al. 2006; Booth et.al, 1997).

One of the limitations of this study is that barriers for physical activity participation were not assessed. Barriers, as well as exercise context (group or individual exercise), are often researched together with the preferences, so that the

factors associated with physical activity behaviour would be comprehensively understood. Therefore, future studies should focus on both barriers to physical activity and physical activity context.

Furthermore, we suggest the analysis of physical activity preferences among different age groups, because differences in preferences between younger and older participants have been found (Booth et al., 1997).

In conclusion, this study presented physical activity preferences among Croatians. The most preferred activities among men were Team sports, Swimming, and Fitness (weight training); and Walking, Swimming, and Dance among women. Since walking is a highly ranked activity among both men and women and is easily attainable for majority of population, physical activity strategies for public health promotion should focus on walking. It was also noticed that a considerable percentage of men and women tend to dislike activities in structural or formal settings, so interventions which encourage involvement in unstructured exercise programs are suggested. Significant gender differences in preferred activities imply that interventions for men and women should be created separately. Results of this study could be valuable for further research interested in developing physical activity interventions in Croatia.

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PROMOTION OF PHYSICAL ACTIVITY IN THE CZECH REPUBLIC

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Abstract

In the Czech Republic, there is a low and still decreasing level of physical activity and increasing prevalence of obesity, cardiovascular diseases, type II diabetes, osteoporosis and colon cancer. Engaging in regular physical activity, even of moderate intensity, reduces the risk of those diseases. Additionally, regular physical activity has also been shown to facilitate better stress management, alleviate depression and anxiety, strengthen self-esteem, enhance mood and boost mental alertness. The experience of foreign countries clearly shows that the issues of promoting physical activity require a systematic and methodical approach in terms of policy on national scale as well as on the level of lower territorial units and municipalities. Policy is understood as the process and method of binding decision making of a certain group of people with pluralistic interests and opinions. In terms of these collective decisions, policy constitutes the art of administering public affairs, the art of governing a country and protecting the interests of one country against another one, creating and maintaining relationships. Within this context, the authors of the article deal with the issues of promoting physical activity and managing community recreation in the Czech Republic and analyse current political documents relating to promoting physical activity.

Key words: *Czech Republic, promotion of physical activity, strategy, government*

Methods

The reviews of intervention to increase physical activity and community recreation management system reflect systematic analysis of political, strategic and conceptual documents on both national and regional levels in the Czech Republic.

We have analysed:

- Health Concept Plan for 2005 – 2009
- Concept of State Policy on Public Health Care Development in the Czech Republic for 2007 – 2013
- Integrated Operational Programme 2007 – 2013 (version 11/2006)
- Global Strategy on Diet, Physical Activity and Health
- Strategy for Economic Growth of the Czech Republic
- Convergence Programme of the Czech Republic
- Macroeconomic Prognosis
- National Development Plan of the Czech Republic 2007 – 2013
- Ex Ante Evaluation of the National Development Plan 2004 – 2006
- National Reform Programme
- Method of Preparation of the Czech Republic for Drawing Financial Means from Structural Funds and Cohesive Funds during 2007 – 2013
- Lisabon Strategy

Swot analysis of political documents relating to health care

Strengths • Increasing mean life as a result of decreased overall mortality, newborn and infant mortality and communicable diseases prevention • Others (irrelevant to our purposes)	**Weaknesses** • Excessive focus on improving impaired health rather than disease prevention • Poor awareness of the lay public of health issues in terms of motivation for responsibility for own health and healthy lifestyle • Continuing high figures of morbidity and mortality connected particularly with cardiovascular diseases and tumour diseases alongside with their increasing incidence and prevalence
Opportunities • Development and support of prevention programmes including active involvement of other concerned departments • Development of health care and citizen motivation for health protection and support in terms of regional health policy development • More intense communication with the lay public, enforcing models motivating active patient participation on their health care	**Threats**

Key points leading to the development of the Czech national strategy for promoting physical activity:

- Clear evidence of positive influence of physical activity on health;
- High financial burden on the state caused by physical inactivity;
- Low level of physical activity in the Czech Republic;
- High prevalence of obesity and non-communicable diseases in the Czech Republic;
- Evidence of financial effectiveness of physical interventions;
- Type of health care system in the Czech Republic;
- Arguments and priorities included in political documents.

Department of recreology – the only institution developing the national strategy for promoting PA

For an individual, physical activity is a mighty means of disease prevention and, for the society (nation), it is also economically profitable. Physical activity is a socially effective method improving the health of the whole population. What immediately comes to our mind is why there is no strategy for promoting physical activity in the Czech Republic and what could help induce some practical thoughts about its creation.

Proofs of the potential that physical activity has for lifestyle are obvious. If we want to use that potential and reach success, a substantial advance must take place within the society. It is imperative that people not only talk about active lifestyle but also (in the first instance) start an active way of life. It is difficult to induce such changes in a society, not unrealistic though. In the first place, it is necessary to create an awareness supporting campaign. People must be aware of the advantages of active life; not the disadvantages of being inactive and perhaps experience (a heart attack). Physical activity must not be regarded an unpleasant requirement but rather an opportunity.

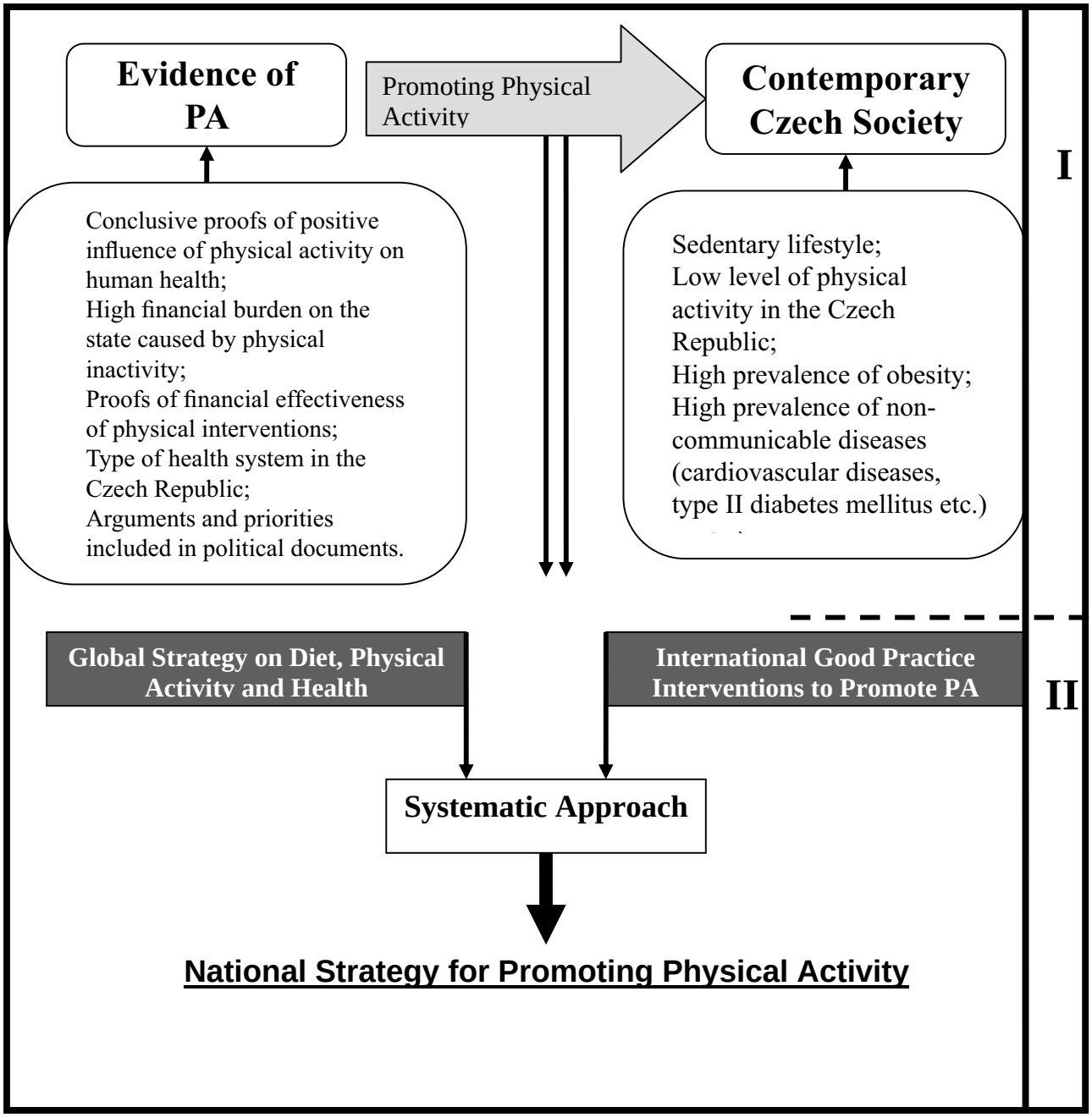
Creating a lifestyle in its basic form is of long-term, spontaneous and subconscious nature and, above all, is the result of realization of prevailing social roles and environments that a person lives in (Hodan, 2000). Therefore, an active strategy for promoting lifestyle must not be of short-term nature, but rather a long-term continuous process. The result of the strategy is then a change in individuals' behaviour, i.e. an active attitude to the prevention of their own health.
In order to reach success, the strategy must include various biomedical, economic, psychological, sociological and other aspects. For that purpose, we need (as we can see from experience of foreign institutions that have already created successful strategies) cooperation with experts in each of the abovementioned fields. In the Czech Republic, there are few organizations capable of creating suitable conditions for meeting of such experts. The Department of Recreology at Palacký University in Olomouc is, in our opinion, an ideal place for originating a strategy for promoting physical activity.

The Department of Recreology is the only Czech institution creating a systematic approach to increasing the level of physical activity.

The Department of Recreology is highly aware of the significant increase of the global burden of non-communicable diseases. It cooperates with international organizations (e.g. WHO, HEPA Europe) to collect as much evidence as possible to push governmental bodies to make appropriate steps to work out problems related to low levels of physical activity in the Czech Republic.

So far, the Czech government does not recognize physical activity a serious risk factor of non-communicable diseases. Therefore, the Department of Recreology is facing a big task of convincing the Czech government that physical activity is one of the major components of healthy lifestyle and has enormous economic benefits especially in terms of reducing health care costs, increasing productivity and healthier physical and social environment.

Conceptual framework for creating and developing the strategy for promoting physical activity in the Czech Republic



Graphically speaking, the logical framework shows the process of creating the strategy for promoting physical activity in the Czech Republic. Within our concept, a sort of bridge must be built between the left and right side. On the left side of the figure there are clear and conclusive proofs confirmed by numerous national as well as international organizations stating that physical activity constitutes an important part of active lifestyle and healthy economy.

The right side of the logical framework depicts the real situation in Czech society. Physical inactivity causes increased morbidity, mortality, depression etc. and thus higher burden on the economy. We believe that, in order to create the strategy

for promoting physical activity, no further biomedical knowledge is needed. There is a general consensus around the world that physical activity is the fundamental health influencing factor. At this moment, another important phase must be performed – i.e. implementation. It is imperative to apply the solutions and knowledge provided on the left side to the problems and drawbacks on the right side. Interconnecting the diagram can subsequently induce changes in social climate to the benefit of active lifelong use of all forms of physical activity by the largest possible amount of people. This should make people take advantage of health prevention, social and psychological values of sport as a part of their lifestyle.

The second stage of the conceptual framework shows the essential systematic approach to creating the strategy for promoting physical activity, which is influenced by, and at the same time complies with the global strategy for promoting physical activity. Furthermore, it is obvious that serious attention will be paid to international "good practice" interventions to promote physical activity.

Conclusion – current situation of physical activity interventions in the Czech Republic

There are programs on both national and local levels to promote physical activity in terms of high performance sport. But there are just a few **local** initiatives to increase physical activity in terms of promotion of physical activity at work, neighbourhood, school, home, active aging etc. Through lack of politically friendly environment, these initiatives do not generally cooperate and do not publicly share their results.

There is no **national** intervention focusing on promoting physical activity. Consequently the questionnaire concerning physical activity intervention in the Czech Republic is not relevant. The Department of Recreology is the only Czech institution that is creating a systematic approach to increasing physical activity.

Up to now, the government has not encouraged people to be active and has not even encouraged institutions (e.g. the Department of Recreology) to create interventions to make Czech society more active.

Results

We have found out that the Czech government (Ministry of Health) does not recognize the low level of physical activity a serious risk factor influencing non-communicable diseases. Enormous sums of money are being allocated for promoting physical activity in terms of high performance sport. But there are very few initiatives focused on increasing the low level of physical activity. There are no interventions relating to promoting physical activity at work, neighbourhood, school, home, active aging etc. Although the health benefits of physical activity are well established; however, politically friendly environment is still absent in the Czech Republic.

Present state of problem solving

Presently, the experts from the Department of Recreology at the Faculty of Physical Culture at Palacký University in Olomouc and the Department of Public Finance at the Faculty of Economics and Administration at Masaryk University in Brno are implementing a project titled "Development and proposal for implementation of strategy for promoting physical activity in the Czech republic", whose main task is to create an empirically documented proposal for the national strategy for promoting physical activity. The project includes some students of doctoral courses of both Departments (Michal Kalman, Zdenek Hamrik, Jan Pavelka, Ladislav Kavrik, Jarmila Neshybova), who work on their dissertations within the project, their supervisors (Tomas Dohnal, Miroslav Hrabovsky, Jan Selesovsky), a partner in the project is also the Czech Office of WHO.

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SPORTS FOR ALL IN MOUNTAIN TOURISM SKI RESORTS USA, 2007-2008 SEASON - SKI–SNOWBOARD

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Abstract

Terrains characteristics of ski runs determine the quality of skiing, as well as the pleasure of staying in a mountain ski tourist centre in the world.

Key words: *Sports for all in Mountain Tourism, Ski Resorts USA, 2007-2008 season - ski-snowboard*

Introduction

Recent researches show that tourists in the developed ski canters around the world emphasize ski runs, slopes and snow as the quality of services which are in the first place. Analysis has been carried out in Europe, Asia, North and South America. 57 developed ski canters in Europe and 14 North-American ski canters, 1 centre in Asia, 1 centre in Australia and 3 canters in South America have been included in this research. It has been shown that these canters have 23% of the runs for beginners, 40% of the runs for the intensive skiing. There are 24% of the terrains for advanced skiers. For the exceptionally demanding skiing, the one which demands increased body efforts, there are 13% of the terrains. If it is known that this analysis encompassed the most developed ski canters in Europe and the USA, it can be concluded that the total of the terrains for the intensive skiing and terrains for advanced skiers make up 64% of the paths. We should add 13% of the ski terrains for skiing under stronger exertion to this percentage, which makes the amount of 77% of the analyzed terrains. A considerable number of 23% of ski-runs remains whose terrain is of such a profile as to enable skiing for individuals who have different limitations, for the beginners, elderly people, children, and people with reduced physical ability.

As a consequence of heterogeneousness in motor knowledge, skills and habits is the fact that a significant number of citizens ski with greater effort, look for shorter ski elevators and lower heights which is the consequence of their insecurity, not knowing the locality of a sport-ski centre. There are different opinions about ski runs. Opinions are noticed which speak about runs as more difficult and more planned for sport competitions and advanced skiers. Such information points to the seriousness of this problem. This realistic situation, which is seen from the information, directly influences the function of sport for all in the mountain tourism. Special problems are frequent physical injuries.

Visitors were asked the following question: How do you feel on ski runs? A considerable number of them ski with a greater effort which shows that one number of skiers have poorer technique of skiing, which presents a problem in continuous skiing on the ski runs. Information of 55,69% of those citizens with who limiting factors are present is also very important.

One of the questions was: Which runs would you like to ski on: a) runs surrounded by trees (through forest), b) runs over clear area, or c) on runs which lead through the forest and over clear areas: 52,73 % of the interviewed citizens chose skiing on runs which lead through forests and over clear areas. This information should be used as the real indicator of a profiled demand and sort of interests of potential guests in one of the modern ski centers.

Research methods

On the basis of the past researches and defined aims of this research, it is necessary to establish characteristics of terrains profiles in Ski Resorts in the USA 2007-2008 season - ski - snowboard. Canters of North America have been chosen on the basis of convenience and availabilities. The greatest number of samples is composed of 13828 ski - snowboard runs from 347 centers in 35 USA states.

For the purpose of data processing and the result analyses, we used suitable logic and mathematic-statistic methods.

Results and discussion

Ski Resorts in USA	Center	Ski Runs	Beginners (%)	Intermediate (%)	Advanced/expert (%)
Alaska	6	206	25,17	45,33	29,50
Arizona	4	122	34,25	43,00	22,75
California (Lake Tahoe ski area)	24	1221	25,13	46,35	28,52
Colorado (Aspen ski area)	25	2057	22,52	41,64	35,96
Connecticut	5	87	39,60	39,60	20,60
Georgia	1	5	40	30	30
Idaho	10	501	23,20	45,60	31,20
Illinois	4	44	40	50	10
Indiana	3	48	23,33	48,33	28,33
Iowa	4	21	25,50	39,75	34,75
Maine	14	534	28,50	42,50	29
Maryland	1	23	20	50	30
Massachusetts	12	253	28,08	49,67	22,25
Michigan	26	1029	27,80	45,00	27,20
Minnesota	23	657	30	45	25
Missouri	2	26	20	70	10
Montana	14	896	21,29	39,71	39,00
Nevada (Lake Tahoe ski area)	3	82	20,23	45	31,67
New Hampshire	17	745	26,18	45,59	28,24
New Jersey	3	65	26,67	41,67	31,67
New Mexico	9	507	26,11	43,67	30,22
New York	33	878	28,42	43,45	28,13
North Carolina	7	88	31,43	45,71	22,86
Dakota	1	40	35	38,33	26,67
Ohio	1	6	25	40	35
Oregon (Mt. Hood ski area)	13	413	24	36	40
Pennsylvania	21	388	31	41	28
Rhode Island	1	12	50	30	20
Utah	13	847	20,08	49,46	30,46
Vermont	18	1265	27	41	32
Virginia	4	49	30	36,25	33,75
Washington	10	257	23,50	45,20	31,30
West Virginia	4	156	36,50	35,75	27,75
Wisconsin	16	385	30	38	32
Wyoming (Jackson Hole)	5	243	17	45	38
TOTAL	347	13828	28,07	43,22	28,62

We should turn to the fact that more than 43 percent of the tourist s come on the INTERMEDIATE runs. It leads us to the logic conclusion that the most profitable investment is in such runs. Runs for beginners and those for advanced skiers are equally well visited.

We can see that there are 39,85% of the runs per one centre.

Conclusion

From the aspect of sport for all, special attention should be direct towards skiers who have no abilities and motives to ski on steeper runs which demand from them increased efforts and fatigue, so that for them it is not rest, relaxation and kinesiology recreation in one of the ski tourist centers. Limiting factors are essential elements in planning kinesiology program for potential users of one or more kinesiology contents in certain sport-tourist place. The mountain profile and ambiance determine a series of very important factors from the aspect of physiology trainings as an important kinesiology discipline in the function of development of modern mountain summer and winter tourism.

The general conclusion is that the profile characteristics of a ski center are greatly determined by ambiance and the quality of skiing, as well as by the pleasure of staying in a certain mountain ski tourist center in the world. Profile

characteristic s of a mountain, as well as a ski center are basic starting points in every kinesiology planning and programming, and also in building and development of a mountain summer and winter sport-tourist centers today in the world. Condition of rich tourist offer in winter tourism is diverse offer with the emphasis on sport for all. Possibility of activities in different winter sports, as well as sport for all of a ski center depends on the profile characteristics profiles of that ski-center.

Without an adequate concept of kinesiology development for the needs of a society for contemporary kinesiology contents will not be satisfied. It is necessary to apply long-term marketing strategies. In this way we would discover and contribute to the satisfaction of users needs. It is necessary to direct kinesiology education to diversity of potential individual users and their needs for sport contents of sport for all in the mountain tourism.

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PHYSICAL ACTIVITY AND SPORT PREFERENCES OF THE SECONDARY SCHOOL STUDENTS

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Abstract

The awareness of the positive effect of active and healthy lifestyle in the adolescent population should be a top priority. The preparation of this research methods (online form of questionnaire), which will uncover the structure of sport preferences, is useful for consecutive interventions. The results indicate, that differences of sport activities between boys and girls are not so obvious. The most preferred sport activities in boys are – soccer, ice hockey, basketball, cycling, snowboarding and skating (in-line). The most preferred sport activities in girls are – aerobics, volleyball, cycling, horse riding, basketball, snowboarding, and skating (in-line). Boys are more active than girls. Boys reached 4992 MET-minutes/week, while girls reached 4246 MET-minutes/week. The online form of survey in school environment was effective. This research is part of international project INDARES (www.indares.com).

Introduction

The present civilization influences human movement significantly, which is the fundamental expression and need of human life (Hodaň, 2000; Stejskal, 2004; Véle, 1994). Once lifestyle is in opinion of many authors, the most important factor, which influences health. A lack of movement routine, which is essential part of our lives, and current sedentary lifestyle has negative impact because of formation of public (mass) noninfectious diseases (Berger & Kemmer, 1988; Dishman, 2003; Garfinkel & Coscina, 1988; Stejskal, 2004; U. S. Department of Health and Human Services, 2002; Vondruška & Barták, 1999). The results of previous research projects and surveys point out the insuficiency of physical activity in all age categories (Frömel, Novosad, & Svozil, 1999; U. S. Department of Health and Human Services, 2000).

The development of physical, mental and social dimension of personality of secondary school students, which is realized by physical activity, is situated mainly to the area of out-of-school interest activity. There are many other institutions (school sports clubs and other leisure time institutions) in this phase of human development, which present unique role for adolescents – family, peers and social surrounding. 75-85% of all physical activity is realized in leisure time, out of school and only 15-25% is organized at school (Bartoszewicz, 1998; Bouchard, Shephard, & Stephens, 1994; Hallal, Victora, Azevedo, & Wells, 2006).

School institutions should respect the wishes and interests of students and contribute to the optimal development of healthy lifestyle. The active contribution of the secondary school is from this point of view often minimal. The orientation on the adolescent phase of human development is crucial, because, that attitude towards physical activity is made in childhood and in adolescence. The schools have a unique opportunity to influence and support physical activity of youth (Wallhead & Buckworth, 2004).

The uncovering of the structure of physical activity and preferences of sport activities of secondary school students should be one of the most productive pillars for improving the current situation. In edition there is a confirmation from various surveys of specific area of preferences of physical or sport activities (Booth, Bauman, Owen, & Gore, 1997; Burgeson, Wechsler, Brener, Young, & Spain, 2003).

We should respect preferences of developing motor abilities in school physical education, which is typical for contemporary conception. The pupil is in the center of our pedagogical focus in this prospective (Jones & Ward, 1998; Virgilio, 2000). Discrepancies between preferences, sensitive phases of human development and goals should be treated by popular content and interesting forms of presentation.

Goals and research questions

The main goal of this project is to analyze structure of sport activity preferences of secondary school population, to describe current state of sport-preferences sphere and to provide to all participating schools with feedback information.

Partial goals

1. Examine the application of online alternative of research at school environment.
2. Contribute to detailed and easy monitoring of sport preferences.
3. What level of physical activity will be in the group of boys and girls?

Research questions

1. What structure of sport preferences of secondary school students will we find?
2. Will we find differences between structure of sport preferences of boys and girls?
3. Will there be similarity between the structure of sport preferences and realized sport activity structure?
4. Will we find differences between particular regions?

Methods

Under the terms of the research were used two questionnaires, which survey basic information about participating of respondents in organized and unorganized form of physical activity – sport preferences questionnaire and IPAQ questionnaire.

The research sample of this pilot study was made up of students of secondary schools of two regions in Slovakia. The total size of this sample (n=3492) was divided to both regions in ratio – Košice region (n=1756) and Prešov region (n=1736).

The research sample of the second part of this research, which is more suitable for evaluating physical activity, were realized via IPAQ questionnaire made up of Czech adolescents of age 15-20 years. The total number of respondents in this part (n=1391), was 618 boys and 773 girls.

Table 1. Basic somatic characteristics of respondents of IPAQ survey

Group/size (n)	Age(years)	Weight (kg)	Height (cm)	BMI (kg/m^2)
Boys (n=622)	17,96 ± 1,70	72,41 ± 11,15	180,00 ± 8,01	22,31 ± 2,97
Girls (n=778)	18,12 ± 1,67	58,87 ± 7,54	168,58 ± 6,23	20,70 ± 2,38
Total (n=1400)	18,05 ± 1,68	64,89 ± 11,49	173,65 ± 9,07	21,42 ± 2,77

The structure of preferences of sport activities was surveyed in eight areas: 1. Individual sports, 2. Team sports, 3. Conditioning activities, 4. Water sport activities, 5. Outdoor sport activities, 6. Martial arts, 7. Rhythmical and dancing activities and 8. Sport activities - overall.

One of the important components of standardization of this questionnaire was verified the stability by means of method test-retest and by Spearman correlation coefficient (r_s). The most balanced results between the first and the second measurement were found in the area of team sports (0.81 and 0.76). On the other side the biggest spreads in ranking between two measurements were found in the areas of rhythmical and dancing activities (0.62 and 0.68) and martial arts (0.68 and 0.61) (Sigmund, Mitáš, Kudláček, & Frömel, 2007). The coefficient of reliability of IPAQ questionnaire is 0,8 (Craig et al., 2003).

The statistical analysis was made in program Statistica 6.0 (StatSoft CR, 2002). After processing the results we used basic statistical data – Spearman correlation coefficient and Mann-Whitney U-test.

The results of sport preferences survey are demonstrated in rankings, because just rankings are proper form of results, which help teachers to prepare better general school programs for their students. The results of IPAQ survey are represented in the same way like in other IPAQ surveys by METs (metabolic equivalents). 1 MET is equivalent to a metabolic rate consuming 3.5 milliliters of oxygen per kilogram of body weight per minute.

Results

Acquired results give us total summary about the sport preferences sphere. In the context with real situation and sport conditions in the given area, we are able to increase the total amount of physical activity. The results from the area of "Individual sports" (Table 2) confirm that the differences in preferred sport activities between girls and boys are not so obvious. These results can be an impulse for launching coeducational physical education classes. The proclamation is confirmed by Spearman correlation coefficient, which was for the area "Individual sports" 0,71 (p=0,05).

Table 2. Sport activity preferences – the area "Individual sports"

Individual sports		
Ranking	**Košice – boys**	**Košice – girls**
1	Cycling (road and mountain)	Skating (inline, skateboard)
2	Tennis (table tennis, soft tennis)	Tennis (table tennis, soft tennis)
3	Pool (billiard)	Cycling (road and mountain)
4	Skating (inline, skateboard)	Badminton
5	Shooting	Pool (billiard)
6	Swimming	Swimming
7	Track and fields	Sport gymnastics
8	Darts	Track and fields
9	Bowling (ninepins)	Darts
10	Golf (mini golf)	Bowling (ninepins)

There were similar results in the other categories, which were in our questionnaire. When we made inter-sexual comparison in the last category "Sport activities – overall", we have found out also similarity between boys and girls. The biggest difference was found in category "Rhythmical and dancing activities" (r_s=0,35). There were found no significant differences between both regions.

Boys are more active than girls. Boys reached 4992 MET-minutes/week, while girls reached 4246 MET-minutes/week. The results confirm previous research projects, according to them girls (women) are less active than boys (men) (Frömel, Novosad, & Svozil, 1999; Garcia, Pender, Antonakos, & Ronis, 1998).

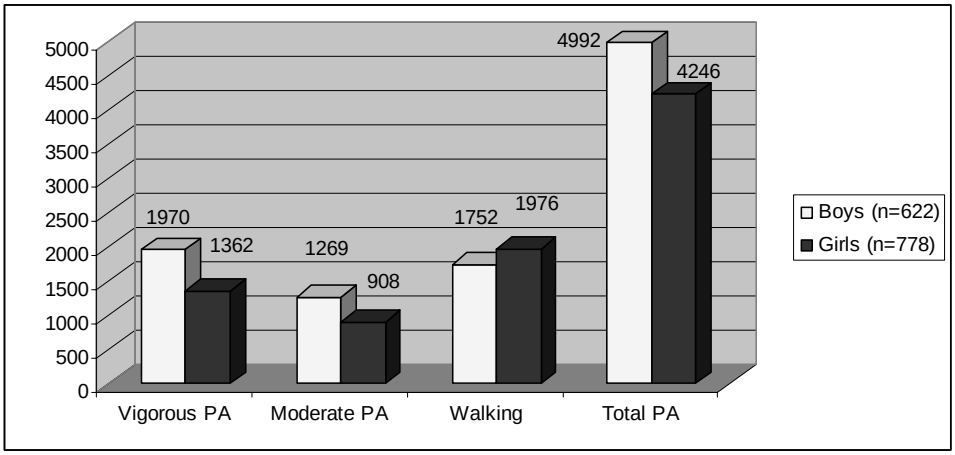

Chart 1. The level of all types of physical activity (MET-minutes/week)

Discussion

The representative research sample of the adolescent population is not casual, because this developmental phase is often labeled critical. This is critical because of the character of this phase, but certain part is the result of impact of social surrounding, environment, mass media etc. One of the possible causes of this unsatisfied trend can be the discrepancy between "supply and demand" on the market, managing with sport activities.

School physical education is the factor, which should contribute to level of physical activity. The current situation in the area of school physical education is unsatisfied and they are needed changes. For example in organizing, personal staff, increase of PE teachers´ qualification, methodical teaching. One of the main reasons is the fact, that school represents one of the basic socializing factors in the human development as well as family and peers and considerably influences human perception of lifestyle (Biddle, Bank, & Marlin, 1980).

We can fight against this inactivity of children and youth by promoting quality school physical education and improving predispositions for physically active lifestyle in adulthood. Physical education represents one school subject, where there are compensated health risks. The underrating of the physical education and the work of PE teachers can lead to deterioration of physical education and belittling of the importance of this school subject.

The human qualities we associate with the mind can never exist separately from the body because movement is an indispensable part of learning and thinking, as well as all integral part of mental processing. Furthermore, thinking and learning does not take place only in our head; people need to become more aware of the body's role in learning. Physical activity can indirectly improve results of education of students by improving mental health, self-respect and vigilance (Blakemore, 2003).

The awareness of the positive effect of active and healthy lifestyle in the adolescent population should be the main goal. The preparation of the research methods (online form of questionnaire), which will uncover structure of sport preferences is very useful for consecutive interventions in the given area.

We have to note, in comparison with previous results from the area of sport activity preferences, that trends in the development of sport preferences are making dynamic system, which is changeable in time (Frömel, Novosad, & Svozil, 1999; Rychtecký, 2006). However, there is a spectrum of sport activities, which were, are and probably still will be preferred (soccer, volleyball, aerobics, swimming).

Acquired results are characteristic for concrete research sample, living in given socioeconomics conditions and influenced by many factors such as culture, traditions and habits, current needs and values, family and peers. The issue of gender is to a certain extent unknown. We have to respect this fact in forming of corresponding conditions and facilities, which will lead to meet needs and wishes of students.

Conclusions

Acquired results indicate, that differences of sport activities between boys and girls are not so obvious. In addition there is a visible dynamic in the development of the structure of sport preferences, despite this fact there is a spectrum of sports, which is constantly preferred (soccer, volleyball, aerobics, swimming). The most preferred sport activities in boys are – soccer, ice hockey, basketball, cycling, snowboarding and skating (in-line). The most preferred sport activities in girls are – aerobics, volleyball, cycling, horse riding, basketball, snowboarding and skating (in-line). In comparison of two different regions, there were not found any significant differences in structure of sport activity (Košice, Prešov). The realization of the online form of survey in school environment was effective The next step in perfecting the survey is to the whole system more attractive.

There is a world widespread problem with obesity and overweight, and constructive changes are necessary. In our research we have found out that boys are more active than girls. The total amount of physical activity in boys is 4992 MET-minutes/week, while in girls 4264 MET-minutes/week.

Our data give reasons for the improvement of current sport facilities and offered sport programs. Results represent one possibility of how we can increase the total amount of physical activity in a given area. The other positive impact of research of sport activity preferences can be seen in helping in socialization of students by activities which are preferred by boys and girls together. For example, coeducational physical education classes can take place.

Lastly, we have seen this research can improve the program of physical education teachers, but also may be used with businesses, employers, towns and other institutions. This research of sport activity preferences can help teachers in the making of a flexible and more suitable school general program.

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THE PRACTICE OF PHYSICAL ACTIVITIES AMONG STUDENTS FROM PORTUGUESE MILITARY SCHOOLS

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Abstract

The purpose of this study was on one hand to analyse, in a subjective way, the quantity of physical activity that the Portuguese military schools provide for their students and on the other hand to verify if that practice can be beneficial to health. Physical activity was assessed by means of a questionnaire. 1,059 students from four Portuguese military schools participated in the study. From the results it was observed that, in general, students were regularly involved in formal and informal physical activity. Due to the fact that most of the students are boarding students, the levels of participation in clubs were low. On the other hand, the participation in extra-curricular activities was higher than results from the available literature. Taking into account the students' levels of practice of physical activity and their goal orientation, it can be hypothesised that these students are experiencing an educational climate that incentive them to become physically active adults.

Key words: *physical activity, goal orientation, school, lifestyle*

Introduction

A sedentary lifestyle has been pointed as an important factor contributing to health risks (WHO, 2003). Portugal shows one of the highest percentages of sedentary people in Europe (Martinez-Gonzalez et al., 2001). Regarding the practice of physical activities, children and adolescents show equally higher levels of physical inactivity than their European counterparts (Ledent et al., 1997; Matos et al., 2003). If we consider the fact that there is a strong likelihood of inactive children and adolescents becoming sedentary adults (Vanreusel et al., 1997) we are facing a dangerous situation.

Knowing that all children, adolescents and youth, are obligated to attend school, and that most of the recommendations to promote an active lifestyle must come from the school (CDC, 1997), it seems that Portuguese schools have been ineffective in accomplishing this goal. In order to understand why Portuguese schools are not being successful in the promotion of active lifestyles, it seems necessary to investigate other educational institutions that are providing the same curriculum (The Portuguese PE National Program) but where there is a climate valuing the practice of physical activities: This is the case of the military schools.

Thus, the purposes of this study were as follow: a) to quantify the physical activity of students from Portuguese military schools and to verify whether or not this practice could be beneficial to their health; b) compare the practice of physical activity among the students, taking into account their ages.

Methods

The sample consisted of 1,059 students (812 males and 247 females), from 4 military schools. The ages ranged from 9 to 25 years (16.31±3.92). In three schools the students were in grades 5-12, and the fourth was a university. Two of the schools were only for males, one for females and the university is coeducational. These institutions have great reputation in Portuguese society, and are known for promoting physical activities and participating regularly in inter-school competitions at the regional and national levels.

We divided the sample into four groups, one for each educational level (Table 1).

Table 1. Distribution of students by educational levels

	2º Level	3º level	Secondary level	Superior level
Grade	5º, 6º	7º, 8º, 9º	10º, 11º, 12º	1º, 2º, 3º, 4º
Students	174 (16.4%)	323 (30.5%)	204 (19.3%)	358 (33.8%)
Age	11.4±1.48	13.8±1.36	16.4±1.8	20.9±3.92

The data was collected using a questionnaire developed by Piéron et al. (1997). The students filled out the questionnaire in physical education classes with the supervision of an investigator and school teachers.

The data was analyzed with SPAD (*Sistème Portable pour l'Analise des Donnés*), version 3.5 from 1988. First we calculated descriptive statistics for all variables. The nominal variables were characterized by the frequency of their categories and the percentage that each category represented in the total. To characterize the educational levels we made a cluster analysis activating these variables. As statistical criteria, we used the calculation of probability to identify the significant characteristics of each category from each variable. In all analysis $p \leq 0.05$ was used to determine statistical significance.

Results and discussion

The instrument used attempted to assessed students physical activity in different contexts and quantify the number of hours per week that they participated in physical activities. In addition to physical education classes, most of the students (79.9%) answered that they participate in extra-curricular activities. Approximately 59% participate two or more times a week and 20.9% only once a week. If we consider the fact that at all educational levels the number of participants was higher than 80%, except in higher education, this shows the importance that schools give to the practice of sports activities, and also shows excellent organization in promoting voluntary activities for almost all students. This higher number of participants can be related to extrinsic motivation (Daley & O'Gara, 1989) or to the diversity of options available. From participants, 51.4% said that they were involved in competitions with other schools. The rest of the students participated only for the benefit of learning the activity. Knowing that when young people leave the school they will no longer have the same opportunities to exercise, these activities seems to represent an important significance for acquisition of behaviour patterns that can continue into adulthood (Delay, 2002).

In leisure time 80.7% of students practiced some informal physical activity. Only 2.8% of them reported not to be involved in physical activities, and 16.4% were irregular participants. These figures are interesting because they are not in according with the results from other studies which demonstrate that spontaneous physical activity is not the primary choice for leisure moments among Portuguese adolescents and youth (Santos *et al*., 2005; Martinez-Gonzalez *et al*., 2001). We believe that the determinant factor behind this high level of involvement is related with the existence of sports facilities in the exterior area and scholar ethos. That strengthens the concept that the school has potential to influence student's lifestyle (Jamner *et al*., 2004). This spontaneous and voluntary behaviour is important and presents better probabilities for physical activity tracking into adulthood (Vanreusel *et al*., 1997).

As for the practice of organized physical activity involving club participation, 21.3% of the students report that they participate every day or every week. These figures are comparatively lower than the results from other studies reporting participation in the same context (Piéron, 2002; Williams, 1988). From a health perspective it would be desirable that this percentage was higher, mainly because of the role organized physical activities have on energy consumption and, because this behaviour is scheduled, the adolescents and youth cannot be engaged in passive activity (Katzmarzyk & Malina, 1998). However, it is important to highlight the fact that boarding students are not easily able to participate in activities outside the school without parental permission. This is probably the reason why these schools promote sports and extra-curricular activities. Thus, we verify that most students, who are limited to practice only inside the school, are more physically active than the Portuguese youth who participated in other studies (Martinez-Gonzalez *et al*., 2001; Góis, 2000, Santos *et al*., 2005). This confirms the potential of schools in promoting active lifestyles.

Attempting to ascertain the motives for physical activity, we analyzed the goal orientation as a way to speculate future involvement. We verified that the majority of students (81.3%) were task oriented. This orientation is associated with the belief that effort leads to success and studies show that this orientation is positively related to the desire to learn and develop physical skills (Bidle *et al*., 2003; Duda & Ntoumanis, 2003). Thus, the results can, in a certain way, put future participation into perspective. Because these schools belong to a military educational system, directed by army officials with the habit of following rules and enforcing discipline, it would be normal to assume that in the teaching routine and in other activities the emphasis on discipline is important. These results confirm this idea, when these students have a task orientation and understand the importance of discipline for learning progression and development (Bidle *et al*., 2003; Duda & Ntoumanis, 2003). In this way, it is possible to affirm, though with some precaution, that the institutional organization and teaching style can change the students' goal orientation, allowing the schools to contribute to students having an orientation that favours the practice of physical activities, which is a task orientation, because this plays an important role in morality, attitude, and behaviour (Bidle *et al*., 2003).

The instrument has a question regarding attitudes toward school and physical education, normally associated with the practice of physical activity. More than 70% of the students affirmed that they enjoy school. Supposedly, many students did not like school because it was a boarding school where physical activities are highly valued; however, the general feelings were positive, demonstrating that they like school as an institution and the activities it offers. Regarding the discipline of physical education, the tendency is similar, but the values are relatively superior (83.7%). The students that reported negative feelings were 9.3% and 5.67%, for school and physical education respectively.

Perhaps it was the result of the influence of school ethos, which led to 92.4% saying that it was important to be good at sports. At the same time, a similar number (90.3%) answered that it was important to be a good student in most subjects. This suggests that, an organized institution can correlate the practice of sports and performing well in other academic subjects, demonstrated by the importance attributed to both.

According to the division of Portuguese schools, we sought to characterize each level of education (2nd level - 5th to 6th grades; 3rd level – 7th to 9th grades; secondary level – 10th to 12th grades; superior level – higher education). Students in the second level were characterized fundamentally by daily sports participation in varying contexts (p=0.00), they liked school and physical education and they had ego orientation.

Students in the third level had a similar participation in physical activities. They could be considered physically active (p=0.016), they liked physical education but they did not like school, even spending every day with their friends. Also, their goal orientations are similar to students in the second level (p=0.034).

In the secondary level, including ages 15-17, feelings toward physical activities were losing importance and students began to have an attitude of indifference toward physical education. On the other hand, the desire to be good students in most subjects gained importance, which is perfectly comprehendible because this grade level determines the entrance into university. Friends were a constant presence and from this point on, their goal orientation would change and they would become task oriented students.

Students at the superior education level differed from what we expected. Again we observed a change in attitude towards physical education, while students also considered that it was important to be a good student in most subjects. Enjoying school is also a characteristic of this class. Having the discipline of physical education at this educational level along with their goal orientation, probably allows us to say that there is a strong likelihood for them to continue to be involved in physical activities. The absence of the practice of formal physical activities characterized this class, but, at the same time, an informal practice was a strong variable that characterized them (p=0.00), corresponding to 81.8% of students in the class.

Analyzing the similarities and differences between classes, it is possible to find some patterns. Sports practices, in greater or lesser degrees, were present at all educational levels, being a strong enough variable that characterized the classes. The youngest students participated more in formal and extra-curricular activities, while the students at the superior level participated more often in informal activities without orientation. The attitudes toward school were a constant variable at all educational levels, except the third level. Regarding the attitudes toward physical education, there was only a change at the secondary school level, but at the superior level the attitudes were exactly the same as those of students at the lowest levels. In spite of the indifferent attitude toward physical education in secondary school, 83.3% of students reported that they participated in extra-curricular activities.

Conclusion

Independent of age or educational level, it was possible to observe that sports practice was a part of student activities. The levels of practice, superior to those we found in literature (Martinez-Gonzalez *et al*., 2001; Góis, 2000, Santos *et al*., 2005), suggest that schools can have an influence on student lifestyle (Jamner *et al*., 2004), and can contribute to the development of an active lifestyle. Although the practice of physical activity of adolescents provides benefits over a short period of time (Hallal *et al*., 2006), it is an important factor which contributes to the levels of adult physical activity (Hallal *et al*., 2006; Vanreusel *et al*., 1997).

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INFLUENCE OF MORPHOLOGICAL CHARACTERISTICS ON THE EFFICIENCY OF CRAWL TECHNIQUE SWIMMING IN FIRST AND SECOND CLASS PUPILS OF THE SPORTS HIGH SCHOOL IN SARAJEVO

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Abstract

The objective of this research was to establish the influence of morphologic characteristics on the swimming crawl technique by planning in teaching of physical and health education of Sports high school students, aged 15–17 years. For this purpose on the sample of 96 subjects of Sports high school in Sarajevo the measurement of 23 morphological measures was completed. There have also been gathered data on the efficacy of crawl swimming technique. On the basis of correlation regressive analysis of morphological characteristics and swimming crawl technique it could be noticed that only three indicators of morphological characteristics had statistically significant influence. It was to conclude that those three variables (fist width, upper leg circumference and foot length) are essential for the formation of the specificity equation for swimming crawl technique for this or for the similar population.

Key words: *swimming, crawl technique, morphological characteristics*

Introduction

On the efficiency of swimming – fall into influence of the whole spectrum of anthropological abilities and characteristics of different intensity. Morphological area (dimensions, characteristics) have preliminary definition that should be called "morphological characteristics" are of that structure of man's anthropological status of that kind that represent determined system of anthropological latent dimensions regardless if they are developed under the influence of external factors or not. In a certain measure they are dependent on inheritance (inheritable basis). It is sure that morphological characteristics have remarkable place in equation of success specification in swimming. One of the new motions used in the frame of numerous researches in swimming is the efficiency of swimming. Efficiency of swimming is not observed exclusively from the point of view of law of biomechanics', than in the frame of spatial and temporal dimension of moving bodies of swimming through the water and to outgoings of energy on swimming activity. The main goal of this research was to establish the influence of morphological characteristics on efficiency of swimming crawl technique planned in teaching of physical and health education of students at Sportive high school, growth from 15 to 17 years old.

Methods

Sample of entities

In the sample of examinees the students of second and third class of Sportive high school in Sarajevo 2001/02 year, aged 15 to 17 years, were included. Number of examinees among both groups of variables was registered and on which the final process and analysis of results has been executed was 96 students.

Sample of variables

In the research 26 treated anthropological variables had been included. Sample of predictor body longitudinal variables embraced: 1. body height 2. arm length; 3. leg length; 4. foot length; 5. fist length. Transversal body measures were: 1. shoulder width; 2. pelvis width; 3 fist width; 4. wrist joint width; 5. elbow width; 6. knee width; 7. foot width. Circular body measures assessing body volume were: 1. chest circumference; 2. upper arm circumference; 3. forearm circumference; 4. upper leg circumference; 5. lower leg circumference; 6. body mass. Subcutaneous fat tissue was measured by skinfolds of: 1. upper arm; 2 scapulas; 3. armpit; 4. iliac crest; 5. upper leg. Sample of the criteria variants comprised: 1. swimming time for the first 10 meters; 2. turning time of 5+5; 3. swimming time 50 meters.

Data processing methods

For the determination of the relationship among predictor (morphological characteristics) and criteria variables regressive analysis was applied.

Results and discussion

Regressive analysis of the main component in swimming crawl technique.

Looking into tables of the regressive analysis of the criteria variables of the swimming crawl technique (table from number 1 to 3) in the space of manifesting morphological significant data it has been noticed enough information on the influence of applied morphological variables onto the success in swimming crawl technique.

Tables 1-3. Regressive analysis of the relationship of the morphological characteristics and the crawl swimming speed.

Table 1.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.599	.358	.154	.920

Table 2.

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	34.057	23	1.481	1.749	.038
	Residual	60.943	72	.846		
	Total	95.000	95			

Table 3.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	body mass	.000	.000	.341	.915	.363
	body height	.004	.003	.304	1.298	.198
	arm length	-.001	.001	-.100	-.881	.381
	shoulders width	.003	.007	.056	.374	.709
	pelvic width	-.004	.007	-.072	-.535	.594
	leg length	-.005	.004	-.270	-1.450	.151
	fist length	.016	.016	.150	.983	.329
	fist width	-.116	.034	**-.557**	-3.427	**.001**
	wrist joint width	-.008	.032	-.031	-.245	.807
	elbow width	.031	.032	.130	.954	.344
	knee width	-.001	.024	-.011	-.058	.954
	foot width	.001	.026	.005	.034	.973
	foot length	.028	.014	**.367**	1.993	**.050**
	chest circumference	.000	.001	.033	.269	.788
	upper arm circumference	.002	.009	.047	.195	.846
	forearm circumference	-.005	.013	-.100	-.397	.692
	upper leg circumference	.006	.002	**.402**	2.393	**.013**
	lower leg circumference	-.010	.007	-.315	-1.521	.133
	upper arm skinfold	.001	.062	.004	.017	.987
	scapular skinfold	-.121	.078	-.388	-1.563	.123
	armpit skinfold	-.056	.072	-.185	-.780	.438
	illiac crest skinfold	.026	.040	.143	.649	.518
	upper leg skinfold	.078	.044	.347	1.766	.082

At .05 level of the reliability, correlation of predictor and criteria is r = .60 explaining 36% of common variability. By means of the analysis of the influence of single morphological variables (table number 3) it can be seen that the biggest and statistically significant influence have the variables fist width, upper leg circumference at the level .01 and foot length at the level .05. The analysis revealed that the fist width as well as the foot length had significant influence on swimming, what gives us the following remarks: when the fist width and the foot length are higher, the better is the body propulsion and, by that, results of crawl technique are better.

Conclusions

In this research we have obtained the biggest influence in three mentioned variables and we can conclude that they have the significant influence on efficiency of swimming crawl technique. Such a result contributes to the specification equation for this and similar populations. Moderate number of other valid variables of partial regressive coefficients obtained in the frame of presented regressive analysis, leads to the conclusion that the prediction of influences of the predictors on criteria variables can perform only by help of the whole system of predictor variables.

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ADULTS IN MUNICIPIALITY OF MARČANA AND THEIR PREFERENCES IN SPORT ACTIVITIES

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Abstract

In this research we used descriptive statistics and factor analysis and tryed to establish adult's interest in sport activities (in municipiality of Marčana) on relevant level, as well as effect on development of sport and quality of life (regarding population of 18 to 65 years old).

Facts for this research were collected by the survey ″PS2″ (Prot, 2007.). Respondents chose one out of 52 offered sports. Regarding their preference they gave grades from one (1) to five (5).

Key words: *physical activity, attitudes, interests, quality of life*

Introduction

School system and sport are two strong and firm factors that have effect on forming interests and making habits of everyday physical activity. Common permanence and affect of school system and sport is not on satisfactory level in municipiality of Marčana (Istria). All this is well evident, especially in default of indoor sport facilities (gym, pool, etc.) and outdoor playgrounds that are totally neglected. These reasons are important because they are slowing down sport development and adults interest in sport activities. We can suppose that this population hasn't got training habits and that they don't understand the importance of it.

Interest for sport activities, regarding sport fields, as well as differences based on gender was researched by many authors (Prot and Bosnar, 2007., Selmanović, A. and associates 2007., Oglesby. and associates 1993., Bass, D. and associates, 1999., Andrijašević, M. 2005., Raudsepp, L., 1999., Petric, V., 2008., Myers, L., and associates. 1996., Hager, M.S., and associates, 2001., and many others). They have established that there are sports in which men are more interested in, sports which attract both men and women, and sports which women are more interested in. Of course, with differences in these interests.

The purpose of this research is to analyse and establish adults interest in sport activities (in municipiality of Marčana) on relevant level, as well as effect on development of sport and quality of life (regarding population of 18 to 65 years old).

Methods

Respondents

Research has been made on a sample of 705 adults. Respondents are in the age of 18 to 65 and they live in municipiality of Marčana (Istria). We had 2 sets of respondents: 341 men and 364 women. They are representative for population of Marčana.

In this study were included respondents with different level of sport achievement: respondents who were never active in any sport, the one that were active only sometimes or for recreation, the one who acomplished significant achievements in school sport, one with achievement on local level, and respondents who had importan sport results on national or inernational level (Bosnar and Prot, 1999).

Sample of variables

Facts for this research were collected by the survey ″PS2″ (Prot, 2007.). Respondents chose one out of 52 offered sports on Lickert's charts (5 grades).

Grade five (5) was given for each sport they would really like to be active, grade four (4) for sports they would like

to be active, grade three (3) for sports they would like to be active from time to time, grade two (2) for sports they are not interested in, and grade one (1) they wouldn't like to be active, not in any conditions.

Methods of analysis

Informations in this research were analysed by the programme Statistic 5.0. Factor analysis was made by using the Guttman- Kaiser's criteria for establishing main components and normalised Varimex rotation. Average grades were shown on charts for each one of mentioned sports.

Results and discussion

In table 1, 2 and 3 we can see the results of interest for each sport activity established by factor analysis both for men's and women's population, as well as each population independent. Charts 1,2 and 3 show average grades for specific sport chosen by citizens of Marčana.

Table 1. Results of factor analysis both for men's and women's population

Factor	Eigenval	% total Variance	Cumul. Eigenval	Cumul.%
1	15,82	30,43	15,82	30,43
2	4,93	9,48	20,75	39,91
3	2,69	5,16	23,44	45,07
4	2,54	4,88	25,98	49,95
5	2,09	4,02	28,07	53,98

Reviewing results of factor analysis (Table 1.) we can conclude that there are five significant factors. *First factor* explains the biggest part of main variance (30,43%) and tell us that population at the age of 18 to 65 prefers complex sport activities (basketball, wolleyball, handball, tennis, table tennis, badmington). These sports are based on simple and complex movements; with one ore more subjects. *Second factor* shows a group of sports which are also very popular with this population. We are talking about esthetic and choreography set of movement structures (ice skating, rollerbading, sport gymnastic, dancing, synchronised swimming, aerobics). *Third factor* was structured with extreeme sport activities (hiking, free climbing, scuba diving, sport diving, parachuting). *Fourth factor* can be described as factor of circular sport activities like cycling, rowing, kayak, canoe, bowling, archery, etc. Finally, *fifth factor* describes martial arts where dominate complex movements with acircular character (judo, taekwondo, wrestling, karate, boxing, etc.)

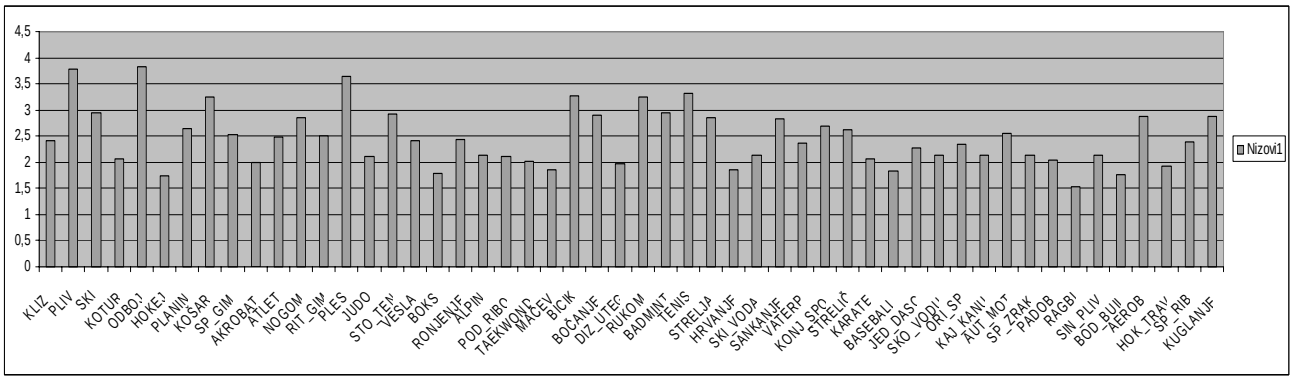

Chart 1. Average grades for offered sports, both men's and women's population.

Reviewing Chart 1. we can see that average grades, both men and women, completely describe established factors. Average grade three (3) was given for sports: swimming, wolleyball, basketball, dancing, cycling, handball, badmington and tennis.

Table 2. Results of factor analysis for men's population (municipiality of Marčana)

Factor	Eigenval	% total Variance	Cumul. Eigenval	Cumul.%
1	16,98	32,66	16,98	32,66
2	4,33	8,33	21,31	40,98
3	3,52	6,77	24,83	47,76
4	3,01	5,78	27,84	53,54

Results of factor analysis for men's population (Table 2.) shows that there are four significant factors. *First factor* which explain the biggest part of main variance (32,66%) we called the factor of complex sport activities (basketball, handball, tennis, table tennis, badmington, etc.). At the same time, these are activities that men prefer the most. *Second factor* describes martial arts (judo, wrestling, taekwondo, karate, boxing). *Third factor* is concerned on esthetic sport activities (ice skating, rollerblading, sports gymnastic, dancing, aerobic). Finally, *fourth factor* describes sports that men don't prefer, like circular sport activities (rowing, kayak, canue, horse riding).

From received informations we can conclude that men's population of Municipiality of Marčana prefers complex sport activities (basketball, handball, tennis) which demand specific infrastructure (sport facilities, gym,etc.), while they are not interested in circular sport activities (rowing, kayak,…). One of the possible reasons for this kind of choice is that in their free time they are already involved in circular activities, so they would like to try some different activities. Unfortunatelly, so far they didn't have conditions for it.

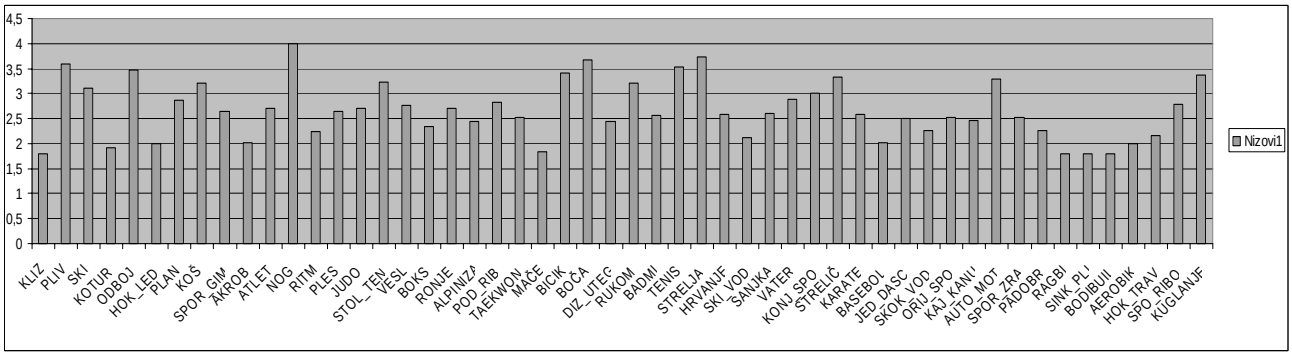

Chart 2. Average grades for offered sports regarding men's population.

Reviewing Chart 2. we can see that grades are coincide with received factors. In average, men's population gave better marks than three (3) for sports: swimming, skiing, wolleyball, table tennis, basketball, cycling, bowling, handball, tennis, archery, car racing and motocycling.

Table 3. Results of factor analysis for women's population (Municipiality of Marčana)

Factor	Eigenval	% total Variance	Cumul. Eigenval	Cumul.%
1	14,96	28,76	14,96	28,76
2	4,14	7,96	19,10	36,73
3	3,01	5,79	22,11	42,52
4	2,78	5,35	24,89	47,87

Results of factor analysis for women's population (Table 3.) show that there are four significant factors. *First factor* which explains 29% of main variance is the factor of complex sport activities (basketball, handball, tennis, table tennis, badmington, etc.). *Second factor* describes circular sport activities (swimming, cycling, athletics), while *third factor* describes esthetic sport activities (dancing, aerobics, gymnastics). *Fourth factor* was based on polistructural sport activities (judo, karate, wrestling, hockey, fencing). From this informations, we can conclude that women's population like activities with ball, too. This fact (that people from rural parts prefer sport activities with ball) was already shown in some other

studies (Petrić and associates, 2007.; Ozdrinec and associates, 2005.). Activities they don't like are polistructural where dominates physical contact.

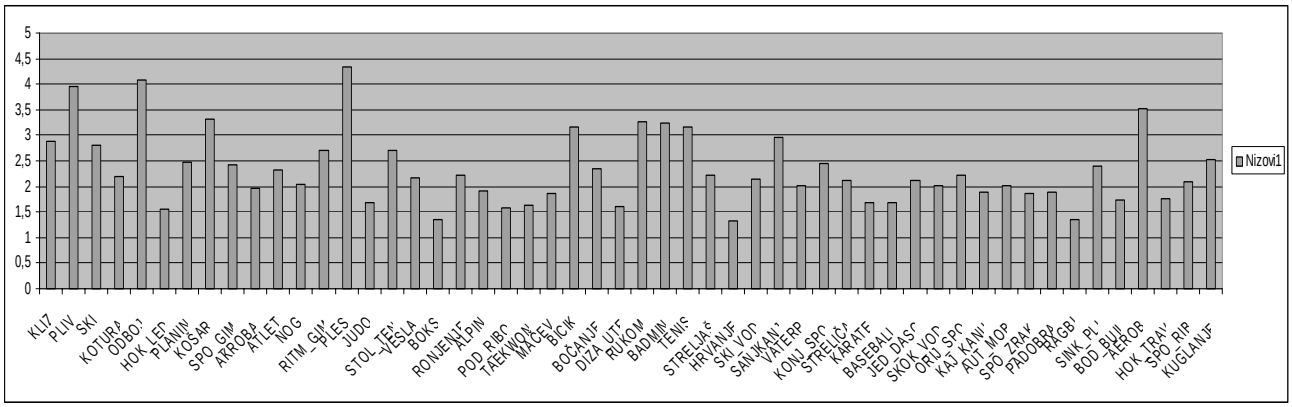

Chart 3. Average grades for offered sports regarding women's population.

In average, women's population gave better marks than three (3) for sports: swimming, wolleyball, basketball, dancing, cycling, handball, badmington, tennis and aerobicc.

Sport activities like swimming and cycling got very high grades for both populations. We can suppose that this is because Marčana is a place with less traffic, so it is very suitable for riding a bike, as well as swimming in summer period.

Conclusion

Regarding received informations of factor analysis at both gender, it is evident that they prefer complex sport activities more than circular activities, esthetic sport activities, while extreem activities and polistructural sport activities are less popular.

The fact that this population (from rural parts) prefers sport activities which includes ball (with necessary infrastructure) was one more time confirmed.

Thanks to factor analysis and average grade we can conclude that there are differences between men's and women's population regarding interests in sport activities. Complex factor is included with men's and women's population, but in different sports (for example, men prefer football, while women prefer wolleyball).

In further researches, it would be good to establish conection between preferences towards sports with activities which respondents realize in their free time, to get precize information about their interests.

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WORK CONDITIONS: A HEALTH RISK FACTOR IN PHYSICAL EDUCATION TEACHERS?

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Abstract

The purpose of this study was to: (1) obtain an insight into the morbidity of the physical education (PE) teachers in primary and secondary schools in the Republic of Croatia, and (2) explore the association of the teachers' health status and their satisfaction with work conditions. A sample of 479 teachers was investigated applying a questionnaire covering personal/demographic data, health status, life-style habits, and workplace satisfaction. Mann-Whitney U-test was used to determine whether differences in workplace satisfaction between PE teachers with and without health disturbances were significant. 62.8% (n=301) teachers reported having health disturbances. The most frequently affected organ systems were musculoskeletal, cardiovascular, gastrointestinal, and respiratory. A significantly higher proportion of the teachers without health impairments reported being satisfied or very satisfied with six workplace aspects: overall job satisfaction, work conditions, interpersonal relations, pupils' behaviour, relations with supervisors, and rewards. Further research on work-related health risk factors in PE teachers in Croatia will provide ground for health enhancement interventions.

Key words: *physical education teachers, occupational health, work conditions, health risk factors*

Introduction

Workplace conditions and professional demands can largely influence a person's health. In comparison to other professions, teaching is considered a high stress occupation. High workload and organizational constraints have been related to illness symptoms (Lazuras, 2006). Different studies have shown that teachers feel strained by large classes, pupils' behaviour, frequent changes in the education systems, by their low occupational image, and lack of support from colleagues (Bauer et al., 2007). The teachers' morbidity spectrum has been shown to primarily include stress-associated diseases (Weber et al., 2005). The impaired health is strongly influencing the rates of teachers' premature retirement, as shown in several European studies (Bauer et al, 2006; Bauer et al., 2007; Weber et al., 2005). E.g., in Germany, the rates of premature retirement among school teachers due to health disorders are consistently higher than those of other public service employees (Bauer et al., 2007), with psychiatric and/or psychosomatic disorders being the leading causes of premature retirement (Bauer et al, 2006; Bauer et al., 2007; Weber et al., 2005).

In addition to the work strains and demands experienced by the school teachers in general, PE teachers are also exposed to physical workload. Although physical activity, in general, represents a health-protective factor, some studies suggest that teaching PE is associated with a high potential of acute and chronic injuries (Lemoyne et al., 2007). PE teaching may also include high energy consumption in terms of running, carrying and setting up equipment. Other factors that might represent risk for injuries are safety spotting of children in gymnastics, skill demonstrations, repetitive movements (e.g. throwing balls), etc. (Lemoyne et al., 2007).

To the authors' best knowledge, no comprehensive investigation on PE teachers' morbidity, work conditions, and their association has so far been conducted in Croatia. Thus, the present study, as a part of a larger investigation, sought to: (1) obtain an insight into the morbidity of the PE teachers in primary and secondary schools in the Republic of Croatia, and (2) explore the association of the teachers' health status and their satisfaction with work conditions.

Methods

Subjects

In this cross-sectional study, a questionnaire was sent to the PE teachers directly or via schools with the support of the Ministry of Science, Education and Sport, and the Education and Teacher Training Agency. Of the 700 questionnaires sent, 491 were returned (response rate = 70.1%). 11 teachers worked in physical recreation centres, and 1 teacher worked at a faculty. These 12 subjects were excluded from the study, thus the final study sample included 479 teachers working in primary or secondary schools. 194 (40.5%) were females. The teachers were aged 23-66 years (mean ± SD: 46.5 ± 11.0 years). The duration of employment in schools ranged from 0.5 to 46 years (mean ± SD: 19.6 ± 12.3 years). The

participants represented all parts of Croatia: 25.1% were from Eastern Croatia, 14.2% from Northern Croatia, 15.0% from Central Croatia, 12.1% from Western Croatia, 20.9% from Southern Croatia, and 12.7% from the city of Zagreb.

Questionnaire

The data analysed in this paper constitute a part of a database collected by an anonymous questionnaire, composed for a larger study on health and quality of life of PE teachers. The questionnaire consisted of questions on personal/demographic data, health status, psychosomatic characteristics during the year prior to the investigation, life-style habits (nutrition and leisure-time physical activity), and workplace satisfaction (overall job satisfaction, work conditions, interpersonal relations at the workplace, pupils' behaviour, relations with supervisors, rewards (salary, and other parameters), professional development possibilities, (local) community's appreciation of their work). A Likert-type scale was used for the workplace satisfaction responses. Possible responses ranged on a 5-point scale from "very unsatisfied" to "very satisfied".

Written information about the purpose of the study was provided.

Statistical analysis

Statistical analysis was carried out using Statistica for Windows (ver 7.0). Frequency tables were used to describe discrete variables. Means and standard deviations were calculated for continuous variables. After testing for their skewness and kurtosis, the workplace satisfaction variables did not show a normal distribution. Thus, Mann-Whitney U-test was used to determine whether differences in the workplace satisfaction between PE teachers with and without health disturbances were significant. Statistical significance was set at $P < 0.05$.

Results

62.8% (n=301) teachers reported experiencing health disturbances during their work life. The following organ systems were most frequently affected: (1) musculoskeletal (47.4%, n=227); (2) cardiovascular (11.1%, n=53); (3) gastrointestinal (7.9%, n=38); and (4) respiratory (4.8%, n=23). As for the specific diseases and symptoms, the highest prevalence was found for low back pain (45.7%), hyperlipidemia (17.5%), arterial hypertension (16.9%), tortuous veins (14.8%), rheumatism symptoms (14.4%), and gastritis and/or ulcer (12.7%). Multi-morbidity (in the sense of more than two diseases/disturbances of different organ systems) was found in 16.7% (n=80) teachers.

When comparing workplace satisfaction aspects between healthy teachers and teachers with health disturbances, a significantly higher proportion of the teachers without health impairments reported being satisfied or very satisfied in six measured aspects: overall job satisfaction ($p<0.01$), work conditions ($p=0.013$), interpersonal relations ($p=0.038$), pupils' behaviour ($p=0.026$), relations with supervisors ($p<0.01$), and rewards ($p<0.01$) (Mann-Whitney U-test; the results are given in Table 1).

Table 1. Differences in self-reported level of satisfaction with the workplace characteristics in PE teachers with and without health impairment (Mann-Whitney U-test)

	mean (healthy)	mean (with health disturbances)	U	Z	p-level	Z adjusted	p-level
overall job satisfaction	4.53	4.10	18777.50	5.03	0.0000	5.53	0.0000**
work conditions	3.38	3.07	22432.00	2.39	0.0168	2.49	0.0128*
interpersonal relations	4.09	3.85	23231.50	1.93	0.0533	2.08	0.0377*
pupils' behaviour	3.90	3.65	23073.50	2.04	0.0411	2.23	0.0258*
relations with supervisors	4.34	3.96	21187.00	3.35	0.0008	3.63	0.0003**
rewards (salary, etc.)	2.69	2.24	20625.50	3.74	0.0002	3.91	0.0001**
professional development possibilities	3.55	3.46	25023.00	0.69	0.4925	0.72	0.4707
(local) community's appreciation	2.84	2.70	24398.00	1.12	0.2623	1.16	0.2475

statistically significant: *p<0.05; **p<0.01

The distribution of the answers regarding the overall job satisfaction in teachers with and without health disturbances is presented in the Figure 1.

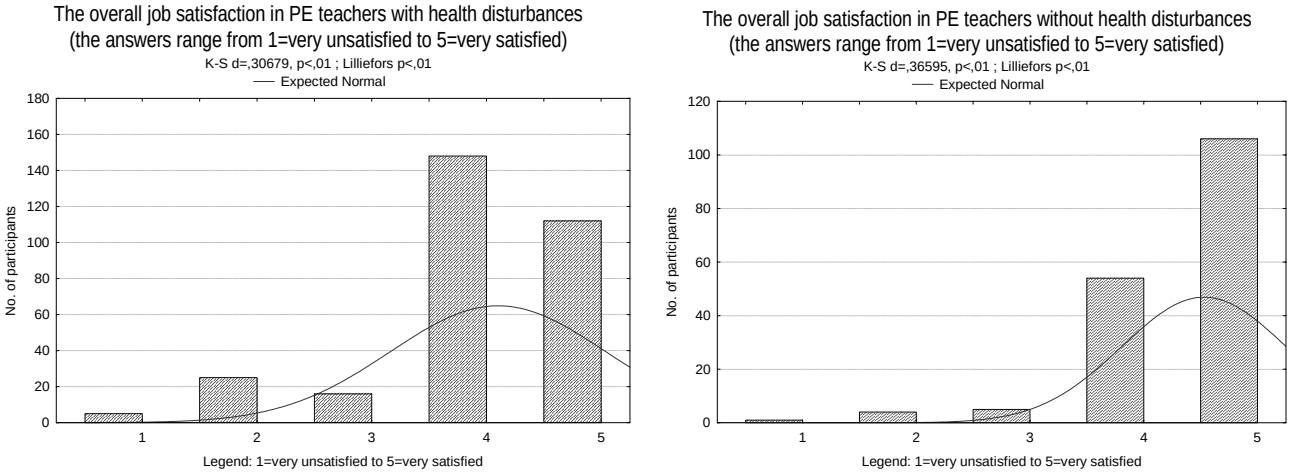

Figure 1. Distribution of the answers regarding the overall job satisfaction in PE teachers with and without health disturbances, respectively (the answers range from 1=very unsatisfied to 5=very satisfied)

Discussion and conclusions

Morbidity spectrum and the association of the health status and satisfaction with the work conditions were analyzed in 479 PE teachers working either in primary or secondary schools in the Republic of Croatia. Although the participants were not chosen randomly, the sample is still representative for all PE teachers working in primary and secondary schools. The teachers from all regions of the Republic of Croatia were included in the study. Sixty-three percent of the teachers had experienced some health disturbances during their work life. The most frequently affected organ systems were musculoskeletal, cardiovascular, gastrointestinal, and respiratory. The finding of the high prevalence of musculoskeletal disorders is in agreement with previously reported results (Lemoyne et al., 2007), suggesting the probable high importance of occupational physical load in the occurrence of acute and chronic (overuse) injuries in PE teachers.

The most frequently stated ailments were low back pain, hyperlipidemia, arterial hypertension, tortuous veins, rheumatism symptoms, and gastritis and/or ulcer. Although we cannot evaluate their cause and aetiopathogenesis, this morbidity spectrum is predominately characterized by the health impairments that could be attributed to the psychosomatic group, i.e. diseases largely associated with exogenous, possibly also work-related, stress factors (Weber, 2005).

Comparison of the workplace satisfaction level (as a possible indicator of work-related stress) between healthy teachers and teachers with health disturbances showed a significantly higher proportion of the healthy teachers being satisfied or very satisfied with six workplace aspects: overall job satisfaction, work conditions, interpersonal relations, pupils' behaviour, relations with supervisors, and rewards. A higher proportion of low satisfaction rates, given by the health-impaired group, is in agreement with previous studies (Bauer et al., 2006; Bauer et al., 2007; Phillips et al., 2007), where similar workplace aspects had been put forth as significant sources of work-related stress in teachers. Bauer et al. (2006) reported that teachers rate destructive and aggressive behaviour of pupils as the primary stress factor. They are burdened by a high working load and dealing with adverse events caused not only by pupils, but also by parents (Bauer et al., 2007). Philips et al. (2007) found work overload and work-life imbalance being the key stressors. Other than to workload, illness symptoms have been shown to be also related to organizational constraints and interpersonal conflict (Lazuras, 2006).

Obviously, we cannot draw conclusions on the causal relationship between the workplace conditions and health impairments due to the limitations inherent to the cross-sectional study design. Namely, it might be possible that the persons with health disturbances rated their work conditions as less satisfactory as a result of their lower overall mood, influenced by the impaired health status. A possible selection bias related to the postal self-reported questionnaire studies should also be taken into account when interpreting the results. Though the response rate was high (70.1%), the possibility that responders and non-responders might differ cannot be excluded. The teachers that did not return the questionnaires might: (1) belong to a more heavily burdened fraction or might have been absent due to illness, or, (2) not have shown interest to participate on account of not being ill nor burdened at all (Bauer et al., 2006; Bauer et al., 2007; Phillips et al., 2007).

In conclusion - albeit limited, the results of this preliminary study indicate an existing need for further research on the physical and mental occupational strain in PE teachers, possibly triggering the development of different health impairments. Defining the association between occupational stress and health outcomes would provide ground for applying appropriate preventive and protective measures.

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THE CATEGORISATION OF SPORT ACTIVITIES IN THE DOMAIN OF CERTAIN ANTHROPOLOGICAL FEATURES

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Abstract

With the purpose of categorising 14 sport activities in relation to the importance of 11 different anthropological features to succeed in them, and through cluster analysis, the expert knowledge of 52 kinesiology teachers has been analyzed. By applying the cluster analysis, hierarchical grouping of sport activities in relation to 11 anthropological features has been done, 4 out of which are variables of the morphological domain, 6 are of the motor and 1 of the functional domain, ordinarily a component of the standard battery for the assessment of anthropological features in children in school system in the Republic of Croatia. Three groups of sports have been categorised. Their detection is used for better comprehension of the structure of sport activities from the anthropological point of view as well as for directing children to a certain sport group primarily if we discuss the process of selection within universal sport schools.

Key words: *sport, anthropological features, cluster analysis, experts*

Introduction

Sport activities differ to a large extent in structure and content. Different sports are characterised by authentic kinesiological structures and specific anthropological features. The success of an individual in a certain sport activity depends mostly on the compatibility of his anthropological features, or the so-called anthropological model for the given sport (Katić et al., 2005). Therefore, it is crucial to select athletes whose anthropological features match specific qualities of a certain kinesiological activity as much as possible. Beginning with the importance of precise selection of children in sport, the Institute of Kinesiology and Polytechnics of Faculty of Science and Kinesiology in Split within the science project *Discovering talents in sport* has developed an expert system for discovering talents in sport – TALENT (Rogulj, N., Papić, V., 2007). The base of knowledge on which the system is founded consists of normative orientational values of school children in the Republic of Croatia obtained through a comprehensive research conducted in 1992 by V. Findak, D. Metikoš and M. Mraković within the project of methodology of monitoring and assessing physical education in the school system. Normative values contain the results of 11 variables to assess anthropological features in school children, 6 out of which are tests for assessing basic motor abilities, 4 for the assessment of morphological characteristics and one to assess functional abilities. The other part of the knowledge base represents grades which kinesiological experts used to assess the importance of the anthropological features measured by the mentioned tests for success in a certain activity. Based on the given grades, the categorization of sport activities in relation to the variables of the anthropological domain will be carried out which is one of the preconditions to make the algorithm of the expert system. Therefore, the purpose of this research is to categorise sport activities according to the expert assessment of certain anthropological features to succeed in them.

Methods

The research was conducted on the sample of 52 kinesiology teachers who used the numerical grades on the scale from (-10) to 10 to evaluate quantitative contribution of certain motor abilities to potential efficiency in different sport activities. The total of 14 sport activities encompassed by this expert system were analysed: football, handball, basketball, volleyball, waterpolo, swimming, rowing, sport gymnastics, athlethics-sprint/jumps, athletics-throws, athletics - long-distance running, martial arts-hitting, martial arts-pulling and pushing and tennis.

Sport activities were assessed in terms of 11 variables to evaluate anthropological features in school children, 6 out of which are to assess basic motor abilities as it follows: training site excercise backwards to assess coordination, hand tapping to assess frequency speed of hand movements, astride touch-toe to assess flexibility, the long jump from a spot to assess explosive power of take-off, lifting trunk to assess repetitive power of trunk, hanging endurance to assess static power of arms and shoulders, one test to assess functional abilities in terms of aerobic endurance (6-minute running) and 4 to assess morphological features (body weight, body height, the circumference of the lower leg and the skin fold of the upper arm).

Within the basic statistical processing, average grades were obtained and they represent the assessment of the significance of a certain anthropological feature for success in each of the analysed sport activities. The categorisation of sport activities was done through cluster analysis under Ward`s model (Ward, 1963). This model reduces the sum of square deviations to a minimum in any two of the hypothetical entity groups, which can be formed at each step.

Results and discussion

Table 1 displays arithmetic mean of grades which the kinesiological experts used to evaluate the significance of a certain anthropological component for success in a certain sport activity. Negative sign is observed only in the domain of anthropometrical varibles such as in sub-skin fat tissue. This is actually ballast mass which has been proved through many researches to have a negative impact on success in almost all sports (e.g. Marić, G., 2007; Babić et al., 2007). Sub-skin fat tissue is particularly counterindicated in kinesiological activities in which one has to `carry` body weight and which therefore require the reduction of the ballast mass to minimum due to rational use of energy and kinetic and kinematic movement efficiency. Fat tissue is accepted, to a certain degree, exclusively in sports in which it supports inertion potential as additional weight when giving acceleration to a projectile of higher weight (e.g. in some throwing disciplines) or in certain martial arts where body weight is used to keep a position or push the opponent out. By inspecting the table it is obvious which anthropological features the experts found most and which ones the least important for success in each of the 14 analysed activities. Body weight and explosive power are significant in the athletic discipline of throwing. Aerobic endurance and low body weight, especially with regard to fat tissue, are significant in the athletic discipline of long-distance running. Explosive power is essential in athletic sprint and jump disciplines as well as in handball. Static strength of arms is important in martial arts based on pushing and pulling, flexibility, hand movement frequency and explosive power in martial arts based on hitting, longitudinal dimensionality of the skeleton, explosive power and coordination in basketball, coordination, aerobic endurance and explosive power in football, explosive power and longitudinal dimensionality of skeleton in volleyball, movement frequency, aerobic endurance and repetitive power in swimming and static and explosive power, flexibility and smaller longitudinal dimensionality of skeleton in sport gymnastics. Aerobic endurance, movement frequency and explosive power are particularly important in tennis, aerobic endurance, repetitive power and more underlined dimensionality of body in waterpolo, while rowing requires repetitive and static power and aerobic endurance.

Table 1. Arithmetic means of the experts` grades

SPORT	SIT-UPS	LONG JUMP	TRAIN. SITE	TAP.	TOUCH-TOE	HANG. END.	6MIN. RUN.	HEIGHT	WEIGHT	LOWER LEG	UPPER ARM
ATHLETICS_THROWING	7,62	8,53	3,15	5,83	3,77	4,47	2,53	8,03	8,76	8,00	4,48
ATHLETICS-LONG DIST.	7,96	2,38	2,55	3,06	3,40	4,26	9,76	-0,31	-6,65	-4,27	-6,46
ATHLETICS-SPRINTS	6,64	9,81	5,45	6,36	6,04	3,77	3,19	6,13	-2,71	1,50	-4,00
MARTIAL ARTS-PULL.	7,77	5,09	7,89	4,43	5,83	8,15	5,70	1,57*	3,65*	6,96	2,91
MARTIAL ARTS-HITT.	5,51	8,13	6,60	8,55	8,87	6,57	5,51	2,90*	0,40*	4,25	-0,30
BASKETBALL	5,51	8,94	7,47	7,45	5,32	4,28	6,87	9,77	2,80	3,77	0,69
FOOTBALL	6,60	8,13	7,98	5,40	5,11	4,11	8,80	3,86	1,64	1,68	0,43
VOLLEYBALL	5,57	9,23	7,40	7,81	6,19	4,70	6,23	9,37	0,10	3,87	-0,60
SWIMMING	7,53	6,51	5,47	7,60	5,70	5,17	7,95	7,96	-0,69	3,46	0,04
HANDBALL	5,13	8,91	6,96	7,85	4,96	5,83	7,51	7,38	3,69	5,97	0,97
GYMNASTICS	8,11	9,04	9,04	7,11	9,57	8,79	3,89	-6,66	-7,31	5,54	-4,00
TENNIS	6,60	7,02	6,00	7,79	5,81	5,19	8,40	5,71	-0,38	5,90	0,71
WATERPOLO	8,02	4,34	5,11	6,57	4,79	6,98	8,38	8,11	5,14	6,96	2,50
ROWING	8,04	5,09	7,26	5,40	4,77	8,19	8,48	7,24	2,45	7,83	1,52

The graph displays the results of cluster analysis. Evidently the first group is made of sport activities which require an anthropological framework based on the combination of higher skeleton dimensionality in addition to voluminousity and body weight with abilities which are mostly based on mechanisms for the regulation of stimulus duration and energy such as repetitive and static power and endurance. Strainings in these sports are more of an energy and muscular than of information type. These are primarily sports dominated by strength and endurance as well as single or repeated overcoming of outer resistance such as water, an apparatus or an opponent which requires a bigger muscular and total body weight.

The second group consists of sports mainly based on mechanisms for maintaining intensity of excitation, regulation of tonus and synergy regulation, i. e. activities dominated by speed, explosive power, agility and flexibility. These are primarily sport games, i.e. polystructural complexed kinesiological activities based on combination of acyclical and

cyclical movement structures. Strainings in these sports are more of an information and muscular, than of energy type and their basic mutual characteristic is multiple performing of different single movements with maximum intensity. This kind of a motor framework is followed by a coorresponding morphological profile where longitudinal dimensionality dominates over the voluminousity measurements and body weight, and which is in better accordance with physical and kynematic demands in these sport activities.

The last group contains sport activities primarily characterised by a specific morphological model based on low longitudinal skeleton dimensionality and body weight. This kind of the anthropological framework is specific for sports where higher skeleton dimensionality, voluminousity and body weight disable efficient use of body to perform demanding kinesiological structures (gymnastics) or rational energy consumption essential in cyclical sports (long-distance running in athletics).

The dendrogram displays pairs of sport activities characterised by a similar anthropological profile such as handball and basketball, swimming and tennis, rowing and waterpolo or martial arts based on hitting and athletic sprint or jump disciplines.

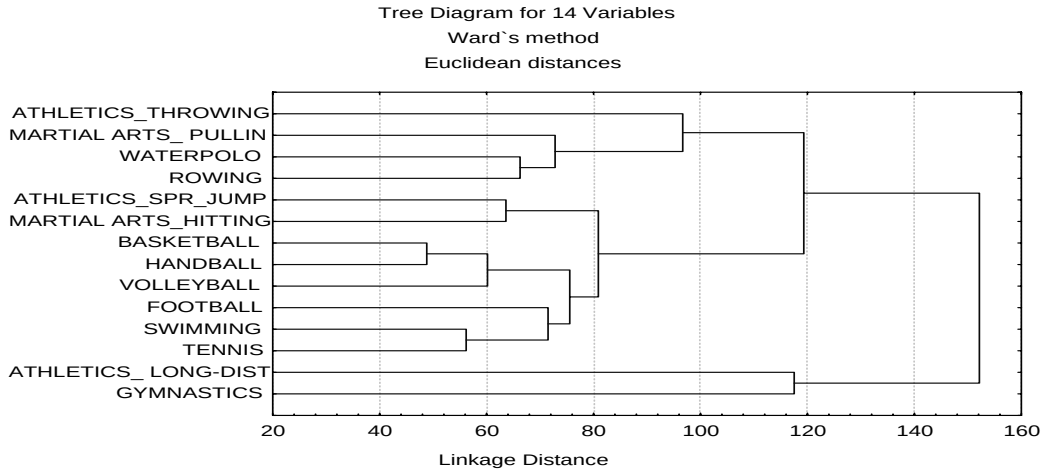

Diagram 1. Graphic presentation of cluster analysis

Conclusion

Selection of athletes is most frequently done without any clear criteria, on a low methodological level and by subjective and not scientifically based assessments. Furthermore, occasionally, and most frequently in more commercial sports, selection is not based on sport, but some other criteria. It is therefore essential that selection in sport is approached in a systematic and scientifically based way through modern information technologies. One of the options is to use expert knowledge and to construct expert systems by which the given knowledge will be directed towards the solution of the problem of selection in sport. The researches whereby kinesiological activities are being cathegorised through factor and taxonomy models and in relation to individual anthropological features in athletes, can certainly contribute to this. However, it should be clear that, as far as the anthropological features are considered, selection should be based on abilities and characteristics genetically determined, not on those which may, to a large degree, be altered under the influence of environment and kinesiological processes. This article is trying to hierarchically group sport activities by the expert kinesiologists` assessment of the significance of certain anthropological features to succeed in them. Obtained results can be used for better comprehension of the structure of sport activities from the aspect of their anthropological basis as well as for a better direction of children and potential athletes to certain sport groups characterised by similar anthropological frameworks. The necessity for the selection of children to related sport groups is a part of the primary selection within universal sport schools.

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NEW PERSPECTIVES FOR PERFORMANCE ANALYSIS IN GYMNASTICS, HANDBALL AND SKIING

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Abstract

Performance analysis for very complex performances in technical disciplines is complicated. The first analysts have traditionally focused on team and match-play sports and various techniques have been effectively used to collect and analyse data in these sports (Hughes and Bartlett, 2002). However, there is no evidence in the literature of computerized, real-time analysis used in rhythmic gymnastics and other type of sports with movement composition. Second, the time cost to obtain the necessary quantitative data from video digitization is so high that the advantages of immediate feedback are not available to the athlete and the coach (Kall, T.O., 2004). To facilitate the immediate feedback benefits to improve performance, rapid performance analysis methods must be developed. Therefore, the aim of this study was to develop and evaluate performance analysis systems to determine real time kinematics for sports such as skiing, gymnastics and handball.

At first a video based computer program was developed in order to get a detailed analysis of the actual performance of elite groups in modern rhythmic gymnastics and second we tried to fulfill these requirements by using a radiofrequency LPM-system (ABATEC) in combination RF@Sports software tool. First the static accuracy of the system was determined by calculating the circular probable error (CEP), after which we determined the system's accuracy in static and dynamic conditions. Pilot applications using three different sports were completed.

The greatest advantage of the systems is the ability of the coach to obtain immediate feedback or real-time data in order to provide immediate performance feedback to athletes. Because this is a new system of measurement, data regarding the mechanical reliability, validity, and required accuracy does not exist in the literature. This program helps to analyze data such as elements with varying difficulties, the area covered, parameters that govern optimal performance while transitioning between gymnastic apparati, the number of appliance changes and the distances covered with each appliance, and the comparison of the synchronicity in movement execution. Variables analyzed in slalom skiing included performance-time and velocity-time structures, distances to other athletes and to goals, drive lines of both skis, and pressure applied to the right or left ski. The calculated accuracy of CEP95 (26,95mm), in combination with the marginal dynamic deviation (0,27%), holds promise as an effective analysis system for predetermined performance variables that are strongly associated with success. In addition, the system covers a wide field (max 500x500m). Further research and software development will focus on quantifying the critical performance values and expanding the software for other sports.

Key words: *performance analysis, computer program, performance feedback*

Introduction

Finding an indoor determining positions system that covers a large area in real time, is a desirable aim in the field off sports analysis. We tried to fulfil these requirements by using the radiofrequency LPM-system from ABATEC in combination with a therefore designed software tool. First we prove the accuracy of the System in static and dynamic conditions. Afterwards we used the opportunities of the system in field of sport at three different examples. By observing the trajectory of the gymnasts during rhythmic gymnastics choreography, we want to figure out how they use the regularized area. The other surveyed sport is handball and alpine skiing. In this field we proved if the system has the ability to clarify the running behaviour of the players on the play ground during the game and to compare different skier or different runs. Finding an indoor determining positions system that covers a large area in real time, is a desirable aim in the field off sports analysis.

Methods

After installing the system the static accuracy has been proved by calculating the Circular Error Probable (CEP). Thus we put 5 transponders in the measurement area to record their position data. A tachymeter was used to detect the real position. To measure the dynamic accuracy we used an odometer which was connected with a transponder of the radiofrequency system. After we covered an arbitrarily chosen distance, we were able to compare the measured distance

of the odometer and the transponder. During the sport measurements a software tool, RF@Sports, was used to record the choreography of six gymnasts inside of the normal competition area (13x13 m). On the other hand we measured the way-time relation (positioning) of handball players on the handball field and alpine skiing athletes on a slalom track. In this part of the study we tried to figure out the different position of the skis to each other in relation to the race time and drift way. This was possible by equipping both skis with two transmitters (Fig.6).

The measurement was done by 2 transponders included in a belt system (Fig.1) The system covers a wide field (max 500x500m).

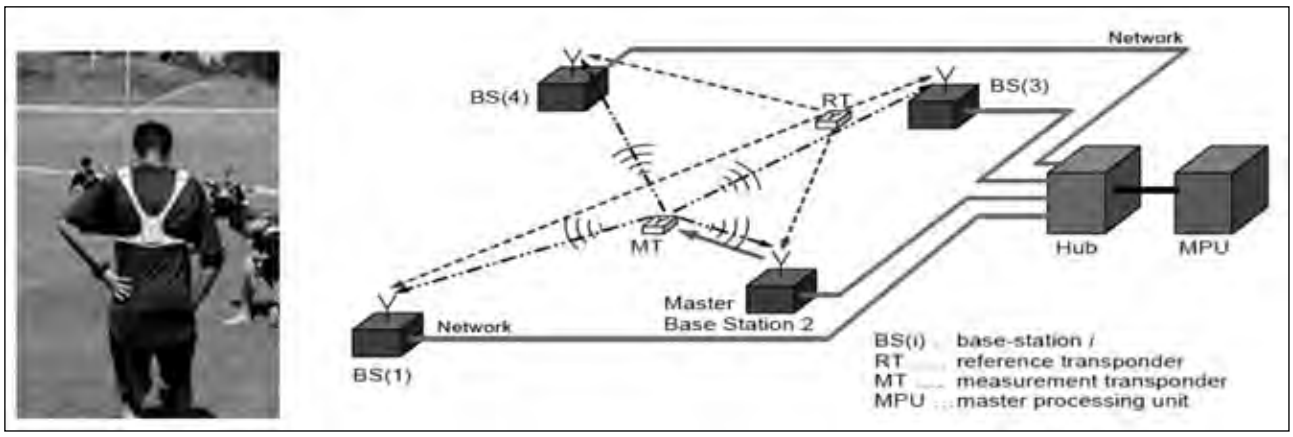

Figure 1. Measurement belt with transponder

Results

Analysis with radio frequency LPM-system and RF@Sport in Gymnastic, Handball and Skiing

This program allows the coach to obtain valuable data and immediate, real-time feedback regarding optimal performance parameters during a gymnastic composition.

Figure 2. Proving the accuracy of formation of groups

These variables include the execution of selected elements with varying difficulties, the area covered, parameters that govern optimal performance while transitioning between gymnastic apparatus, the number of appliance changes and the distances covered with each appliance, and the comparison of the synchronicity in movement execution.

The system gives immediate information about the motion position of all gymnasts and the accurate standing position during the execution of different formation and formation changes on the competition area (Fig.2). For evaluation of keeping in line or defined pattern structures is a big advantage. But the system is presently not able to analyse parameters as way and time trajectories of apparatus, to identify movement elements and the synchronicity of movements.

Handball

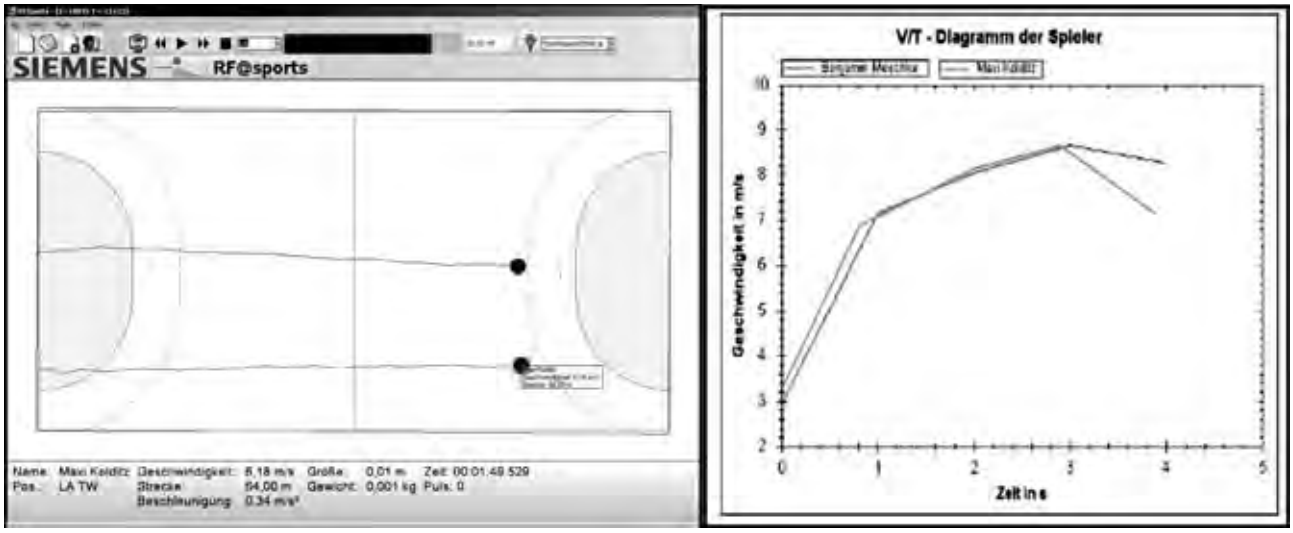

Figure 3. Trajectories of 2 players during 30m sprint and v-t Diagram of one player

This system can be also used during the Handball training. The coach can monitor his players to receive information about the running behaviour and the velocity of the players (Fig. 3) on the competition field with respect to the heart rate. The system delivers information where the players are moving during attacks and defending parts of the game. The coach can follow the player and prove over a definite time whether the player is doing his special task or not, is he playing on the right position or not. For instance, is the player covering a special place on the field for which he is responsible (Fig. 4). This system also allows the individual players to receive objective feedback about his performance and about interactions between his own team members and that of the opponents.

In the future we hope to develop the hard and software of the system to enable coaches to have real-time information about

- the ball trajectories,
- the number of different techniques for throwing the ball,
- for the number of attempts on goal,
- the ability to defend the goal area and to prevent the attacking members of the opposition from creating goal chances.

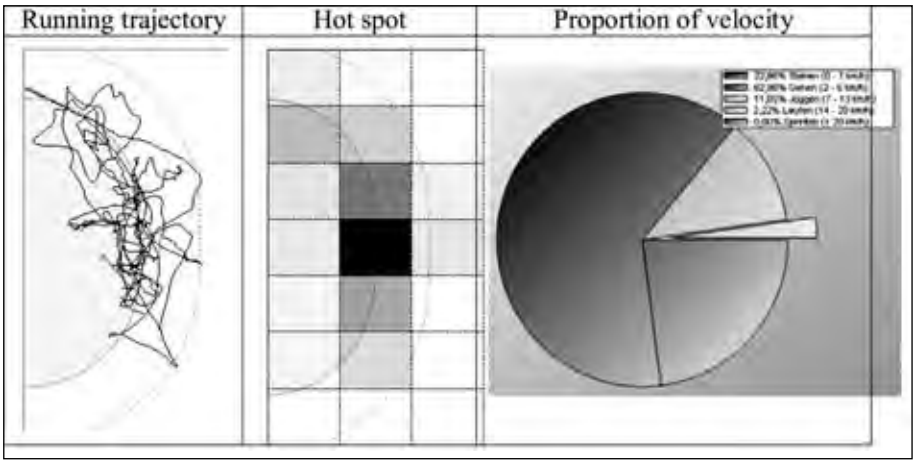

Figure 4. Running trajectories and hot spot

Furthermore, it will be possible to determine how often a payer can implement techniques which confuse/mislead the opponents, and identify key players who have a strong influence on the results of the game.

Skiing

Variables analyzed in slalom skiing included performance-time and velocity-time structures, distances to other athletes and to goals, drive lines of both skis, and pressure applied to the right or left ski.

Figure 5. Ski with two transmitters on both ends of the ski

The calculated accuracy of CEP95 (26,95mm), in combination with the marginal dynamic deviation (0,27%), holds promise as an effective analysis system for predetermined performance variables that are strongly associated with success.

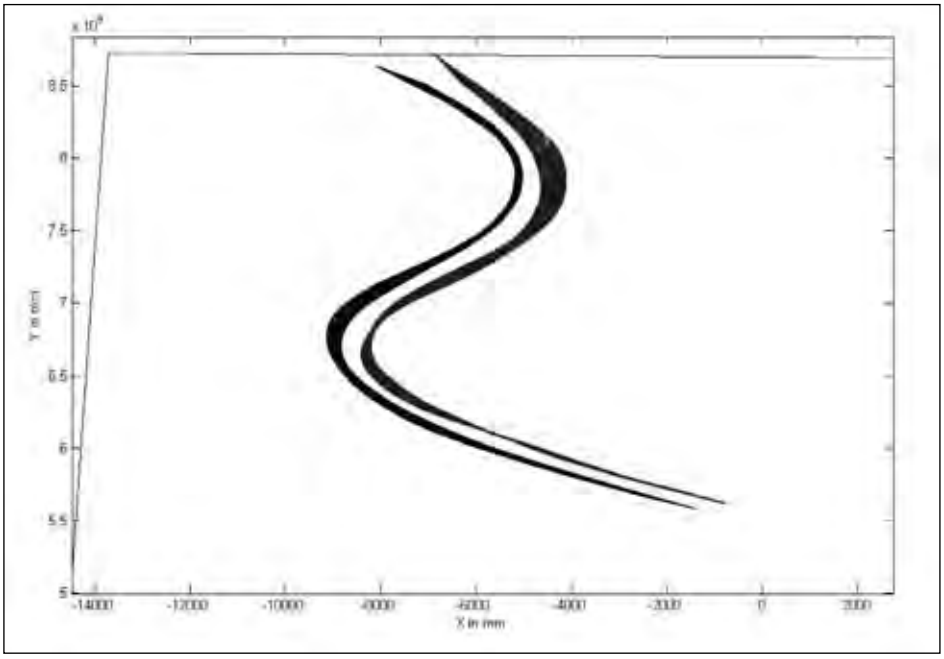

Figure 6. Ski technique

It is possible to identify the ski technique of the skier. The picture shows a part of the racing curves (Fig. 5, 6).

- The position of the skis clearly show a snow plough form at the beginning;
- Subsequent parallel, i.e. the right and left skis merge to form parallel lines;
- Surface demonstrates drifting and in which curve the pressure on the ski is exerted;
- Ideal is: the rear trajectory congruent to the forward trajectory of the skis

The system allows an automatic recognition of skiing technique or style as well as an analysis of errors.

The LPM system has been developed especially for indoor skiing, to promote summer training and thus to improve the ski techniques of the skier, and make them more effective. There has been a special emphasis on slalom skiing. The detailed real time feedback data gives the opportunity for conclusions regarding material requirements under special snow conditions.

Conclusions

Both systems help to get in real time or after short time detailed information about important performance parameters for gymnastics, for handball and for skiing. So, the systems can help to make the trainings process more effective. The aim for the next time is to find technical solutions to include the trajectories of used apparatuses (ball, hoop, clubs).

Further research and software development will focus on quantifying the critical performance values and expanding the software for other sports.

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ADVANCED LEFT-HANDED ATHLETES OF DIFFERENT SPORT DISCIPLINES IN THE MOTOR EDUCATION SYSTEM FOR RIGHT-HANDED PERSONS

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"The hand is the outer brain of the human being"
[E. Kant, 1724-1804]

Abstract

Different scientific disciplines, including also the science of human movements - anthropokinesiology [Starosta, 2006], comprise issues that are vital and those that are marginal.

1. In various countries left-handed persons constitute on average from 5 to 50% of the entire population. As they have to live in a society of right-handers, they are forced to become adapted to them. Effects of such adaptation depend on individual predispositions of the person and on the attitude of the society to left-handed persons. 2. Depending on the progress of the adaptation process its consequences may vary. In many cases it was based on adaptation of left-handed persons to the surrounding society, i.e. becoming converted to right-handedness. As such conversion was conducted as a rule in an atmosphere of mental pressure and without knowledge of necessary teaching principles, it led to numerous disorders in functioning of the entire organism of a left-handed person. 3. The contemporary civilisation tends to give preference to right-handed persons. Left-handed individuals demand its modification which would take into account their functional distinction, and expect greater tolerance. 4. The present system of sport training had been prepared for right-handed persons. It has not been provided with a technique teaching programme or individualisation of their training which would be appropriate for left-handed persons. Consequently as left-handed persons have no other choice, they are forced to become adapted to the system. 5. There are various types of such adaptation. Sometimes left-handed persons achieve their biggest sport successes on the international arena with the help of the right hand (e.g. A. Grubba in table tennis or K. Date in lawn tennis) or thanks to being both-handed (e.g. M Strupler in handball). 6. An analysis of sport careers of various athletes, including also prominent ones, indicated the existence of great difficulties experienced by left-handed persons in adapting to training schemes designated for right-handed persons, and concurrently extraordinary adaptation abilities of the human organism. It also pointed to the existence of an unsolved problem of the distinct nature of sport training for left-handed persons, which, after all, concerns a significant population in the majority of countries worldwide. 7. A partial solution to this problem may be facilitated by application of an original concept for teaching and improvement of the sport technique based on movements symmetrisation (balancing the efficiency of both sides of the body) which allows maintaining the dominating side.

Key words: *motor education system, different sport disciplines, left-handed*

Introduction

Different scientific disciplines, including also the science of human movements - anthropokinesiology [Starosta, 2006], comprise issues that are vital and those that are marginal. The attention of scientists is focused on the first ones. It seems that the latter groups also included functional differentiation of the upper extremities observed in left-handed persons, who **constitute 5 to 50% of the population in different countries**. Their biggest number live in African countries (**Fig. 1**).

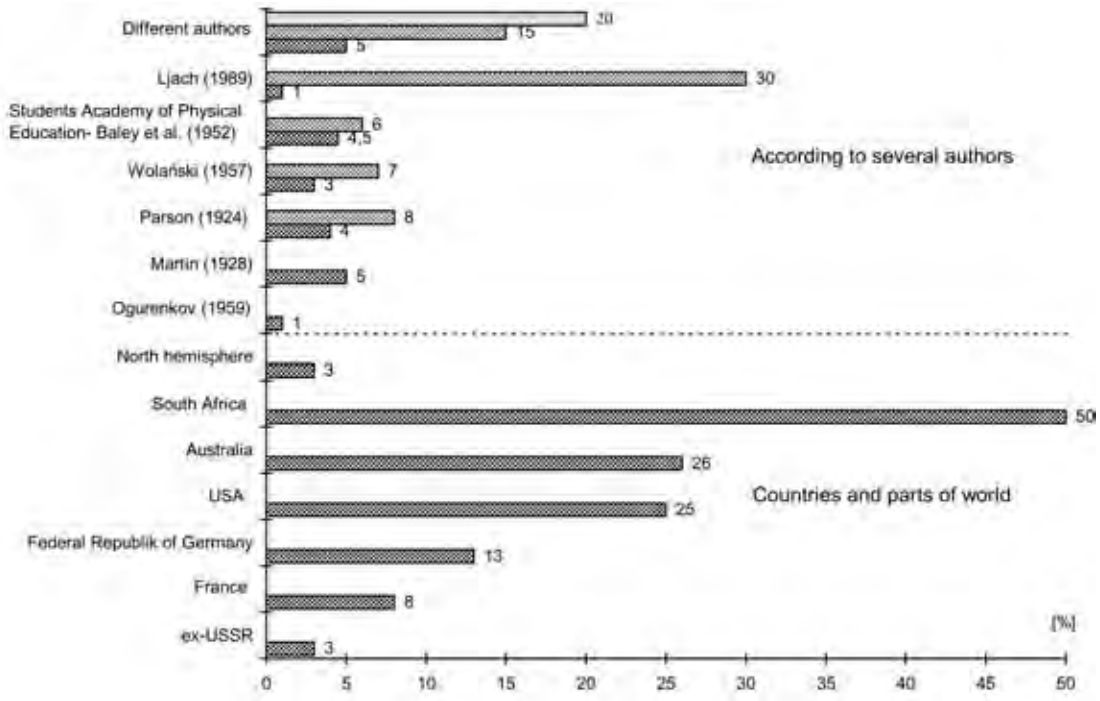

Fig. 1. Left-handed subjects to total ratio population (%) of selected countries and according to several authors [Starosta 1995]

Maybe because *that is where the human being comes from?* According to estimated data, which are not the latest, **there are over 240 million left-handed persons worldwide**. In Germany there are more than 8 million left-handers, and in the USA they constitute ¼ of the population [Meyer, 1995]. Reasons for left-handedness have not been identified yet. However, different hypotheses exist on this issue.

One of them assumes a inborn character of left-handedness and its development related to the dominating gene [Annet, 1979]. Another hypothesis gives priority to environment related impacts. However, a lot of facts speak for the third hypothesis, according to which **right-handedness, sanctioned by tradition and cultivated for centuries and passed on from generation to generation, in the end has become an inborn feature** [Handelsman and Smirnow, 1960; Krestownikow, 1951; Starosta, 1975, 1977, 1990, 2003, 2008]. This appears all the more probable as according to some researchers [Kobler, 1932; Ludwig, 1931] in his evolution, which lasted many centuries, man has gone through various stages: at the beginning he was left-handed, later both-handed and in the end – right-handed.

Already in the Stone Ages existed tools both for right-handed and left-handed persons, and in early cultures appeared both left-handed and right-handed forms of writing. It should be presumed that in the past a relative balance existed between right-handed and left-handed persons [Meyer, 1995, 15]. This hypothesis appears to be likely, because also now we tend to finds relics of both-handed education in some societies (e.g. in Japan). Results of studies carried out by numerous authors [Kretz et al. 1970; Passjan, et al., 1969, Pocelujew, 1951; Peiper, 1956; Storjohann, 1969; Suchenwirth and Gallenkamp, 1967; Szuman, 1957] concerning domination of the upper extremity in the ontogenetic motor development of man, also speak for the last of those hypotheses. These indicate an increasing domination of the right hand in grip of infants between the 4th and 11th month of life (**Fig. 2**) [Peiper, 1956].

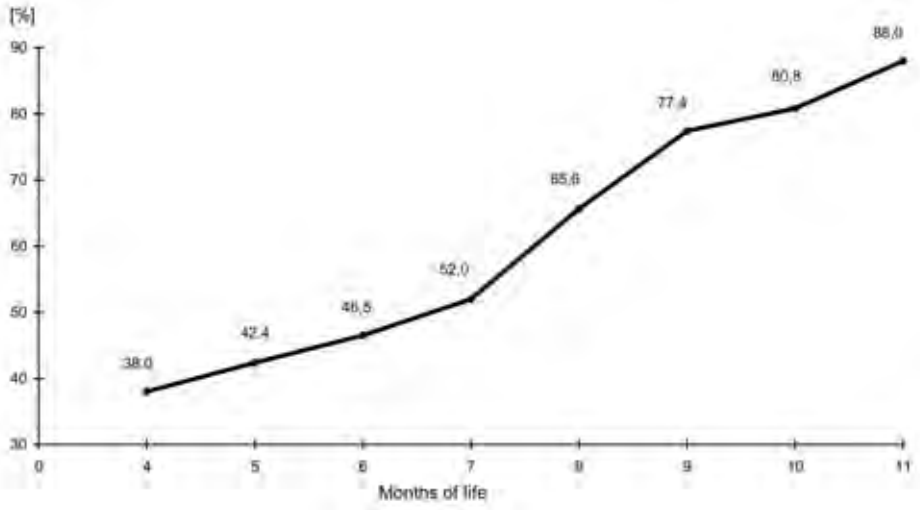

Fig. 2. Right hand catch to total catch ratio (%) in new-born child in different months of life [Szuman, 1957]

The decreasing tendency in the number of left-handed and both-handed persons with age among persons of both genders has also been proven by comprehensive studies of numerous authors (**Fig. 3, 4**). Results of those studies tend to indicate a **modifying role of the environment in development of the dominating extremity in man.**

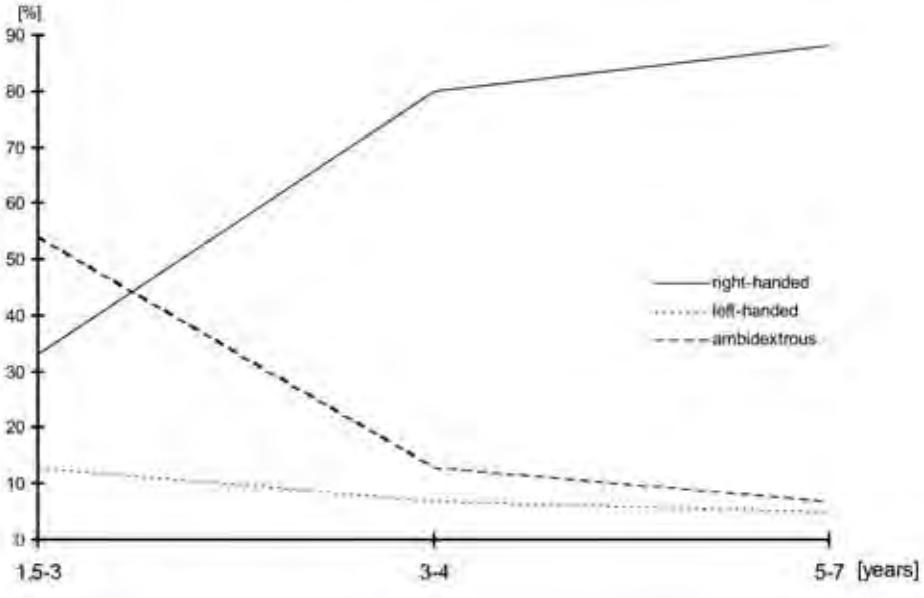

Fig. 3. Ratio of right- and left-handed and ambidextrous childs in pre-school years [Pocelujev, 1951]

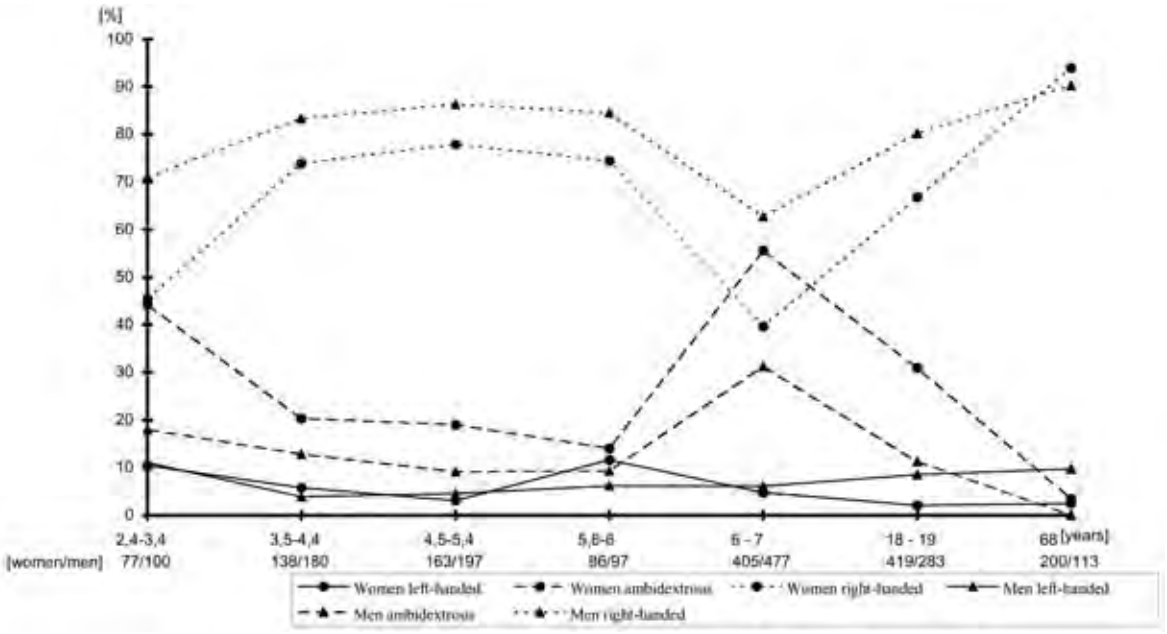

Fig. 4. Ratio of right- and left-handed and ambidextrous persons in different years of life after many authors n=2935 [Starosta, 1995]

Do left-handed persons, who are forced to live in a society of right-handed persons, have to become adapted to it? Over millennia this was pure necessity, because left-handedness was considered to be a mistake of nature, and left-handed persons were treated as persons belonging to an inferior category. This was manifested in numerous caustic descriptions: leftie, *"cack-handed", "put something back on the left (wrong) side", "to have two left hands", "to get out of bed on the left (wrong) side".* Throughout the ages almost all human societies have ignored and even persecuted left-handed persons. **Domination of the right hand as the dominating one was kept up by religious cults. In the Middle Ages the general opinion was: right hand from God, left hand from the devil**. For this reason left-handed persons were persecuted by the inquisition, among others in Spain. In social awareness a conviction has become fixed, and exists even to day, which implies that **left-handedness is a deviation from accepted standard, while right-handedness is considered to be the accepted one**.

Throughout centuries left-handedness was treated as handicap, illness, or even disability. That is why left-handers were forced to convert to right-handedness by all people that formed their community (family, teachers, coaches). Under such pressures left-handed persons tried to adapt as quickly as possible to the society they had to live in. **As a rule such converting was executed in an atmosphere which in practice resembled a psychosis and was deprived of appropriate knowledge of didactic principles, which as a consequence caused numerous disorders in functioning of the entire organism of a left-handed individual** (**Fig. 5**).

Such endeavours are especially intensified in early childhood. The process of converting, which may be more or less successful, led to the creation of different types of left-handedness (**Fig. 6**). Consequences of imposed converting of left-handed persons have become a serious social problem. For example in the Federal Republic of Germany, in which live over 8 million left-handed individuals, the **Consulting and Information Centre for Left-Handers and Converted Left-Handers was established**, and then "*Guidebook for left-handed persons*" was published [Meyer, 1991]. At present thanks to better tolerance and democratisation of social life it is now possible to remain being left-handed in the majority of countries.

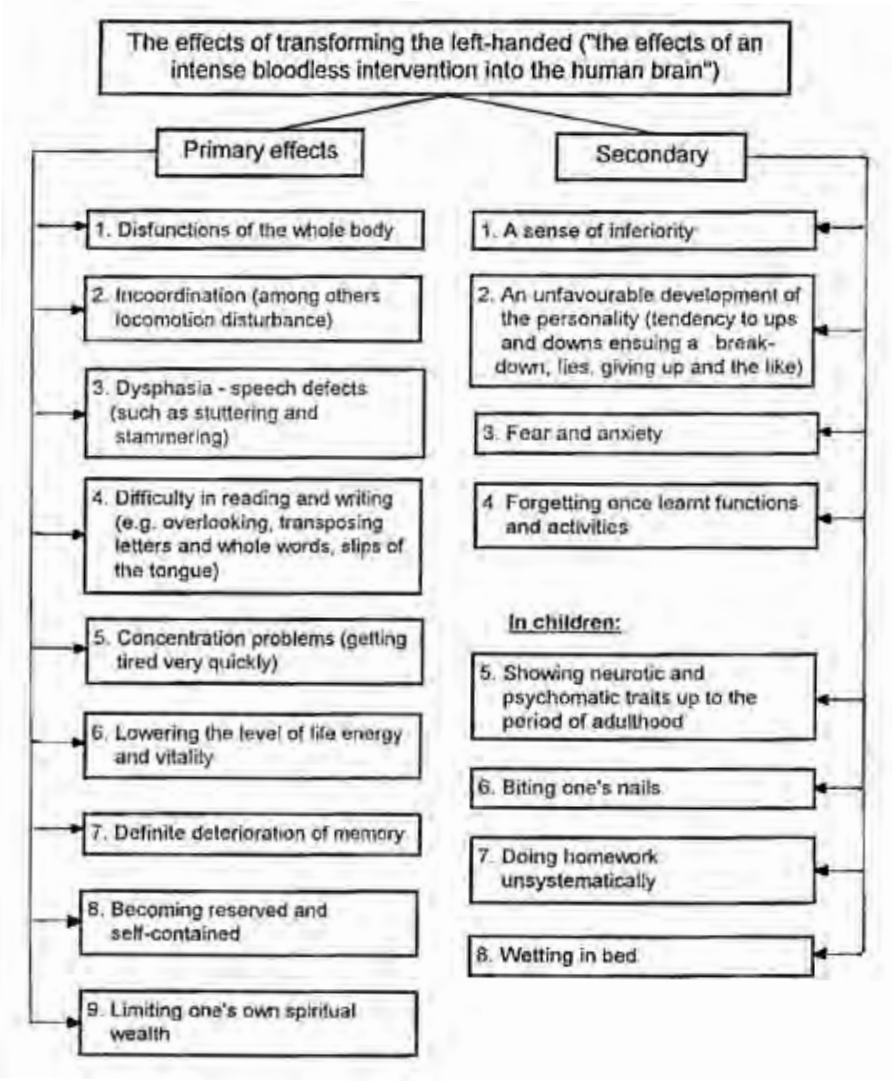

Fig. 5. The effects of transforming the left-handed into the right handed, i.e. the change of the dominant limb in everyday living [Starosta, 1995]

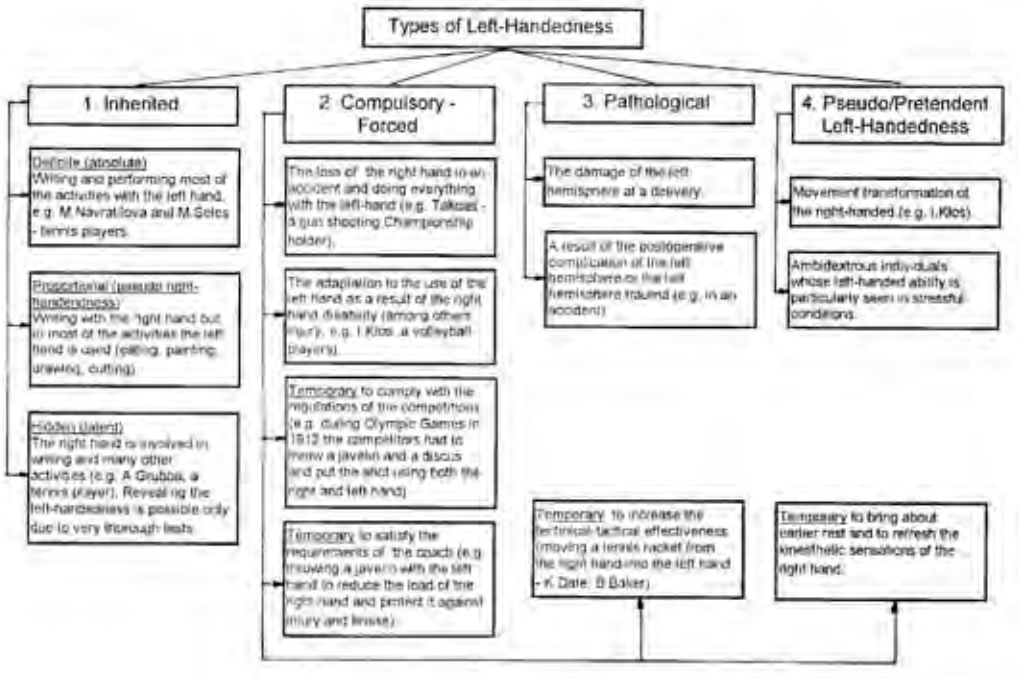

Fig. 6. The types of Left-Handedness in sport everyday life [Starosta 1995]

Left-handed persons in sport training

And what does the problem of left-handed persons look like in sport? Similarly as in other spheres of life – tolerance proved to be the desired achievement! *How was tolerance manifested in practice?* By providing possibilities for participating in training developed for right-handed athletes. **A left-handed athlete was as a rule forced to adapt himself to the training schedule designated for right-handers only**. A rare achievement was if some fragment of a training programme was implemented separately for a left-hander. In most cases this would be taking place on the initiative of the athlete himself and according to a schedule worked out by him. It is not easy to say: *what percentage of left-handed persons have indeed applies this type of self-improvement?*

Unable to become adapted to requirements of the imposed training system (mainly of the technical preparation) designated for right-handed persons, a lot of left-handed individuals had to give up practising their favourite sport discipline or had to limit their left-handedness. This problem concerned practically all sport disciplines. It was particularly intensified in disciplines characterised by lateral differentiation in efficiency of extremities or the entire body, which tend to prevail. What is more, numerous publications were oriented first of all at caring for right-handed persons only. In many cases they were given advice: *how they can win with the left-handed athletes* [Ogurenkov, 1959]. **In my long-term studies of the lateralisation problem in sport I have not managed to find a technique teaching programme or individualisation of such training that would be adequate for a left-handed person**.

This could be just as expected, as this problem has practically not been taken into consideration in the theory of physical education [Aszmarin, 1990, Kuramszin, 2004; Nowikow and Matwiejew, 1959; Osiński, 2002] and sport training [Ulatowski, 1981; Ulatowski, et al. 1992]. It had not been noticed in the theory of motor teaching, or in anthropomotorics [Szopa, 1992; Szopa, et al. 1996] and sport motorics [Hirtz, et al., 1994]. It was mentioned in the anthropomotorics guidebook [Celikowski, et al., 1979], yet no endeavours were undertaken to find an appropriate solution. More substantial attention was dedicated to this issue only in some monographs [Fischer, 1988; Oberbeck, 1989; Osiński, 1993, 2003; Starosta, 1975, 1990, 2003]. **The problem of individual character of sport training for left-handed persons remains unsolved despite the fact that it concerned a major part of population in particular countries worldwide**.

Consequently **the aim** of this study was: 1. To seek genetic factors which cause left-handedness. 2. Endeavouring to define the impact exerted by the environment on converting left-handed persons to right-handedness. 3. Studying opinions of athletes with respect to taking into consideration the distinctive character of left-handed persons in physical education and sport trainings. 4. Determination of the way that left-handedness affects achievement of success in diverse sport disciplines.

Methods

The study comprised 156 left-handed persons, including 51 women aged 16- 45 (x – 23.9 females, x = 23.5 males) who practice 20 various sport disciplines in over 75 clubs operating in different parts of Poland. The biggest number of women (25.6%) and men (43.2%) played handball. The average length of their professional experience ranged between 8 and 8.6 years. A considerable group belonged to highly advanced athletes and had significant achievements in various sport disciplines. **A significant majority of the respondents considered the upper left extremity as the more efficient (96.2%) and more accurate one (92.4%)**. A much less noticeable differentiation concerned their lower extremities (56.9%-58.8%).

Opinions of respondents were studied with the use of a specially developed questionnaire, which comprised 32 open and closed questions related to lateral differentiation, such as in everyday activities, motor development in ontogenesis, left-handedness of family members, impact of practised sport disciplines and environment on change of the dominating hand. Opinions expressed by particular athletes were of a subjective nature, however, taking into consideration their number and experience, as well as data provided by numerous authors, they may be considered to have been of expert nature, i.e. having an objective dimension. This was mentioned already a long time ago by the distinguished Russian physiologist A. Uchtomski: *"The so-called subjective indices are just as objective in their nature as all the remaining ones, especially for a person who can comprehend and interpret them"* [1951].

Results

Everyday life activities

The magnitude of lateral differentiation of the hands in the studied athletes depended on the type of activity (**Fig. 7**). A similar number of women (90%) and men (88.6%-82.8%) used their left hand to draw and to write. Such domination also comprised threading a needle, which was more pronounced in women (88.2%) than in men (80%). It was much less pronounced for winding up a watch: in women up to 52.9%, and in men – 56.2%. Gradual and similar increase in the use of the right hand in the above mentioned activities in women (9.9% – 47.1%), and also men (10.5%-42.9%) may constitute proof of the impact exerted on the tested subjects by their immediate environment.

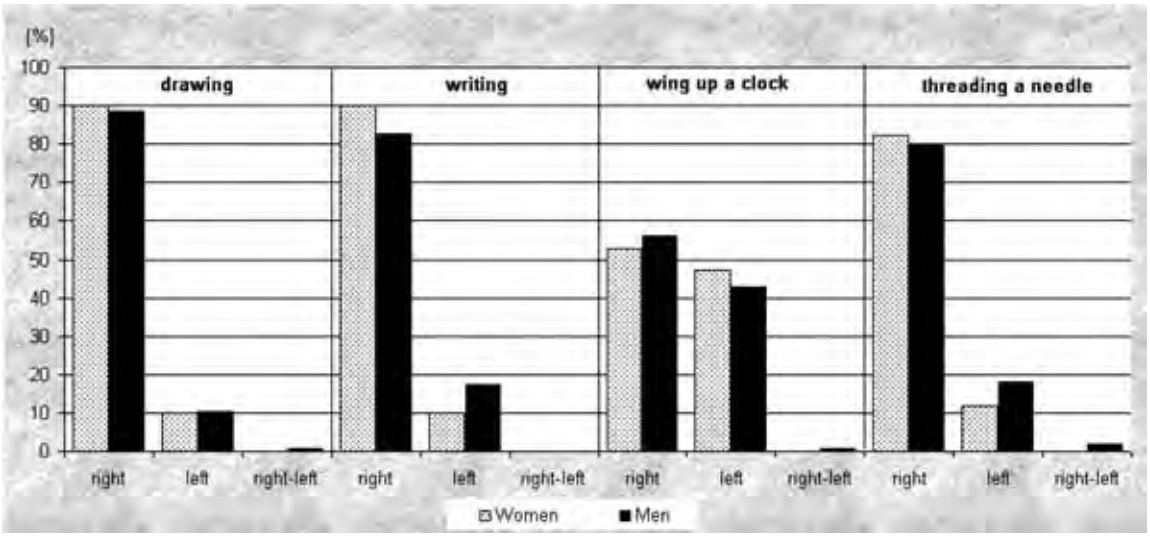

Fig. 7. Dominant hand in left-handed persons in selected everyday activities (%) n = 156 [Starosta, Dunal, 2008]

Left-handedness among family members

Endeavours were undertaken to determine left-handedness back to the third generation inclusively (**Fig. 8**). In families of women the percentage of left-handed persons in particular generations (2-11.8%) was lower than in men (2.8-7.15). The lowest, and simultaneously the closest values in both groups concerned great-grandmothers (5.7-5.9%) and great-grandfathers (2-2.8). They could result from considerable time gap between the generation of studied persons and their ancestors. The data compiled on a numerous group of persons (n=156) seem to prove a relatively low impact of genetic factors on left-handedness or insufficient knowledge about its domination in their ancestors. As many as 44.2% of all respondents confirmed there being left-handedness among members of their families, and 12.2% in their siblings.

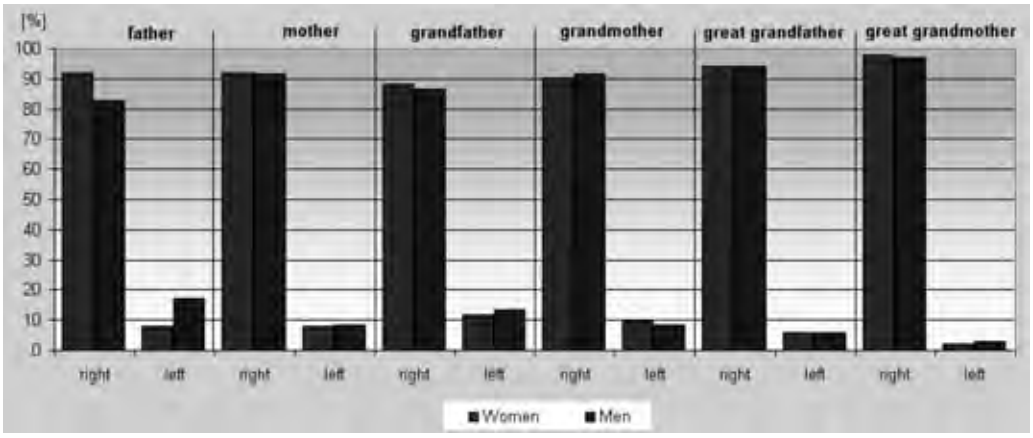

Fig. 8. Dominant hand in families of left-handed persons (%) n = 156 [Starosta, Dunal, 2008]

Forcing conversion to right-handedness

More than a half of women (52.9%) and men (50.5%) were forced to use their right hands (**Fig. 9**). The applied forms of pressure included among others persuasions, pleading, shifting the pencil or pen to the other hand. The tested subjects have also described much more drastic methods: *"tying the left hand to the chair"; "slapping the hands"; "I was constantly reproved that I was using the wrong hand to hold a pen, to eat, and sometimes the left hand was bandaged".* There were also various penalties: *"when I tried to eat with my left hand, food was taken away from me, and in school I was spanked on the hands"; "told to run around the playing field"; "the teacher told me to write with my right hand in front of the entire class"; "if caught writing with my left hand, I had to write a hundred times with my right hand the same sentence: I will also write with my right hand"; "for using building bricks with my left hand in kindergarten I was threatened that I would have to stay after classes".*

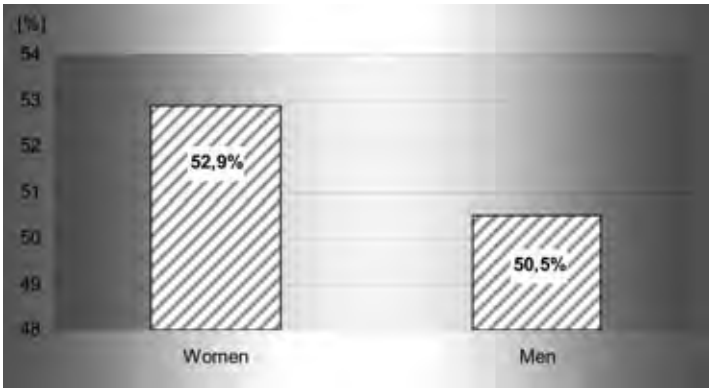

Fig. 9. Number of left-handed persons forced to right-handedness (%) n = 156 [Starosta, Dunal, 2008]

Over 1/5 women (23.5%) and almost the same number of men (20.9%) have been subjected to substantial pressure already in kindergarten, and 23.5-27.5% persons of both genders in primary school (**Fig. 10**). As many as 86.5% of all respondents stated that endeavours aimed at changing the leading extremity affected adversely their psychomotor development. A few selected opinions were: *"because I remained in constant stress having to remember using my right hand"; "I was very upset by it and was fed up with the whole thing".* A small number of respondents (13.5%) declared an advantageous impact of those endeavours: *"it helped develop the efficiency of my right hand"; "this made my right hand a little efficient"*. Both women (15.7%) and men (17.1%) were subjected to mental pressure.

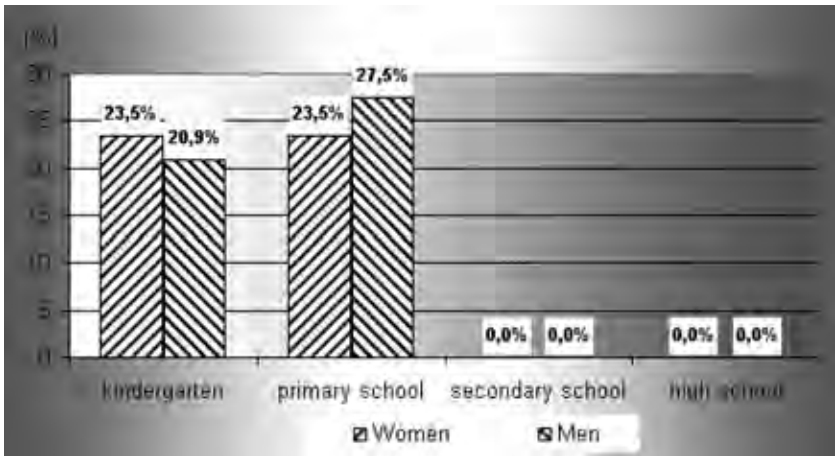

Fig. 10. Number of left-handed persons forced to right-handedness in kindergarten, primary school, secondary school and high school (%) n = 156 [Starosta, Dunal, 2008]

Interesting were responses concerning difficulties experienced in becoming adapted to the right-handed surroundings. Such difficulties were experienced by over ¼ of women (25.4%) and decidedly fewer men (15.2%). Selected opinions of respondents show what such difficulties were as follows: *"when I was in school sitting with a right-handed friend on the right side of the school desk, none of us could write comfortably"; " I cannot distinguish the right and the left side in a flash, it has to take a while"; "right-handed persons were convinced that I was not as good as they were in performing various works and physical exercises".*

Particularly interesting were opinions of respondents with respect to forcing left-handed persons to using their right hand. Their majority (89.7%) had not accepted the process at all, and 78.8% considered it to be disadvantageous. Here are some selected statements: *"it is something unnatural, which can lead to shock"; "this is a gross mistake, as it is detrimental to the natural form of movement"; "a child might become stressed and develop a neurosis".* It is symptomatic that practically all respondents (women – 98%, men – 96.2%) declared that they were not forcing or had no intention to force in the future their left-handed children to using their right hand.

Impact of left-handedness on course of life and movement efficiency

A decided majority of women and men (85.9%) were of the opinion that their left-handedness had no effect on the course of their life. The remaining respondents have noticed a beneficial impact: *"there were many right-handed girls in the team, and as I was left-handed, I had a better chance"; "being left-handed, I was noticed by the coach much earlier"; "as I am a left-handed boxer, I am a more difficult opponent"*. As many as 90.4% respondents were able to execute correctly a lot of things using their right hand: such as writing, drawing, eating, using a lighter, combing their hair, winding up a wrist watch, using the scissors or a computer mouse.

A considerable majority of women (88.2%) and men (82%) failed to see the dependencies between performing activities with the right hand and improving the efficiency of the left one. A relatively small group (women – 11.8%, men – 18%) noticed a positive effect of such a measure. Here are a few opinions on this issue: *"when I was doing something with the right hand, I felt that the left one has also developed much better"; "this improved manipulation abilities in both hands"; "when the right hand got tired, I continued writing with the left one".*

Importance of left-handedness in sport and in physical education

The majority of respondents, both women (72.6%) and men (70.5%), did not sense being different during physical education lessons (**Fig. 11**). Almost one third of persons of both genders perceived left-handedness positively and negatively. Here are some selected statements made about positive experiences: *"it was helpful in playing handball"; "it was more difficult to foresee my reactions during the game"; "the coach presented exercises to the entire class of right-handers and separately for me as a left-hander".* There were, however, many more negative opinions: *"there was no show for left-handers"; "it was difficult for me to learn as the teacher presented exercises only for right-handers"; "constant reproval of the teacher"; "teaching the methodology of particular exercises was oriented on right-handed persons, so I had to adapt myself to it"; "I had to perform all exercises the opposite way than my colleagues".*

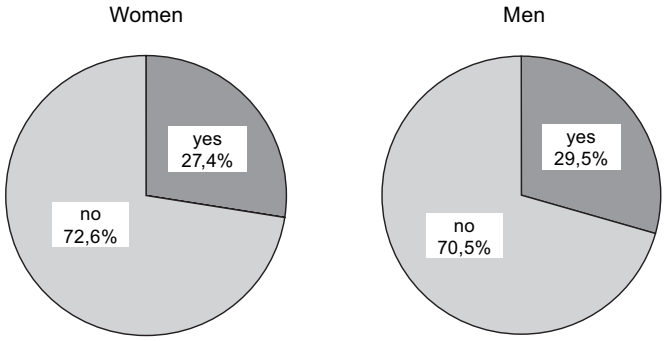

Fig. 11. Number of left-handed persons feeling his different during physical education lessons (%) n = 156 [Starosta, Dunal, 2008]

Only 14 persons (8.9%) were required to be right-handed in some sport disciplines, and in 36 persons (23.1%) left-handedness was accepted as it allowed application of unconventional methods in sport competitions (**Fig. 12**). Here are a few opinions: *"the team needed a left-hander – libero"; "I played on the right-winger position and my left hand proved to be useful"; "a good left-handed athlete is practically half the success, as he finds it much easier to deceive the full-back and goal keeper"*. Left-handedness helped in achieving a high technical championship level to as many as 39.8% respondents. Different justifications of this fact were presented: *"a reverse position is particularly helpful in a double game and allows playing in a non-schematic way"; "the majority of people are right-handed and expect attack from the right"; "goalkeepers in handball were convinced that throws of left-handed athletes are very difficult to defend"*.

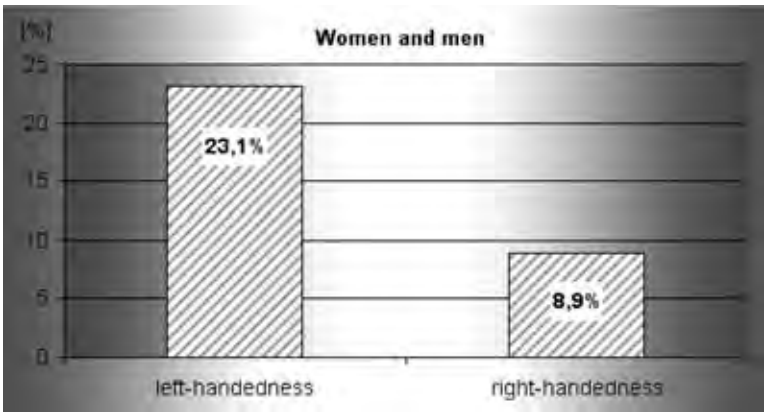

Fig. 12. Number of left-handed persons forced to right or left-handedness in selected sport disciplines (%) n=156 [Starosta, Dunal, 2008]

We received interesting opinions from respondents describing the relation of coaches to their left-handedness (**Fig. 13**). In the majority of cases it was positive (54.5%) or neutral (44.2%). Here are some selected opinions: *"I was lucky as regards my coaches, as they always considered me to be a valuable athlete"; "he needed a player able to dribble and throw with the left hand"; "I proved to be the desired right-winger"; "the training and exercise plan gave preference to my left-handedness".*

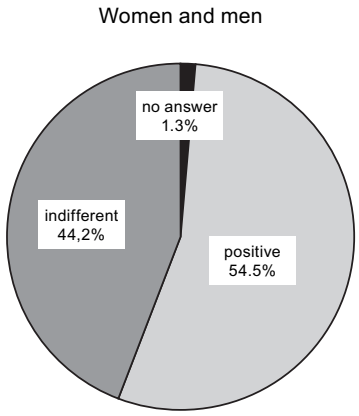

Fig. 13. Relation of trainers to left-handed persons (%) n = 156 [Starosta, Dunal, 2008]

The decided majority of women (78.4%) and men (82.8%) came to the conclusion that their left-handedness has not contributed to their achieving success in sport. Some respondents justified this as follows: "each person has the same chances independently of the dominating hand"; "this depends on the person and his or her ambition, and not on the hand or leg that is more efficient"; "hard work is half success". A great number of women (82.4%) and men (80%) were not aware that left-handed persons were treated in a different way in other countries. The remaining respondents had a different opinion in this issue. Here are a few opinions: "in the USA more persons are left-handed and they are better off"; "that country has better tolerance, and left-handedness is normal"; "there is no discrimination against them in that country".

Opinions received from respondents were differentiated as regards establishing identical conditions for right-handed and left-handed persons (Fig.14). The majority of women (60.8%) and men (56.3%) considered that those conditions were identical, while the remaining ones were of a different opinion, and insisted that everyday use tools, household equipment, physical education classes and sport training are all adapted specifically to right-handed persons.

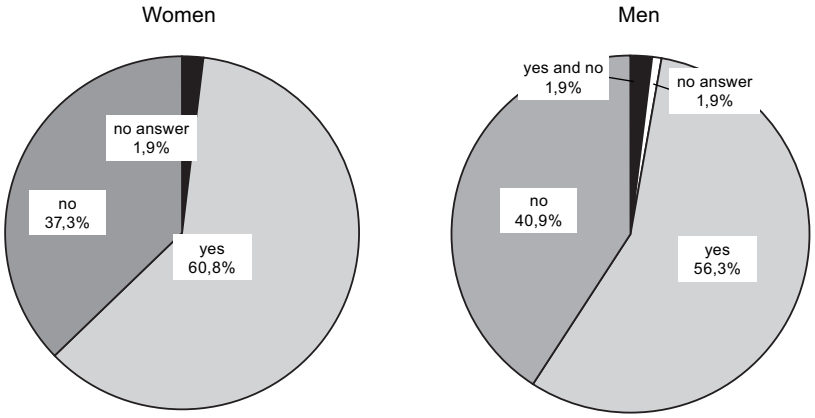

Fig. 14. Opinion of left-handed persons creating the some conditions for right and left-handed athletes (%) n = 156 [Starosta, Dunal, 2008]

Types and consequences of movement adaptation of famous left-handed athletes in sport

Taking into account the presented extensive study material (n=156), it seems to be justified to carry out an analysis of various cases of movement adaptation of 5 distinguished athletes, which ended successfully. Literature contains frequent quotes of the example of a right-handed Hungarian, **K. Takacs** [Jokl, 1981]; having lost the dominating hand he won gold medals in world championships and Olympic games in shooting a handgun using the second hand. Taking into account a division of sport disciplines according to their coordination-related complexity, the described type of adaptation is contained on the first level, i.e. the lowest one [Farfel, 1960; Starosta, 2003, 2006]. A more complex form of modification has taken place in the case of the great table tennis champion from Poland, **A. Grubba. This decidedly left-handed athlete has achieved his major successes in sport on an international arena using his right hand**. He was not forced to change the dominating extremity. It resulted from certain accidental circumstances from childhood, which at a later age were fixed by successes in a sport discipline that required the highest – third level of motor coordination.

Another case was described by R. Stadler and W. Bucher [1986]. In the Swiss first league handball team the left-handed **M. Strupler** played for 15 years. Having adapted himself to his right-handed colleagues he mastered performing all technical elements with the right and left hands. This put him at an advantage, because both-handed athletes are much more dangerous as opponents. Throws made with the left hand were not always effective, and his coach was dissatisfied with such a manner of their execution. During contests there were frequent disagreements between him and the coach. Their culmination was a statement made by the coach: *"If you throw the ball at the goal with your left hand once more, you will be out of the field."*

Left-handed athletes were forced to change the dominating extremity, especially commonly in disciplines with asymmetrical performance of basic movements. For example a left-handed tennis player from Japan, **K. Date**, was forced to play using her right hand under strong pressure of her family. In her home country left-handed women are not perceived well. **In critical situations taking place on the tennis court Date would take over the racquet with the "*forbidden*" hand**. Despite such modification arising from pressure of the closest surroundings she managed to occupy a very high position among the 10 best female tennis player worldwide.

An individual tends to adapt movements of his entire body to the dominating hand. A higher efficiency level of one upper extremity "*is transferred*" onto the lower extremity and determines the direction of turns in sport exercises [Dębczyńska-Wróbel and Starosta, 2008]. As a rule right-handers perform those exercises to the left, and consider the right leg as dominating [Starosta, 1975, 1990, 2008]. In those complex movements – which involve the entire body – only exceptionally talented persons can achieve success. For example the left-handed **C. Colledge** from Great Britain became a European champion in figure skating. A hindrance that prevented further achievements was the inability of mastering multi-turn jumps which are complex as regards coordination. Her new coach decided that her difficulties were caused by **the fact that turns in her jumps were made in a direction that was not the right one for her**. Despite the fact that she already was a European champion she had to learn jumps with turns in the other directions. **This ice skater endeavoured twice to modify her technical abilities: at the beginning of her career, when she adapted to making jumps that are specific for right-handers (with turns left), and then left-handed ones (with turns right)**. In both cases the conversion was successful.

I have quoted examples in which conversion, i.e. a change of the dominating extremity or direction of turns caused by diverse factors, was successful. However, such modifications do not always progress successfully. Being unable to adapt to requirements of the imposed training system (first of all with respect to technical preparation) that is designated for right-handed persons, numerous left-handed athletes gave up practicing their favourite sport discipline or limited manifestation of left-handedness. **This problem concerns practically all sport disciplines characterised by a lateral differentiation in efficiency of particular body parts (extremities) or the entire body**. And these obviously prevail.

Numerous publications have been oriented very obviously at right-handed athletes, who are being clearly advised: *how to win with left-handed athletes* [Ogurenkov, 1959]. I have not found any such studies which would provide similar advice to left-handed persons. Consequently it may be considered a paradox that representatives of this social minority should strive to achieve the best awards on an international arena in various disciplines - not only in **boxing** and **fencing** (**Fig. 15**), but also in **tennis** (**Fig. 16**) and **table tennis** (**Fig. 17**). On the basis of opinions of 16 table tennis experts I have worked out a psychomotor description of a left-handed athlete (**Fig. 18**). Such an athlete has specific virtues which arouse respect in right-handed individuals. This allows creating a favourable psychological climate which is favourable in allowing left-handed tennis players to achieve success.

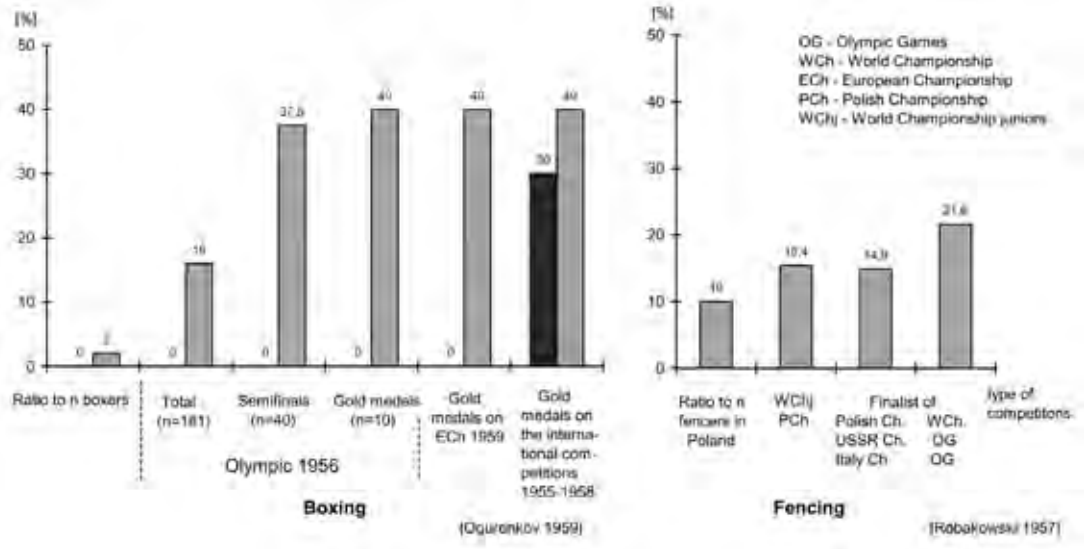

Fig. 15. Left-handed sportsmen and his achievements in boxing and fencing [Starosta 1991]

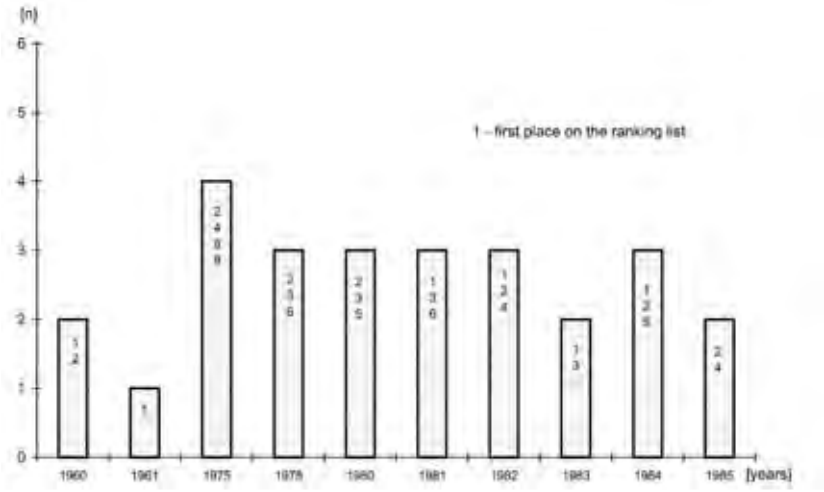

Fig.16. Number of left-handed tennis players among 10 best competitors (according ATP ranking) in different years [Starosta 1991]

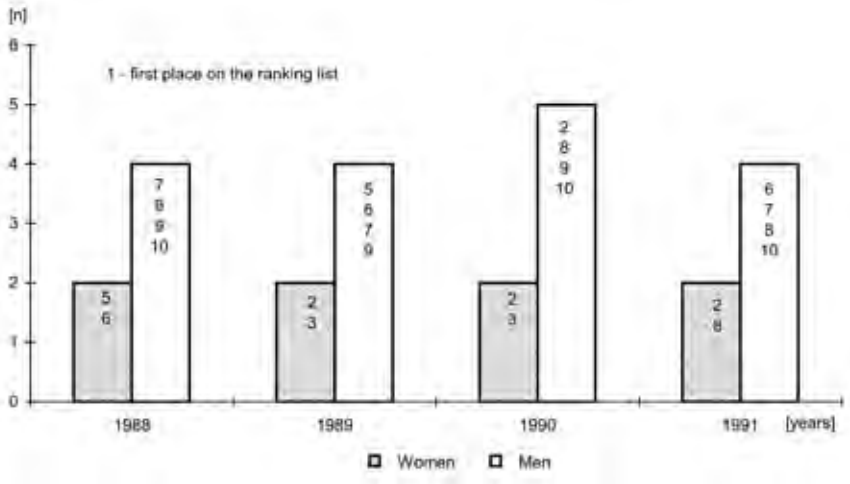

Fig.17. Number of left-handed table tennis players among 10 world best women and men competitors (according ITTF ranking) in different years n=25 [Starosta, Perek 1991]

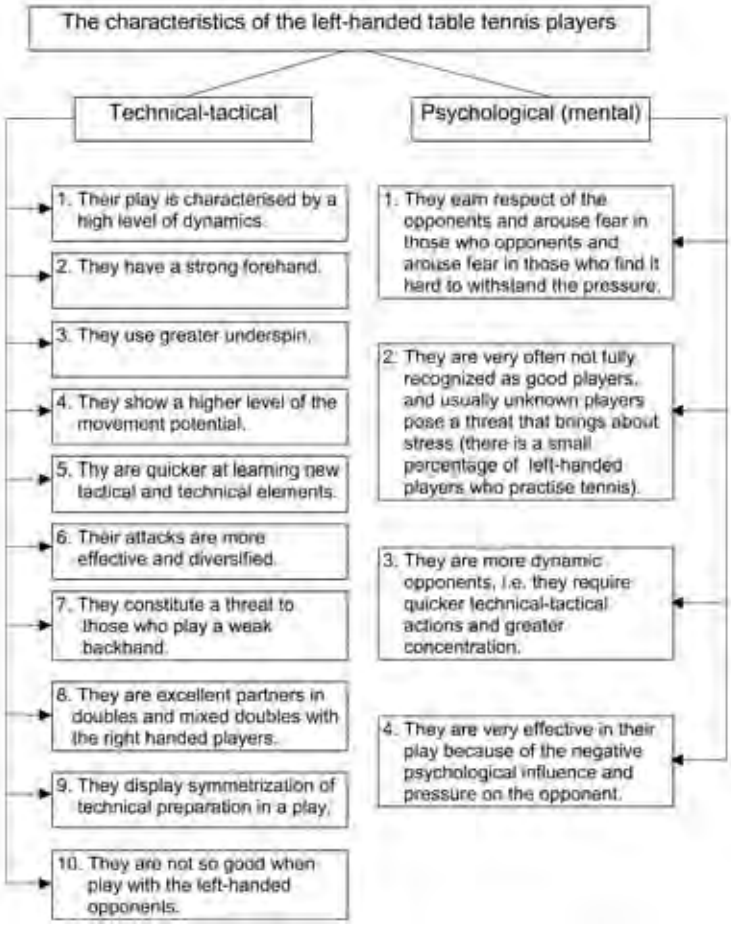

Fig. 18. Technical-tactical and psychological characteristics of the left-handed table tennis players in the opinion of the table tennis specialists [Starosta 1995]

Seeking more rational ways of training for left-handed athletes

With view to the numerous facts presented in the study a question arises: *is it possible for the training to comprise psychomotor distinction of left-handed persons?* The answer is yes. This problem remains important, as further functioning of the training variant designated for right-handed persons does not assure a high technique effectiveness for left-handers. **A new concept of teaching and advancement** of the sport technique could prove to be helpful in solving this problem [Starosta, 1990, 2003, 2008]. **The essence of this concept is movement symmetrisation, i.e. balancing the efficiency of both sides of the body and hence maintaining the dominating side of the athlete** independently of requirements of the practised sport discipline (be it asymmetrical or symmetrical). **This is a new approach in the theory of movement teaching which assures equal opportunities to right-handed and left-handed persons** regardless of technical abilities acquired by them (Fig.19). It assures a better effectiveness of movement teaching thanks to a better utilisation of bilateral transfer, and hence a more intense activation of the second cerebral hemisphere.

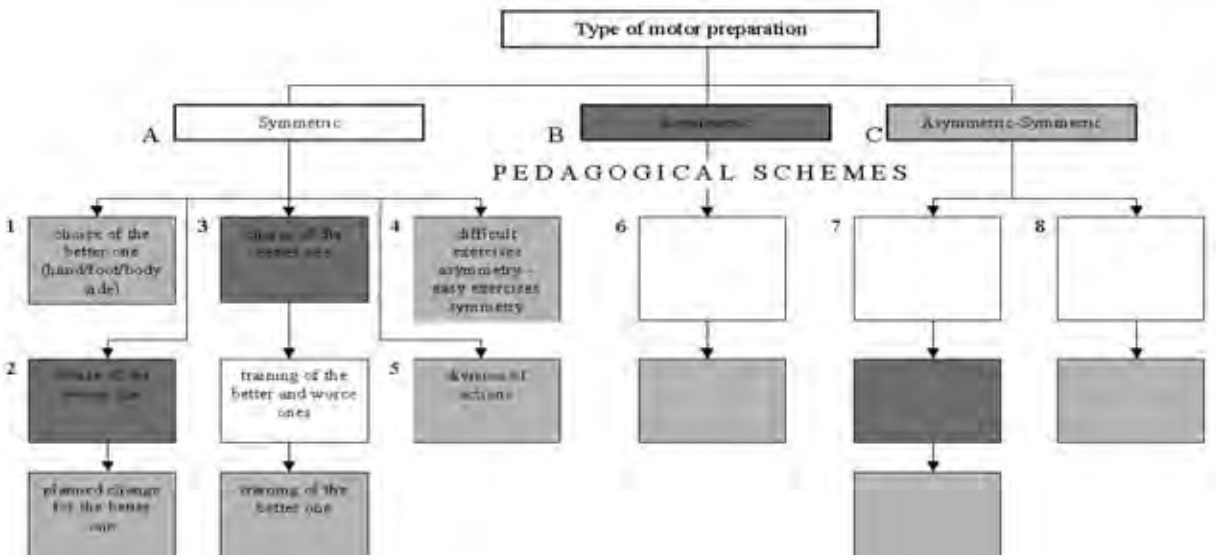

Fig. 19. Variants of motor preparation and recommended pedagogical schemes [Starosta 1975]

Application of the proposed concept depends on which option is selected by the responsible person. The coach may choose from eight available options the one that seems to be the most appropriate for the given athlete with view to individualisation, e.g. the option with short-lasting and fragmentary symmetrisation. It allows **solving the problem of the distinct character of teaching left-handed persons within a particular training group without the necessity of assuring additional financial resources or work input**. Achievement of technique symmetrisation in many exercises is not a simple feat, especially in the case of advanced athletes, as each of them as a rule has a different set of abilities. This should be a starting point for commencing an individualised symmetrisation process. Symmetrisation of movements which are complex as regards coordination is particularly difficult. That is why it should be undertaken by persons able to apply teaching principles in a skilful way and with a great deal of tact, especially in relation to left-handed persons. Only then will technique symmetrisation become an interesting process of advancing the sport technique and development of movement coordination, both for the coach and for his athletes.

Discussion and conclusions

1. In various countries left-handed persons constitute on average from 5 to 50% of the entire population. As they have to live in a society of right-handers, they are forced to become adapted to them. Effects of such adaptation depend on individual predispositions of the person and on the attitude of the society to left-handed persons. 2. Depending on the progress of the adaptation process its consequences may vary. In many cases it was based on **adaptation of left-handed persons to the surrounding society**, i.e. becoming converted to right-handedness. As such conversion was conducted as a rule in an atmosphere of mental pressure and without knowledge of necessary teaching principles, it led to numerous disorders in functioning of the entire organism of a left-handed person. 3. The contemporary civilisation tends to give preference to right-handed persons. **Left-handed individuals demand its modification which would take into account their functional distinction**, and expect greater tolerance. **4. The present system of sport training had been prepared for right-handed persons. It has not been provided with a technique teaching programme or individualisation of their training which would be appropriate for left-handed persons**. Consequently as left-handed persons have no other choice, they are forced to become adapted to the system. 5. There are various types of such adaptation. Sometimes left-handed persons achieve their biggest sport successes on the international arena with the help of the right hand (e.g. A. Grubba in table tennis or K. Date in lawn tennis) or thanks to being both-handed (e.g. M Strupler in handball). 6. An analysis of sport careers of various athletes, including also prominent ones, indicated the existence of **great difficulties experienced by left-handed persons in adapting to training schemes designated for right-handed persons, and concurrently extraordinary adaptation abilities of the human organism**. It also pointed to the existence of an unsolved problem of the distinct nature of sport training for left-handed persons, which, after all, concerns a significant population in the majority of countries worldwide. 7. A partial solution to this problem may be facilitated by application of **an original concept for teaching and improvement of the sport technique based on movements symmetrisation** (balancing the efficiency of both sides of the body) which allows maintaining the dominating side [Starosta, 1990, 2003]. This is a new solution in theory of motor teaching which provides equal opportunities to right-handed and left-handed persons, independently of the acquired set of technical abilities. It assures a better teaching effectiveness thanks to better utilisation of bilateral transfer.

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CONSTRUCTION AND VALIDITY OF THE NEW TEST FOR EVALUATION OF FLEXIBILITY AND VELOCITY OF WRESTLERS' MOVEMENTS

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Abstract

Within the scope of this research a specific sample of subjects consisting of 30 attenders of wrestling training in a wrestling club in Zagreb was measured. The subjects are aged 13±1 and their wrestling experience is approximately equal. The aim of this paper was to determine metric characteristics of a measure instrument for which it is assumed to be serving for the evaluation of the flexibility and velocity of movement. The research showed high reliability of the test according to the classic and Guttman and Harris's measuring model. The normality of distribution of the test result is confirmed with the Kolmogorov-Smirnov test, although a slight positive asymmetry and mild elongation of distribution was noticed. With the factual analysis of the tests according to the Guttman-Kaiser criterion of extraction, we were given a common factor with very high correlation of variable and the factor, and this determined the factual validity of the newly designed test. This confirmed that the test evaluates dimensions defined as specific flexibility and velocity of movements considering it is statistically significantly correlated with the tests that evaluate the above mentioned motor abilities.

Key words: *Greco – Roman wrestling, motor abilities, seniors*

Introduction

By the term flexibility we understand the production of a movement with the maximum amplitude in a joint or a series of joints involved in the movement. It is not justified to talk about a general level of flexibility of the locomotor system, but it has to be said that the flexibility is characteristic of a joint or a group of joints. Whereas in some sports it is important to achieve high level of flexibility, in other sports these demands are not so noticeable. In wrestling, the flexibility of the spine, of the shoulder blade and of the pelvic bones is the most important. The velocity is the ability to react quickly or to produce one or more movements, which can be seen in surmounting the longest possible path in the shortest possible time. In wrestling, all forms of velocity are of the utmost importance, and especially the frequency of movement (i. e. fast production of more connected simple or complicated movements).

The construction of the tests is a complex kinesiometric procedure and as such demands a fulfillment of certain kinesiometric characteristics, like validity, reliability, sensitivity and objectivity. Given the fact that the sportspersons who are active in wrestling find the test simple to perform (because these and similar forms of movement are practiced at every training), it is believed that the test would confirm all of its metric characteristics. Such a test will definitely be used in the analysis of wrestlers' conditioning readiness. A test of a similar kind has been included in one of the most famous sets of tests for older advanced wrestlers (Starosta & Tracewski, 1981; 1998).

Methods

The aim of this paper is to construct and validate i. e. to establish the metric characteristics of a measure instrument. The construction is started with the assumption that the instrument serves to evaluate the manifestation of the flexibility and the velocity of movement. Within the scope of a pilot research a sample of subjects consisting of 30 attenders of wrestling trainings of a wrestling club in Zagreb has been measured. The subjects are aged 13±1 and their wrestling experience is approximately equal. The sample of variables consists of standardized measure instruments of known metric characteristics for the evaluation of flexibility and velocity of movement:

1. Pirouettes in 30 seconds (PIRUET30) – a test to evaluate the specific flexibility and the velocity of movement
2. Semipirouettes(PIRPAR) – a test to evaluate the specific flexibility and the velocity of movement
3. Strive- running around the head (SESTARENJE) – a test to evaluate the specific flexibility and the velocity of movement

Metric characteristics in the first two tests were verified by Marić, J. et al. and the third test was verified by Starosta, W et al. (2005). During the construction of the new measure instrument it was assumed that it would also evaluate the flexibility and the velocity of movement. The new measure instrument was named *Semistrive* (*POLSES*).

Description of the new measure instrument

Semistrive (POLSES) – a test to evaluate the specific flexibility and the velocity of movement.

Description of the test:

The test semistrive serves to evaluate the specific flexibility and the velocity of movement that can be seen in wrestlers, and which is based on the ability to pass from the front walkover to the back walkover and vice-versa. Flexibility and velocity of this kind are of great importance in wrestling.

Description of the place where the exercise is performed: the exercise is performed in a wrestling gym on a wrestling mat.

Exercise: the subject takes the initial position "the front walkover" – the position in which the subject has turned his chests towards the mat, leaning against the mat on the balls of his toes, his forehead and palms of his hands, in which process he is holding both his feet on the other side of the line that has been drawn on the mat with a chalk.

Performing the exercise: on the mark "now" the subject begins the turning on the chosen side, but in a way that he only performs one passing from the front to the back walkover and then returns to the initial position of the front walkover. After that he makes the same movement on the other side. The stop – watch is turned on at the moment of the subject's crossing the line with his foot. The exercise is over when the subject performs six semi turnings (i. e. three on each side), at the moment of crossing the line with both feet. During the performance semi turnings are counted for the subject. The exercise is performed three times. Between each attempt the subject can take a break during which the other 3-4 subjects do the exercise.

Evaluation: time is recorded in one hundredth of a second of every of the three test particles.

Comment: the exercise is repeated if the prior performing does not count.

Duration: estimation of the total duration of the test for one subject is 4 minutes.

Number of examiners: 1

Aid: one stop – watch, one chalk

For the analysis of the reliability, three successive measurings (particles) in all the tests were conducted. All analyses were done with the help of the statistical system *Statistica*, version 7.1, (StatSoft, Inc., Tulsa, OK) and *Statistica*, version 5.0 expanded with the *RTT.stb* program that was written by Dizdar (Dizdar, 1999) and implemented into the program language for multivariate data analysis, *STATISTICA BASIC*. The *RTT.stb* program enables the reliability of the composing measure instruments under the classic measuring model to be established and enables the reliability after the transformation of the results into Harris's and image metric to be established. The following features have been calculated: basic variable parameters, average correlation among the test particles, Cronbach-α, standardized α reliability coefficient, Cronbach-α with the exclusion of a particular particle and reliability through the use of *RTT.stb* program.

Results

The descriptive indicators for all variables have been calculated, i. e. arithmetic mean (AS), minimum (MIN), maximum (MAX), standard deviation (SD) and the measures of elongation kurtosis (KURT) and asymmetry skewness (SKEW) of the result distribution.

Table 1. Descriptive indicators of all variables

	AS	MIN	MAX	SD	SKEW	KURT
PIRUET30	16,12	9,33	22,67	2,57	-0,05	1,38
PIRPAR	9,64	7,73	16,30	1,60	2,80	10,20
SESTARENJE	12,73	9,76	14,52	1,22	-0,53	-0,39
POLSES	7,00	5,82	8,72	0,63	0,85	1,20

Metric characteristics of the tests

Reliability according to classic measuring model

The average correlation between the test particles is 0,93. The analysis of reliability gave us the following coefficients: Cronbach α: 0,971 and standardized α: 0,973. Such high coefficients, almost 1, prove the high reliability of the *POLSES* test. The coefficient α data without including certain particles (Alpha without=Alpha bez) in the analysis, show that repeating the exercise three times is enough.

Table 2. Analysis of the reliability of the POLSES test (n=30)

	POLSES1	POLSES2	POLSES3	AS	SD	Alpha bez
POLSES1	1,00	0,89	0,91	7,02	0,68	0,979
POLSES2	0,89	1,00	0,97	7,00	0,67	0,949
POLSES3	0,91	0,97	1,00	6,98	0,60	0,944

Reliability according to Guttman and Harris's measuring model

Based on the matrix of the correlation between the particles, and with the classic measuring model, with the application of the RTT.stb program, the following reliability measures were calculated in this research:

RTT – calculated under the assumption that all the particles in the real object of measuring were equally included (Cronbach, Spearman-Brown).

Table 3. Coefficients of reliability, representative quality and homogeneity for the POLSES exercise (n=30)

RTT	ALPHA	ALPHA 1	ALPHA 2	LAMBDA 6	RH 1	RH 2
0,973	0,973	0,421	0,877	0,973	0,947	0,999
TAU	**MSA**	**AVR**	**HOMI**			
0,942	0,998	0,923	0,990			

When observing the table 3 we can conclude that slightly higher values of the RHO1 and RHO2 coefficient were achieved. When we consider lower and upper limits of reliability achieved within the two different measuring models, the predominance of Guttman's model is obvious, especially at the lower limit of reliability (RHO2). Momirović's homogeneity coefficient (HOM1) is predominant in the evaluation of homogeneity based on the average correlation of all.

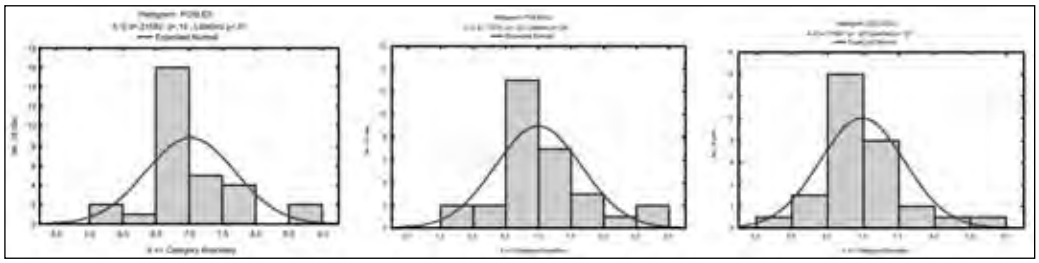
Homogeneity

We were given the following average correlation for the *POLSES* test: 0,93. High average correlation among the three repeated measurings is a proof of good homogeneity of the measure instrument in the test.

Sensitivity

Table 4. Descriptive parameters for the POLSES exercise (n=30)

POLSES	AS	MIN	MAX	SD	SKEWNESS	KURTOSIS
Measuring 1	7,02	5,76	8,80	0,68	0,87	1,36
Measuring 2	7,00	5,79	8,71	0,67	0,95	1,26
Measuring 3	6,98	5,92	8,64	0,60	0,75	1,08



Graph 1. Distribution of the results of the POLSES test in three measurings

In this research it is visible from graph 1 that the distribution is almost symmetrical. Slight positive asymmetry (skewness bigger than zero) is visible in every measuring. A slight leptokurtosis, elongation of distribution is also visible. But, Kolmogorov-Smirnov test showed that the distribution was normal (table 5).

Table 5. Test for determining the normality of the empirical distribution of the POLSES test

	max D	K-S
POLSES1	0,21	p > .20
POLSES2	0,18	p > .20
POLSES3	0,12	p > .20

Validity

With the matrix of cross-correlation of the results of the subjects condensed into the first main component in the *PIRUET30, PIRPAR, SESTARENJE and POLSES* tests, a statistically significant correlation between those tests (table 6) was recognized. With the factual analysis of the *PIRUET30, PIRPAR, SESTARENJE and POLSES* tests according to the Guttman-Kaiser criterion of extraction, a common factor with very high correlation of variables with the factor (table 7) was achieved. On the basis of all these results we can conclude that the *PIRUET30, PIRPAR, SESTARENJE and POLSES* tests measure the same dimension, and the *POLSES* test is a factually valid test.

Table 5. Matrix of cross-correlation of the results of the subjects condensed into the first main component in the PIRUET30, PIRPAR, SESTARENJE and POLSES (n=30) tests

	PIRUET30	PIRPAR	SESTARENJE	POLSES
PIRUET30	1,000	-0,823	-0,766	-0,808
PIRPAR	-0,823	1,000	0,575	0,739
SESTARENJE	-0,766	0,575	1,000	0,661
POLSES	-0,808	0,739	0,661	1,000

*correlations marked are statistically significant on the level of error p<0,05

Table 6. Matrix of factual structure, variant of the extracted factor (Expl.Var) and the proportion of the explained part of the variant (Prp.Totl)

	PIRUET30	PIRPAR	SESTARENJE	POLSES	Expl.Var	Prp.Totl
Factor 1	0,954	-0,880	-0,835	-0,900	3,193	0,798

Discussion and conclusions

Flexibility and velocity of movement, i. e. specific manifestation of these abilities through movement in the wrestling walkover is of great importance for success in wrestling. Construction and validity of a measure instrument for evaluation of specific flexibility and velocity of movement, shown in this research, determined the following: the test is highly reliable, therefore an error in measuring is small; the test is satisfyingly sensitive and factually valid. It really does evaluate dimensions defined as specific flexibility and velocity of movement, and it is statistically significantly correlated with the tests that evaluate the above mentioned motor abilities. With metric characteristics, it was established that the POLSES test can be used as a good instrument for the selection of subjects who are active in wrestling, which demands high level of flexibility and velocity of movement because it distinguishes the subjects according to these abilities. Since this was a pilot research, a surprisingly good sensitivity, homogeneity and reliability of the instrument was achieved, that can significantly improve in the continuation of the research.

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THE DIFFERENCES IN ATHLETES' MOTIVATION TRAINED BY COACHES OF DIFFERENT PROFILES

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Abstract

The variations in motivation are a function of the interaction between the athletes' individual differences, their perception of motivational climate and their coaches' leadership behaviour. The aim was to investigate coaches' contribution to team sports athletes' motivation. Two types of coaches were identified. Athletes who were trained by more athlete-directed, low ego oriented coaches showed preferable motivational pattern; they perceived mastery motivational climate in their teams, were more intrinsically motivated, highly task and moderately ego oriented. The athletes trained by less athlete-directed and high ego oriented coaches perceived less mastery motivational climate signs in their teams, were less intrinsically motivated, their task and ego goal orientation were lower. Those athletes' and their coaches' motivational structure seems incongruent, and this incompatibility might induce athletes' lower motivation.

Key words: *motivation, leadership, team sports, cluster analysis*

Introduction

Each individual possesses certain dispositional goal orientations and also some kind of situational goal structure, i.e. individually perceived environmental climate. Those two perspectives could be either congruent or not and represent two dimensions of athletes' motivation that affect his/her behaviour (Roberts, 2001). The situational goal structure mainly depends on a coach and his/her leadership behaviour. According to the *Integrated Model of Antecedents and Consequences of Coach Leadership* (Duda & Balaguer, 1999), the variations in individual or team motivational patterns will be a function of the interaction between the athlete's individual differences variables and his/her perception of motivational climate operating in one's team. Previous studies assume that coach is one of the key factors that influence motivational climate development (Chelladurai & Reimer, 1998; Duda & Balaguer, 1999; Mageau & Vallerand, 2003). Coaches have important role in the development of athletes. The coaches' behaviour is predicted to be influenced by their orientations, predominant motivation, situations in which they work, and by perceptions of their athletes' motivation. In sport context different types of coaches may exist, with regard to their personality traits, coaching experience, age, or educational level, leadership style, etc. It is also possible to presume that there are different types of coaches with regard to their motivational structure. Coach's motivation could have high impact on his/her leadership behaviours which in turn can cause differences in prevalence of particular types of motivation in athletes, regarding their goal choices, the domination of a particular motivational pattern in the team and, it can influence the athletes' experience of their coach. All these influence team functioning, quality of its sport performance, achievements and athletes' persistence within their sport. Leadership in sport is a process that involves the interaction of a coach, an athlete and situational factors (Chelladurai, 1993). Coach's leadership style depends on the way he/she interacts with athletes and on his/her decision making processes. Coach's social interactions consist of several different processes: coach's instructiveness, supportiveness, and coach's rewarding behaviour. In sport we usually distinguish between two types of coaches - autocratic and democratic.

This study examines coach's contribution to athletes' motivational structure. We wanted to determine different profiles of coaches using two sources of information: coaches' self-evaluation of their motivational tendencies (goal orientation and intrinsic motivation) and athletes' evaluations of their coaches' leadership. Also, we investigated the differences in motivational tendencies between the athletes led by the coaches of different profiles. We expected to obtain two types of coaches and a difference between motivational structures of their athletes coached by coaches of different profiles.

Methods

Participants. The sample was comprised of 577 young male Croatian athletes (M=15.6 yrs., SD=1.2 yrs.), and their 51 male coaches (M=39.2 yrs., SD=10.0 yrs.). The athletes were basketball, football and handball players from 51 clubs, from 9 Croatian counties, 17 from each sport ($N_{basketball}$=192, $N_{football}$=205, $N_{handball}$=180).

*Instruments.*The Croatian version of Task and Ego Goal Orientation in Sport Questionnaire (CTEOSQ; Barić & Horga, 2007) assessed dispositional goal orientations. Participants were asked to think when feel the most successful in

their sport. We used Croatian version of Intrinsic Motivation Inventory (IMI – Barić et al., 2002; McAuley et al.1989) to assess intrinsic motivation, and a Croatian version of Perceived Motivational Climate in Sport Questionnaire (PMSCQ; Barić, 2004; Seifriz et al.1992) to assess motivational climate. To evaluate coaching behaviour we administered British version of Leadership Scale for Sport (LSS; Lee et al., 1993), translated and adapted in Croatian (Barić, 2004).

The measurement was conducted over a year period, all ethical demands regarding scientific research procedure were respected. All participants were measured by all instruments, but items were adapted to their sport roles (either an athlete or a coach).

Results

Separate composite scores were calculated for each subscale. Hierarchical cluster analysis was used to classify coaches with regard to their leadership style, goals and type of motivation. The sample of athletes was divided into two different groups according to the criterion based on different coaches' profiles. The differences between athletes' motivational tendencies with regard to different coaches' profiles were calculated by discriminant analysis.

Table 1. Descriptive statistics for coaches' and athletes' subsamples

Variables	Coaches (*N=51*)			Athletes (*N=577*)		
	M	*SD*	*Range*	*M*	*SD*	*Range*
Task	4.57	0.43	3.43-5.00	4.19	0.66	1.29-5.00
Ego	2.71	0.96	1.00-4.67	2.98	0.90	1.00-5.00
Interest/enjoyment	4.75	0.26	4.00-5.00	4.64	0.39	2.60-5.00
Competence	4.51	0.39	3.40-5.00	4.10	0.54	1.20-5.00
Effort investment	4.81	0.29	3.75-5.00	4.50	0.54	1.25-5.00
Pressure/tension	1.63	0.56	1.00-3.50	2.00	0.71	1.00-4.50
Mastery	4.42	0.34	3.56-5.00	3.96	0.55	1.44-5.00
Performance	3.01	0.60	1.67-4.00	3.07	0.69	1.08-4.75
Instruction	4.60	0.37	3.29-5.00	3.93	0.61	1.71-5.00
Positive feedback	4.48	0.53	2.50-5.00	3.95	0.72	1.00-5.00
Social support	4.11	0.49	3.00-5.00	3.36	0.88	1.20-5.00
Democratic style	2.54	0.69	1.00-4.20	2.66	0.93	1.00-5.00

Athletes rated themselves relatively high on task orientation and intrinsic motivation, while reporting moderate ratings on ego orientation and motivational climate dimensions. In these teams both types of motivational climate are moderately present. Athletes evaluated their coaches mostly with average grades; they perceive them as instructive, relatively ready to give positive feedback, but less supportive and low democratic. The coaches presented themselves as highly task oriented, and moderately ego oriented. Mean values show they are highly intrinsically motivated for their coaching job, enjoy it, feel competent, invest much effort and feel low pressured from coaching. Coaches evaluated motivational climate in their teams as dominantly mastery oriented, with lower presence of imperative for results. They described themselves as highly instructive, supportive and ready to give positive feedback, but low democratic. Reliability coefficients are acceptable for most of dimensions. The exceptions were intrinsic motivation dimensions, especially in coaches, that was probably caused by a small numerus, but also due to possible misunderstanding of two negatively formulated items - that is congruent to results of previous studies which used translated version of IMI (Kim et al., 2003).

Cluster-analysis indicated that two different coaches' profiles exist (Table 2). In both clusters coaches from all three sports were distributed equally.

Table 2. Descriptive parameters and differences (ANOVA) between coaches' of different profiles

	Mean		*SD*		*F p*	
	Cluster 1	Cluster 2	Cluster 1	Cluster 2		
Interest/enjoyment	4.76	4.74	0.28	0.24	0.03	.87
Competence	4.56	4.40	0.38	0.40	2.07	.16
Effort invested	4.80	4.83	0.27	0.34	0.19	.67
Pressure/tension	1.48	1.89	0.40	0.72	6.65	.01*
Task	4.62	4.45	0.46	0.39	1.20	.28
Ego	2.13	3.51	0.71	0.69	44.89	.00**
Instruction	4.05	3.72	0.30	0.26	14.77	.00**
Feedback	4.05	3.72	0.35	0.35	10.68	.00**
Support	3.46	3.15	0.46	0.43	5.56	.02*
Democratic style	2.67	2.70	0.51	0.37	0.04	.84

The coaches from the *first cluster* feel less pressured by coaching job, are less ego oriented, more supportive, more instructive and more ready to give positive feedback. The coaches from the *second cluster* are more ego oriented, less instructive, less supportive and less ready to give positive feedback to their athletes and also feel higher pressure while coaching. All coaches' intrinsic motivation and task orientation is pretty high and all are low democratic. The first cluster coaches can be described as *more athlete-directed and low ego oriented (T1)*, while the other profile can be described as *less athlete-directed and highly ego oriented coaches (T2).*

Athletes were divided in two groups according to the criterion of two types of coaches. The results of discriminant analysis indicate small, but significant difference between those groups (λ=0.09; *Can*. R=0.28, Λ=0.92, χ^2=46.93, p<0.00).

Table 3. Discriminant coefficients and structure matrix

	Interest	Competence	Effort	Pressure	Task	Ego	Mastery	Performance
Discriminant coefficients	0.03	-0.15	0.35	-0.05	-0.05	0.45	0.83	0.04
Correlation with DF	0.37	0.20	0.50	-0.12	0.47	0.38	0.83	0.08

The biggest contribution to the results on a discriminant function had the athletes' perception of mastery climate, athletes' level of ego orientation and effort investment. The groups are best differentiated by the perception of mastery climate, effort, followed by the task and ego goal orientation and athletes' interest/enjoyment. The discriminant function represents a *conglomerate of mastery motivational climate signs and intrinsic motivation determinants as are effort and interest/enjoyment followed by strong task orientation and moderate ego orientation.* Position of group centroids (G_1= 0.22; G_2=-0.39) indicate that the athletes trained by T1 coaches perceived motivational climate in their teams as more mastery, invested more effort, enjoyed better in their sports, their task goal orientation was higher, but also had elevated ego goal orientation. The T2 athletes perceived less signs of mastery motivational climate, enjoyed less their sport, invested less effort and their task, and ego goal orientation were lower.

Disscussion and conclusion

Coaches communicate differently with their athletes, manifest different behaviours that might influence athletes' motivation for sport in different ways. The democratic coaching style is more appropriate for the development of desirable motivational patterns in athletes, which may result in higher commitment, sportpersonship and higher achievement (Stornes & Bru, 2002). In this study two types of coaches were established. First cluster coaches were less ego oriented, more supportive, more instructive and more ready to give positive feedback to their athletes in comparison to the coaches from the second cluster who were more ego oriented, less instructive, les supportive and less ready to give positive feedback. In line with the *matching hypothesis* (Ntoumanis & Biddle, 1999) the task-involving environment would be created by task oriented coach, and ego-involving environment would be created by less task and more ego oriented coach. Coach's personal goals and criteria for evaluating success are reflected in his/her leadership, congruent to goals which determine his motivation. Athletes who were trained by more athlete-directed, low ego oriented coaches perceived motivational climate as more mastery and cooperation directed. More athlete-directed, low ego oriented coaches were evaluated as more supportive, instructive, and more feedback giving in comparison to the less athlete-directed, high ego oriented coaches. All coaches were evaluated as low democratic. It reflects the traditional coaching style that prevails among Croatian coaches. First type coaches showed a clear goal orientation profile (high task - low ego), while second type coaches show combined goal orientation profile (high task-moderately ego goal orientation). More coaches of the sample belong to the first cluster, their characteristics are preferable and more adaptive for successful coaching, i.e. for creating the more desirable environment from the athletes' motivational and adaptive behavioural responses point of view. Athletes trained by more athlete-directed, less ego oriented coaches perceive mastery climate in their teams, invest more effort and enjoy their sport better. They are predominately task and moderately ego oriented. According to sport motivation theories this finding also indicates certain compatibility between athletes' and their coaches' motivational structures. Coaches' leadership behaviour emanates the environmental signs that athletes interpret as mastery climate which refers to the social environment which accentuate learning, improvement, hard work and cooperation (Seifriz et al., 1995). Those goals are supported by coaches' tendency to be instructive, supportive and ready to give positive feedback to athletes. The congruence between athletes' and their coaches' motivation and leadership style indicates the interpersonal compatibility between athletes and their coaches (Jowett, 2003). Athletes trained by less athlete-directed, high ego oriented coaches perceive fewer signs of mastery motivational climate, enjoy less in training and competitions, invest less effort and their ego, but also task goal orientation was lower, that is less desirable motivational pattern. Such coaching style is more controlling and doesn't provide enough signs which may be interpreted as mastery climate that diminishes athletes' motivation. The motivational structure of these athletes and coaches seems not to be congruent. This

incompatibility might be the reason that induced the obtained motivational structure which reflects; in general, athletes' lower motivation. Probably some other factors, e.g. athletes' dispositions, influence those athletes' motivation more than their coaches' leadership style and motivation which is reflected through their leadership behaviour.

According to our results it seems that coaches who are more athlete-directed and highly task oriented have athletes whose motivational structure is more congruent to coaches' motivational structure, which is one of the main prerequisites of satisfaction in sport, according to the matching hypothesis (Newton & Duda, 1999). If a coach wants his athletes to perceive a more desirable pattern of motivational climate (i.e. mastery climate) in their teams, if he/she wants to have athletes who are highly interested, who enjoy much in their sport, who are ready to invest effort in it, feel competent and who do not feel much pressure while playing or competing, they should be instructive, ready to give social support and positive feedback; they should promote learning and improvement more than winning and results (Barić, 2007). In this case, their athletes' motivation would be higher.

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INFLUENCE OF BASIC MOTOR ABILITIES ON PERFORMANCE OF BOXING-SPECIFIC MOVEMENT PATTERNS

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Abstract

The sample of 92 Croatian boxers of various weight categories was tested with a system of 23 variables (8 variables of boxing-specific movement patterns as the criteria, and 15 variables of basic motor abilities as the predictors). The cross-correlation matrix was used to determine the relations between these two different systems of manifest variables, whereas the influence of the system of basic motor abilities (as the system of predictors) on the individual criterion variables of boxing-specific movement patterns was computed with regression analysis. Relatively high and statistically significant correlations were obtained in the matrix of cross-correlations between the pairs of the most applied variables. Also, the predictor system of basic motor abilities had the statistically significant on each individual criterion variable at the level of .00 (p=.00). Therefore it may be concluded that the development of basic motorics contributes indirectly to the development of relevant specific movement patterns.

Key words: *boxers, boxing specific movement patterns, basic motorics, regression analysis*

Introduction

The determination of relations between certain segments of anthropological status and their influence on specific motor abilities of athletes in particular sports is still a fundamental, very actual practical and theoretical issue due to its importance for the design of as sensible and economic procedures as possible, aimed at the optimal orientation and selection of athletes, at training programming and monitoring, as well as at effective monitoring of the relevant anthropological characteristics development during training process (Malacko & Rađo, 2004).

Having in mind that a boxer must solve many problem situations that demands cognition, assessment, anticipation, and responses to ever changing, thus unknown, situations in a bout, it is hypothesized that the determination of the influence basic motor abilities have on the boxing-specific movement structures may be one of very important performance indicators. Since boxing is a very complex kinesiological activity, it is hard to say which anthropological characteristics are more, and which are less important in performance equation. Therefore, their ranking is more a result of a subjective evaluation than of unbiased hierarchy within the performance factor specification equation (Blažević, 2006; Blažević, 2007).

The goal of the research was to compute, by means of the cross-correlation analysis, the relations between the systems of basic motor abilities and specific movement patterns, on the one hand, and on the other to determine the influence of the predictor system of basic motor variables on individual criteria of boxing-specific movement patterns in order to sensibly and economically program and monitor training effects.

Methods

On the sample of 92 Croatian boxers of various weight categories, a system of 23 variables was applied, out of which 8 variables were measurement instruments of specific motor variables (criteria), whereas 15 were measures of basic motor abilities (predictors).

The following variables were used for the assessment of specific motor abilities: 1. rope skipping in 10 seconds (SSKIP), 2. speed of performing 100 directs (straight punches) against a punching bag (SBR100D), 3. speed of performing combined punches against a punching bag – two directs, two hooks (crochet) and two uppercuts (SBR100K), 4. two-legged hops and performance of left-right directs in 10 seconds (SSUNPOD), 5. two-legged hops and performance of left-right hooks in 10 seconds (SSUNPOK), 6. two-legged hops and performance of left-right uppercuts in 10 seconds (SSUNPOA), 7. defence against a left direct and countering with three directs – defence against a right direct by ducking and countering with three directs against coach's hands (SKONTRA), and 8. a series of 100 combined punches against coach' hands: a left direct, a right direct, a right uppercut, a left-right hook, ducking to the right while defending from a left direct and countering by a right direct (SSER100). Metric characteristics, performance standardization and procedures of these 8

boxing-specific motor tests were investigated and determined in the paper by Savić (1986). He utilized the diagnostics (factorial) validity, where the first principal component embraced 89.40 % of common variance.

Basic motor abilities were assessed by the following tests: 1. passing through and jumping over (MBKPOP), 2. agility in the air (MKTOZ), 3. obstacle course backwards (MREPOL), 4. hand tapping (MBFTAR), 5. foot tapping (MBFTAN), 6. foot tapping against the wall (MBFTAZ), 7. standing long jump (MFEDM), 8. medicine ball throwing from lying on one's back (MFEBML), 9. 20m run from the high start (MFE20V), 10. raising legs when lying (MRCDNL), 11. deep squats with a load (MRLDCT), 12. under grip chin-ups on a bar (MRAZGP), 13. forward bent on a bench (MFLPRK), 14. straddle seat forward bent (MFLPRR), 15. forward bent to the right (MFLPRD). Metric characteristics of the tests assessing basic motor abilities have been investigated in numerous previous research studies (Gredelj, Hošek, Metikoš, & Momirović, 1975) by means of factor validity analyses and reliability parameters.

For the utilized variables the following statistical central and dispersive parameters were computed: arithmetic mean (M), minimal value (min), maximal value (max) and standard deviation (S). The fit goodness of the data was tested with skewnes (Sk) and kurtosis (Ku). The relations between the variables of both spaces (basic and specific motor spaces) were determined by the cross-correlations matrix of the manifest variables. Regression analysis was used to compute the influence of the system of basic motor abilities (the predictors) on particular criterion variables of boxing-specific movement patterns.

Results

In Table 1 central and dispersive statistical parameters are presented as well as their discriminant power by means of skewness. All the applied variables demonstrated satisfying discriminant power in the system of basic motor abilities (marked with one *). Namely, the values of skewness did not surpass 1.00. The subject scored somewhat poorer results only in the variables *passing through and jumping over* (MBKPOP) and *agility in the air* (MKTOZ), but they were still within the borders. In the system of specific movement patterns normal distributions were obtained (symmetric) in all but one variable: *rope skipping in 10 seconds.*

Table 1. The basic statistical parameters and the results of testing the normality of the distribution of variables

Variables	M	min	max	S	Sk	Ku
MBKPOP	104.09	70.00	190.00	24.45	1.38	2.73
MKTOZ	59.79	38.00	118.00	16.47	1.57	2.67
MREPOL	87.29	59.00	140.00	16.17	**.64***	1.64
MBFTAR	40.54	30.00	49.00	3.94	**-.41***	-.26
MBFTAN	57.38	43.00	72.00	6.42	**-.39***	-.26
MBTFAZ	28.85	20.00	36.00	3.49	**-.28***	-.40
MFEDM	237.13	168.00	279.00	23.62	**-.52***	.09
MFEBML	79.39	61.00	98.00	10.29	**-.04***	-1.31
MFE20V	30.55	27.00	38.00	2.96	**.36***	-.08
MRCDNL	72.36	46.00	97.00	12.73	**.29***	-.68
MRLDCT	28.31	18.00	41.00	4.48	**.59***	.25
MRAZGP	17.63	9.00	28.00	5.02	**-.03***	-1.05
MFLPRK	28.03	6.00	41.00	7.94	**-.57***	.10
MFLPRR	59.01	27.00	78.00	9.81	**-.75***	1.53
MELPRD	46.29	20.00	65.00	9.08	**-.67***	1.07
SSKIP	20.70	13.00	25.00	2.73	-1.11	.43
SBR100D	185.80	139.00	269.00	25.93	**.79***	2.00
SBR100K	249.86	160.00	345.00	37.65	**-.29***	1.39
SSUNPOD	18.96	12.00	24.00	2.43	**-.41***	.55
SSUNPOK	17.95	11.00	23.00	2.45	**-.46***	.61
SSUNPOA	17.48	11.00	24.00	2.75	**.08***	-.06
SKONTRA	21.48	14.00	32.00	4.79	**.76***	-.41
SSER100	262.31	180.00	329.00	37.38	**-.81***	-.13

Legend: **M** - mean, **min** - minimum value, **max** - maximum value, **S** - standard deviation, **Sk** - skewnes, **Ku** - kurtosis

Relatively high and statistically significant correlations of the pairs of most variables (Table 2) from both systems of anthropological space (the predictor basic motor variables and the criterion specific movement patterns) were obtained, except for the variable *undergrip chin-ups on a bar* (MRAZGP).

Table 2. Cross-correlation between the systems of basic motor variables (predictors) and criterion variables (specific movement patterns)

Variables	SS KIP	SBR 100D	SBR 100K	SSUN POD	SSUN POK	SSUN POA	SKO NTRA	SSER 100
MBKPOP	**-.72***	**.91***	**.85***	**-.88***	**-.88***	**-.86***	**.83***	**.84***
MKTOZ	**-.83***	**.90***	**.85***	**-.88***	**-.88***	**-.85***	**.89***	**.80***
MREPOL	**-.69***	**.86***	**.84***	**-.87***	**-.87***	**-.88***	**.79***	**.92***
MBFTAP	**.71***	**-.49***	**-.43***	**.63***	**.63***	**.51***	**-.72***	**-.44***
MBFTAN	**.70***	**-.64***	**-.59***	**.79***	**.78***	**.73***	**-.85***	**-.68***
MBTFAZ	**.65***	**-.59***	**-.49***	**.70***	**.70***	**.62***	**-.76***	**-.54***
MFEDM	.16	.12	.19	**-.20***	**-.20***	**-.31***	.09	**.52***
MFEBML	**-.43***	**.66***	**.67***	**-.73***	**-.73***	**-.76***	**.69***	**.83***
MFE20V	**-.52***	**.44***	**.33***	**-.52***	**-.53***	**-.48***	**.45***	**.36***
MRCDNL	.08	.16	**.23***	**-.27***	**-.26***	**-.36***	.17	**.50***
MRLDCT	.01	.15	.18	**-.22***	**-.22***	**-.26***	**.21***	**.37***
MRAZGP	**.31***	-.05	.02	-.08	-.08	-.15	-.10	**.35***
MFLPRK	**-.25***	**.42***	**.50***	**-.48***	**-.48***	**-.57***	**.49***	**.74***
MFLPRR	**-.27***	**.47***	**.56***	**-.46***	**-.45***	**-.55***	**.49***	**.72***
MELPRD	**-.34***	**.55***	**.64***	**-.50***	**-.49***	**-.59***	**.54***	**.71***

Table 3. Effects of the predictor system of basic motor variables on the criterion variables

Variables	SS KIP	SBR 100D	SBR 100K	SSUN POD	SSUN POK	SSUN POA	SKON TRA	SSE R100
MBKPO	**.04***	**.00***	**.01***	.71	.66	.81	.83	.21
MKTOZ	**.00***	.16	**.01***	**.04***	**.03***	**.00***	.07	.12
MREPOL	.70	.41	.50	.82	.64	.41	.71	.05
MBFTAP	.19	.09	.14	.73	.70	.23	.94	.82
MBFTAN	.36	.25	.67	.56	.61	.90	**.00***	.11
MBTFAZ	.95	.35	.55	.78	.77	.91	.99	**.03***
MFEDM	.47	.37	.05	.34	.45	.90	.24	.25
MFEBML	.06	.71	.43	.36	.33	.50	.69	.90
MFE20V	.56	.95	**.01***	.09	.07	.07	.06	.20
MRCDNL	.72	.42	.12	**.00***	**.00***	**.00***	.38	**.00***
MRLDCT	.42	**.04***	**.00***	**.00***	**.00***	**.00***	.42	**.00***
MRAZGP	.98	.55	.01*	.06	.07	.12	.16	**.00***
MFLPRK	.55	.07	.32	.76	.77	.38	.72	.67
MFLPRR	.67	.67	.86	.04	**.03***	**.02***	.57	.49
MELPRD	**.03***	**.00***	**.00***	**.01***	**.01***	**.01***	.06	.11
R_0^2	.83	.92	.92	.88	.87	.87	.89	.95
R_0	.91	.96	.96	.93	.93	.93	.94	.97
F	26.59	65.59	60.58	37.45	36.81	35.78	45.12	104.85
p	**.00***	**.00***	**.00***	**.00***	**.00***	**.00***	**.00***	**.00***

Legend: **Ro^2** - multiple Ro square; **Ro** - multiple correlation; **F** - F-test; **p** - level of significance

Table 3 shows that the expected results were obtained: the predictor system of basic motor variables had a significant influence on each individual criterion variable of boxing-specific movement patterns, thus establishing statistically significant relations (multivariate influence) between them at the level of .00 (p=.00). The basic motor variables displayed the following individual statistically significant influence on the each criterion variable:

SSKIP: passing through and jumping over - MBKPOP (.04), agility in the air - MKTOZ (.00) and forward bent to the right - MFLPRD (.03);

SBR100D: passing through and jumping over - MBKPOP (.00), deep squats wit a load - MRLDCT (.04) and forward bent to the right - MFLPRD (.00);

SBR100K: passing through and jumping over - MBKPOP (.01), agility in the air - MKTOZ (.01), deep squats wit a load - MRLDCT (.04), under grip chin-ups on a bar (MRAZGP) and forward bent to the right - MFLPRD (.00);

SSUNPOD: agility in the air - MKTOZ (.04), raising legs when lying - MRCDNL (.00), deep squats wit a load - MRLDCT (.00) and forward bent to the right - MFLPRD (.01);

SSUNPOK: agility in the air - MKTOZ (.03), raising legs when lying - MRCDNL (.00), deep squats wit a load - MRLDCT (.00), straddle seat forward bent - MFLPRR (.03) and forward bent to the right - MFLPRD (.01);

SSUNPOA: agility in the air - MKTOZ (.00), raising legs when lying - MRCDNL (.00), deep squats wit a load - MRLDCT (.00), straddle seat forward bent - MFLPRR (.02) and forward bent to the right - MFLPRD (.01).

SKONTRA: foot tapping - MBFTAN (.00);

SSER100: foot tapping against the wall - MBFTAZ (.03), raising legs when lying - MRCDNL (.00), deep squats wit a load - MRLDCT (.00) and under grip chin-ups on a bar - MRAZGP (.00).

Discussion and conclusions

Modern boxing is a high tempo performance sport with paramount amount of specific movement patterns (techniques). Also, specific motor abilities are very important, predominantly speed, coordination, explosive strength (power), strength endurance of a dynamic type and speed-strength endurance. However, basic motor abilities are also relevant. Therefore, the authors wanted to see which of them would display higher relevance for top-level performance.

This experiment confirmed, by means of cross-correlation analysis, high relevance of well performed specific technical elements (directs, hooks, uppercuts) and of specific motor abilities: movement speed, arm-leg coordination, explosive strength, strength endurance of a dynamic type as well as of anaerobic-aerobic capacities (speed-strength endurance). Almost equally important for performance in a boxing bout are basic motor abilities: body coordination, speed of alternate movements, performance, flexibility, explosive strength and strength endurance of a dynamic type.

The determination of influence of the system of predictor basic motor variables on the criterion variables of specific motor movement patterns was conducted by means of regression analysis. It revealed that the predictor system established statistically significant multivariate relations (Ro^2, Ro) at the level (p) of .00 with all the applied criterion variables. It could be stated that that the applied system of basic motor variables as a whole contributed to a great extent to specific abilities.

Individual influence of each standardized predictor variable on each individual criterion variable was computed by means of the regression coefficient (β). T-test was used to test the significance of influence of each predictor variable on each criterion variable. The statistical significance of influence was obtained for all the predictor variables at the level from .05 to .00 (p= .05-.00). Individual basic motor variables which had statistically significant influence on six were ranked as follows: *deep squats wit a load* (MRLDCT) and *forward bent to the right* (MFLPRD), followed by *agility in the air* (MKTOZ), *raising legs when lying* (MRCDNL) and *passing through and jumping over* (MBKPOP).

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INTEGRATION OF BASIC AND SPECIFIC MOTOR ABILITIES IN ELITE KARATEKA

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Abstract

The aim of the study was to identify motor structures of the integral space of basic motor abilities, specific motor abilities and motor skills (techniques) in elite karateka, and to determine relations between the basic and specific motoricity in karateka. The study included a group of 85 karateka aged 18-29 years, competing as senior category athletes within the Croatian Karate Society. A battery of 22 motor tests (9 basic motoricity tests and 13 specific motoricity tests) were used. Factor analysis of the basic and specific motoricity pooled variables revealed existence of four significant factors as follows: general factor of technical efficiency with basic explosive strength; factor of speed (basic and specific); factor of basic coordination; and factor of specific agility. Canonic correlation analysis yielded two significant linear combinations between the tests on basic motor abilities and tests for assessment of specific motor skills and performance. First canonic correlation was based on general efficiency of specific skills and performance, determined by the basic motor abilities of explosive strength, movement frequency and agility. Second canonic correlation indicated the karateka of above-average explosive strength but below-average speed to achieve above-average results, while those with above-average speed but below-average explosive strength achieved below-average results on specific agility tests and technical element performance.

Key words: *elite karateka, basic motoricity, specific motoricity, canonic relations*

Introduction

In karate, the fight dynamics and high movement frequency are especially emphasized, necessitating from a karateka a high level of motor and functional abilities, speed and strength[4], and coordination[5] in particular.

In karate, only the karateka with potentially above-average motor abilities, primarily explosive strength, speed and coordination[1], can achieve top results; it is especially pronounced in karate blows performed in combination, *such as jaku zuki-mawashi geri* and *kizame zuki-jaku zuki*[2]. It is just the speed and quality of performing these actions (techniques) that influence directly the attack efficiency in karate.

Upon achievement of top quality in performing particular karate techniques, the speed of reaction and the skill of predicting the opponent's attack are crucial for success in karate (Mori et al., 2002)[3].

The aim of the study was to identify motor structures – complex in elite karateka on the basis of interaction relationship and/or mutual determination of the basic motor abilities, specific motor abilities and specific motor skills – karate techniques, the formation of which eventually results in high performance efficiency in karate.

Methods

The study included a sample of 85 karateka aged 18-29 years, at least brown-belt owners competing as senior category athletes as members of the Croatian Karate Society. Measuring instruments covering specific psychomotor space segments were employed on assessment of primary motor abilities: explosive strength (standing long jump, standing high jump, and throwing medicine ball from supine position); movement frequency (hand tapping, foot tapping, and hand rotation); coordination (figure eights with bending, hand and foot tapping); and equilibrium (standing with both feet in transverse position on the bench with the eyes closed)[1].

On choosing tests for assessment of the situation motor abilities, due care was taken to select the tests that provide best estimate of the most important factors of fight performance, i.e. specific agility-mobility (speed of specific movements) and specific speed (speed of technique performance)[1]: side steps on taking guard with hands lifted up, speed of movement in a triangle, speed of blockade performance and hand blow as a combined technique, speed of the *gedou barai* blockade technique performance, and speed of the *mawashi geri* foot kick technique performance.

Technical efficiency was determined on the basis of subjective evaluation by four judges calculating the first main judgment component in 8 karate techniques. The following techniques were evaluated: *jaku zuki, kizame zuki, ushiro mawashi geri* and *mawashi geri*, and in combinations *jaku zuki – mawashi geri, jaku zuki – uraken, ashi barai – ushiro mawashi* and *kizame zuki – jaku zuki.*

Factor analysis was employed to determine factors of the integral motor space composed of the sets of variables for assessment of basic motor abilities, specific motor abilities and quality of karate technique performance. The algorithm consisted of oblimin transformation of the latent dimensions obtained by orthoblique transformation of characteristic vectors of the matrix of variable inter-correlations.

Classic canonic correlation analysis was used to determine relationships with and/or impact of basic motor motor abilities on specific motor abilities and motor skills (quality of performance of particular basic karate techniques).

Thus, the ideal complex of general and specific motor abilities of karateka, necessary for superior performance in karate, was determined by the use of factor and canonic correlation analysis.

Results

Basic motoricity and specific motoricity are closely related in karateka, i.e. these abilities are highly mutually determined and should therefore be integrally observed. That is why factor analysis of the tests assessing basic and specific motor abilities as an integral space was employed. Factor analysis of the tests of general motoricity (basic motor abilities) and specific motoricity as an integral set of variables produced four significant factors, their structure suggesting the same mechanisms to be most probably responsible for the general motor and specific motor manifestations in elite karateka.

Canonic correlation analysis yielded two significant linear combinations between the tests assessing basic motor abilities and tests assessing specific motor abilities and motor skills (Table 1).

Table 1. Structure of oblimin factors (F) and results of canonical correlation analysis between of basic motor variables and specific motor variables

Variable	F 1	F 2	F 3	F 4		C 1	C 2
Standing long jump (cm)	0.42	0.16	-0.04	-0.17		-0.56	0.21
Standing high jump (cm)	0.54	0.26	0.02	-0.34		-0.85	0.40
Medicine ball throw (dm)	0.51	-0.09	0.40	-0.36		-0.44	0.53
Hand tapping (f)	-0.19	0.85	-0.24	-0.10		-0.62	-0.52
Foot tapping (f)	0.15	0.69	-0.02	0.41		-0.57	-0.69
Hand rotation (f)	0.01	0.72	0.17	-0.14		-0.56	-0.16
Hand and foot tapping (f)	-0.08	-0.05	-0.81	-0.23		-0.15	0.06
Standing on equilibrium bench (s)	0.41	-0.05	-0.72	0.15		-0.43	0.10
Figure eight with bending (s)#	-0.26	-0.26	0.57	0.06		0.60	-0.03
Sidesteps (s)#	-0.15	-0.05	0.23	0.78		0.53	-0.44
Movement in triangle (s)#	-0.38	-0.12	0.03	0.65		0.68	-0.52
Block-blow (s)#	-0.47	-0.46	0.05	-0.03		0.76	0.06
Gedou barai (f)	0.67	0.26	-0.02	0.02		-0.77	0.25
Mawashi geri (f)	0.38	0.68	0.08	-0.03		-0.93	-0.22
Jaku zuki	0.90	-0.06	-0.03	-0.15		-0.76	0.47
Kizame zuki	0.92	0.01	-0.05	-0.04		-0.81	0.38
Ushiro mawashi geri	0.91	-0.02	-0.06	0.07		-0.71	0.25
Mawashi geri	0.96	-0.02	-0.10	0.06		-0.77	0.30
Jaku zuki – mawashi geri	0.95	-0.01	-0.02	-0.04		-0.80	0.42
Jaku zuki – uraken	0.89	-0.02	0.10	-0.13		-0.75	0.49
Ashi barai – ushiro mawashi	0.94	0.00	-0.08	0.11		-0.76	0.30
Kizame zuki – jaku zuki	0.91	0.03	-0.01	-0.10		-0.83	0.42
LAMBDA	11.60	2.14	1.60	1.11	CC	0.92*	0.77*
Variance %	52.72	9.73	7.29	5.03			

LAMBDA – characteristic values, Variance % – percentage of variance explained by a particular factor, C – canonical variable, C R – canonical correlation

variable with opposite metric orientation, * p<0.001

Discussion and conclusions

The tests assessing performance of all karate techniques showed highest projections upon the first factor isolated, followed by basic explosive strength (standing long jump and supine med-ball throw in particular). The variable of *gedou barai* blockade frequency, found to be saturated by force rather than speed and used to block forceful opponent's leg kicks against lower trunk, yielded significant projection upon this factor.

The second factor isolated was defined by the tests assessing the frequency of simple (routine) movements and basic karate techniques, i.e. frequency of leg kicks (*mawashi geri*) and speed of the combined block-kick performance. This factor integrated basic and specific speed into an integral motor ability as a predominant feature of elite karateka.

The third factor isolated was mostly defined by the tests assessing basic coordination, i.e. factor responsible for movement structuring underlain by agility, coordination of upper and lower extremity movements, and equilibrium.

The fourth factor isolated was predominantly defined by projections of the tests assessing specific agility, i.e. situation mobility of the karateka.

The first canonic factor of the predictor set of variables was defined by extremely high projection of the motor variable assessing explosive strength (standing long jump) and motor variables assessing the frequency of movements and coordination/agility. It is a general motor factor defined by the abilities of explosive strength, psychomotor speed and agility.

The structure of the first canonic factor of the criterion set of variables was characterized by extremely high projections of all variables assessing specific motor skills and specific motor abilities. It is a general factor responsible for the manifestation of all specific motor abilities and skills in karate.

The first canonic correlation was underlain by general efficiency of specific abilities and skills determined by basic motor abilities of explosive strength, movement frequency and agility.

The second canonic correlation between the predictor and criterion sets of variables of 0.77 was bipolar, pointing to two types of karateka with opposite motor abilities. The karateka with above-average explosive strength but below-average speed achieved above-average results on the tests of specific agility and on performing technical elements, whereas those with above-average speed but below-average explosive strength showed below-average results on the tests of specific agility and on performing technical elements.

Factor analysis of the tests of basic and specific motor abilities clearly showed the very basis of the motor performance of the karateka, which results from the nature of karate as a sports discipline. In the fight conditions, the speed of action performance plays crucial role in both defense and attack efficiency of the fighter, with a major role of explosive strength.

Study results revealed the karate techniques to be predominantly determined by explosive strength, followed by coordination, i.e. the basic motor abilities regulated by the cortical mechanisms, which are innate and therefore cannot be significantly influenced upon by any kinesiologic treatment. That is why top results in karate can only be achieved by the karateka with potentially above-average motor abilities, primarily explosive strength and coordination, which are then integrated in the general motor efficiency through karate training.

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DOES THE LIVE HIGH – TRAIN LOW MODEL WORKS?

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Abstract

Training near sea level while living at an altitude of 1700 - 2000 m for a month enhances subsequent endurance performance, probably by increasing the oxygen-carrying capacity of the blood through an increase in production of red blood cells. Many athletes and coaches have generally accepted the idea that traditional altitude training-living and training high-benefits sea-level endurance performance. The question is what the best way to get an altitude exposure is. To answer this question, we controlled the effect of two types of getting the hypoxic influence – live high – train high (traditional concept) and live high – train low (new concept). The reasons for not having a positive effect are caused by the: insufficient acclimatization effect for elite athletes to stimulate an increase in red cell mass/haemoglobin mass because the altitude was too low(<1700 m) and/or the altitude training period was too short(<2-3 weeks); (2) the training effect at an altitude may have been compromised due to insufficient training stimuli for enhancing the function of the neuromuscular and cardiovascular systems; and (3) enhanced stress with possible overtraining symptoms and an increased frequency of infections. When comparing HiHi and HiLo (living high and training low), it is obvious that both can induce a positive effect and increase the oxygen transport capacity of blood, at least in 'responders' if certain prerequisites are met. The minimum dose to attain a haematological effect is at least 3 weeks at an altitude. The increased oxygen transport capacity of blood allows training at higher intensity during and after HiLo, thereby increasing the potential to improve some haematological and cardiovascular determinants of endurance performance. To interpret the changes correctly, by provoking an altitude exposure, different strategies need to be applied (HiHi and HiLo) as well as a concept of the magnitude and quality of the changes that matter to the considerable inter-individual variation in sea level performance after altitude training.

Key words: *high altitude training, live high – train low, live high – train high, haematological changes, long and middle distance runners, biathlon athletes, and orienteering athletes*

Introduction

Training near sea level while living at an altitude of 1700 - 2000 m for a month enhances subsequent endurance performance, mainly by increasing the oxygen-carrying capacity of the blood through an increase in production of red blood cells (1, 2, 4, 7. 8, 13).Many athletes and coaches have generally accepted the idea that traditional altitude training--living and training high--benefits sea-level endurance performance (3). The question is what the best way to get an altitude exposure is. To answer this question, we controlled the effect of two types of getting the hypoxic influence – live high – train high (traditional concept) and live high – train low (new concept).The reasons for not causing a positive effect are related to: acclimatization effect may have been insufficient for elite athletes to stimulate an increase in red cell mass/haemoglobin mass because of low altitude (<1700 m) and/or a short altitude training period (<2-3 weeks); (2) the training effect at an altitude may have been compromised due to insufficient training stimuli for enhancing the function of the neuromuscular and cardiovascular systems; and (3) enhanced stress with possible overtraining symptoms and an increased frequency of infections (14). When comparing HiHi and HiLo (living high and training low), it is obvious that both can induce a positive effect and increase the oxygen transport capacity of blood, at least in 'responders', if certain prerequisites are met (5, 9, 11, 12, 16). The minimum dose to attain a haematological effect is at least 3 weeks at an altitude. The increased oxygen transport capacity of blood allows training at higher intensity during and after HiLo, thereby increasing the potential to improve some haematological and cardiovascular determinants of endurance performance. To interpret in a correct way the changes provoked by the altitude exposure applying different strategies (HiHi and HiLo), we need to build some concept of the magnitude and quality of the changes that matter to the considerable inter-individual variation in sea level performance after altitude training.

Hypothesis

1. Are their any differences in the magnitude and the quality of the effect on different parameters – haematological and physiological comparing the two hypotheses: Live high – train high (conventional concept) and Live high – train low (new concept)? And

2. Is it possible to alter the haematological and physiological status of the athletes during the 16 days stay on altitude under the 2000 m, or 1720 m?

Methods

Subjects

The subjects of the study were 18 high-level biathlon, ski-orienteering and track and field athletes (middle and long distance running) – 9 training and living high and 9 training low but living high. No medication was taken by the subjects, which would have been expected to affect physical performance. All procedures were performed in accordance to the Declaration of Helsinki on the use of human subjects. After provision of written and oral information regarding the possible risks and discomforts of the study all subjects gave their written consent before participation.

Design of the study and exercise protocols

The altitude training camp took place in Maliovitza – (Rila Mountain) 1720 m, Bulgaria; 2006, for the period of July – August.The groups followed training sessions twice per day during 16 day general basic mesocycle with main the task of developing and improving the aerobic capacities of the athletes and their gradual transformation into the specific competitive work-capacity. The applied training tools were continued and variable running on the level of the anaerobic threshold (**Fig. 1 and 2**), individually determined by the laboratory tests; interval work, trekking, GPP and specific sport-oriented exercises. Experienced coaches supervised training. Blood samples were taken twice – before and after training camp from the antecubital vein under standardized conditions between 7.00 and 8.00 a.m. The following parameters were determined using RAL (Spain) apparatus: haemoglobin (Hgb); erythrocytes; leucocytes, haematocrit (Hct), mean corpuscular volume (MCV); mean corpuscular haemoglobin (MCH), mean corpuscular Hgb content (MCHC), thrombocytes and lymphocytes. The maximal step spiroergometric test using the cycling ergometer type "ER-900" and spiroergometric apparatus "Oxycon Alpha" with continuous gas analyse by "Breath – by – Breath" has been applied to determine the following physiological parameters: BM%, BMI, Wmax, Wmax/kg, VO2max (ml), VO2max/kg (ml/min), HRmax and AT.

Statistical analyses

All variables are presented as means (± S.D.). As normal distribution was assumed, the t-criteria of Student for parametric comparisons of the two related and independent samples compared the changes in haematological and physiological parameters. In order to look at intra- and interindividual variations, the mean change in each parameter has been derived prom pre- and post-treatment values by computing the following:

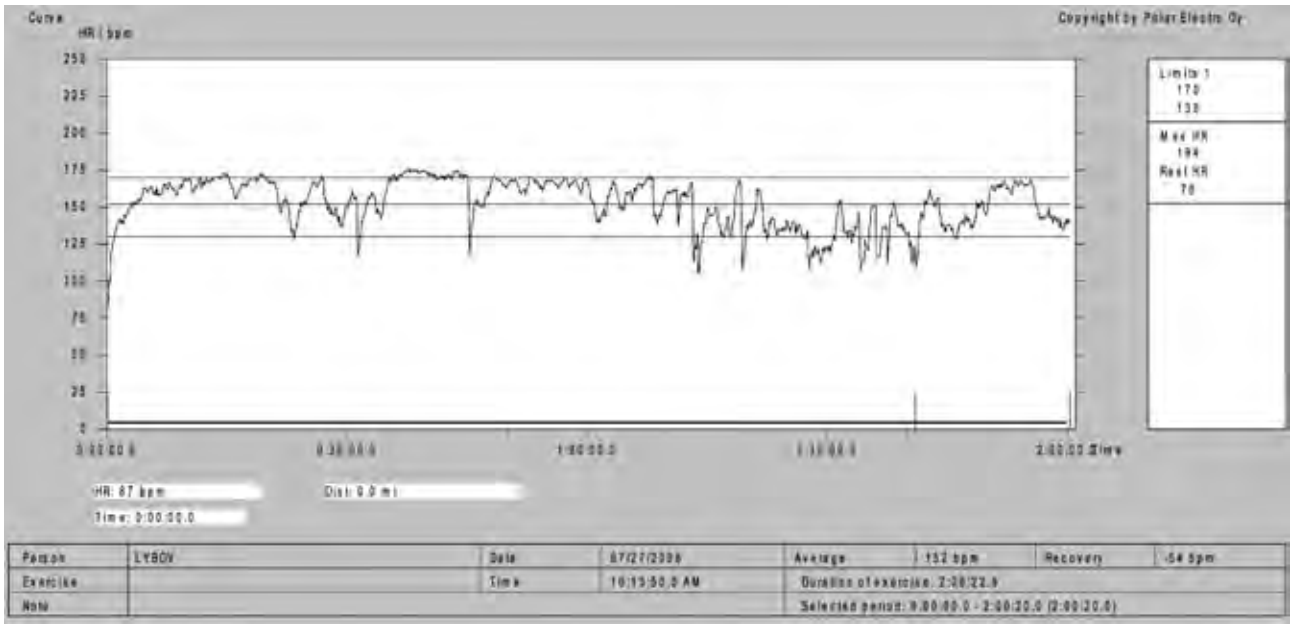
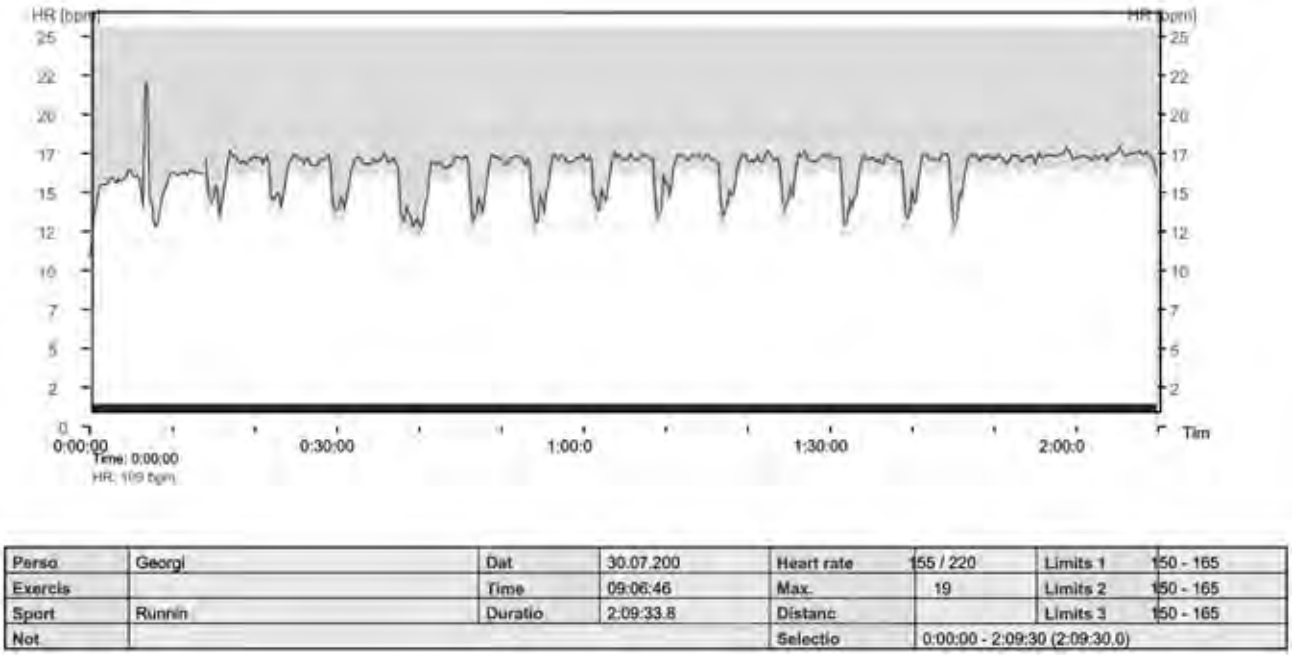


Figure 1. HR dynamic of I.K. (Living and training high).



Perso	Georgi	Dat	30.07.200	Heart rate	155 / 220	Limits 1	150 - 165
Exercis		Time	09:06:46	Max.	19	Limits 2	150 - 165
Sport	Runnin	Duratio	2:09:33.8	Distanc		Limits 3	150 - 165
Not				Selectio	0:00:00 - 2:09:30 (2:09:30.0)		

Figure 2. HR dynamic of G.D. (Living high – training low).

$\sum Post_n - Pre_n / Pre_n X100$

Parameters

Statistical significance was set at $P< 0.05$. For all statistical tests, SPSS.13 software was used.

Results

For live high – train high (HiHi) statistically significant differences can be observed for the following variables: total number of erythrocytes; MCV; MCH; MCHC. Approximately 7,8% decrease of the erythrocytes is observed but the improvement with 2% of MCV, 8% of MCH and 6% of MCHC is very indicative for the influence of the hypoxia and long lasting adaptation (Table 1).

The high homogeneity of the haemoglobin level after the exposure can be established, in comparison to the pre-test, therefore, the altitude changes the haematological status of the athletes (Fig. 3.)

Also the high homogeneity of MCV can be stated before and after the altitude exposure (Fig.4). The improvement of the MCV is evident, as a guarantee of better work-capacity of the athletes on sea level.

In reference to the non-traditional concept live high – train low (HiLo), the statistically significant differences can be observed for the following parameters (variables): haemoglobin; leucocytes; MCV and MCH (Table 2). The 2% haemoglobin improvement can be established and also 6 % improvement of MCH and significant improvement of leucocytes – 17%.

Analysing the differences in haemoglobin individual values with HiHi (Fig.5) – as it can be observed, the pictures before and after the altitude exposure are identical. In contrast to the traditional concept (trend), the dispersion of the values before and after the exposure looks almost the same but small improvement can be stated.

In comparison with the traditional concept (hypothesis), the high dispersion of the MCVH values can be observed both before and after the exposure. This fact can be explained by the different time course of the individual athletes' adaptation towards the altitude exposure (Fig. 6.).

In comparative aspect between the two hypotheses, statistically significant differences for haematological parameters cannot be established (Table 3).

Statistically significant improvements of the VO2max/kg(ml/min/kg) in two groups of athletes - about 5% for those training high and living high (HiHi)(Table 4) and 6% for those training low – living high (HiLo) (Table 5).

Several studies demonstrated the inhibition of the level of VO2max/kg(ml/min/kg) after 2-3 weeks, altitude acclimatisation in comparison to the sea level.

*Table 1. Changes in haematological parameters (means±standard deviation and comparative t-criteria) after 16 day live high – train high - (p0,05, * – statistically significant)*

Variables	Referents values	Pres		Post		t -test	P
		$\overline{X}$	S±	$\overline{X}$	S±		
Haemoglobin	111-168 g/l	154,88	15,25	154,75	10,05	0,04	0,97
Erythrocytes	3,7 – 5,2 T/l	5,20	0,55	4,80	0,24	2,75*	0,03
Leucocytes	4,4 – 12,5 G/l	7,23	0,95	7,10	1,45	0,29	0,78
Haematocrit	31 – 45%	45,86	5,15	43,13	2,48	2,13	0,07
MCV	70 – 93fl	88,25	2,12	90,00	1,85	4,78*	0,00
MCH	23-43 g/l	29,88	0,95	32,25	0,97	8,42*	0,00
MCHC	320 – 360 g/l	338,13	6,98	358,50	4,78	6,27*	0,00
Thrombocytes	154 – 521 x 10^9/l	252,00	33,45	262,75	49,34	0,64	0,54
Lymphocytes	20 – 40 %	34,10	5,51	32,09	6,59	1,10	0,31

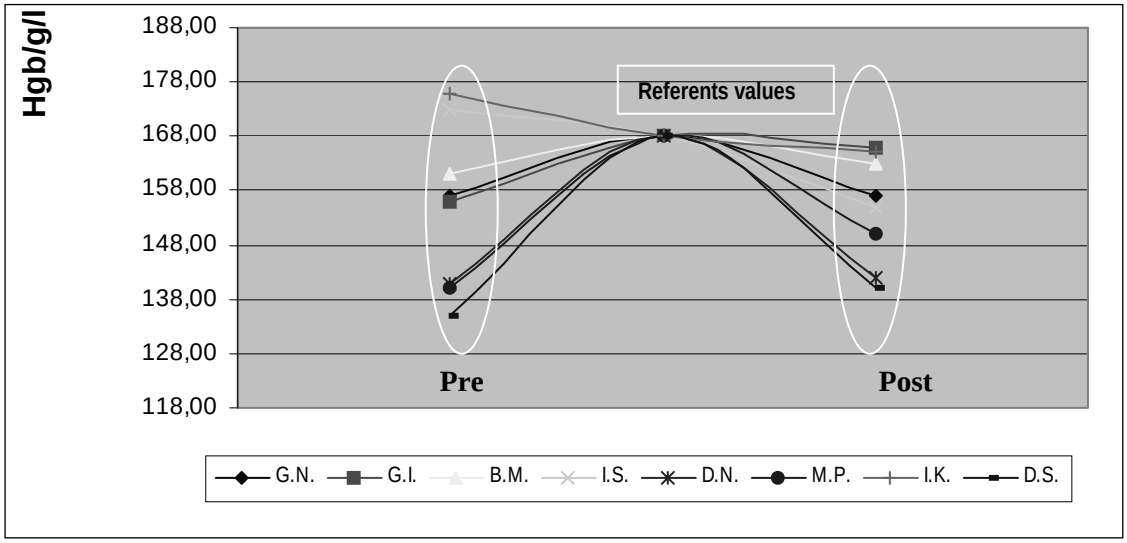
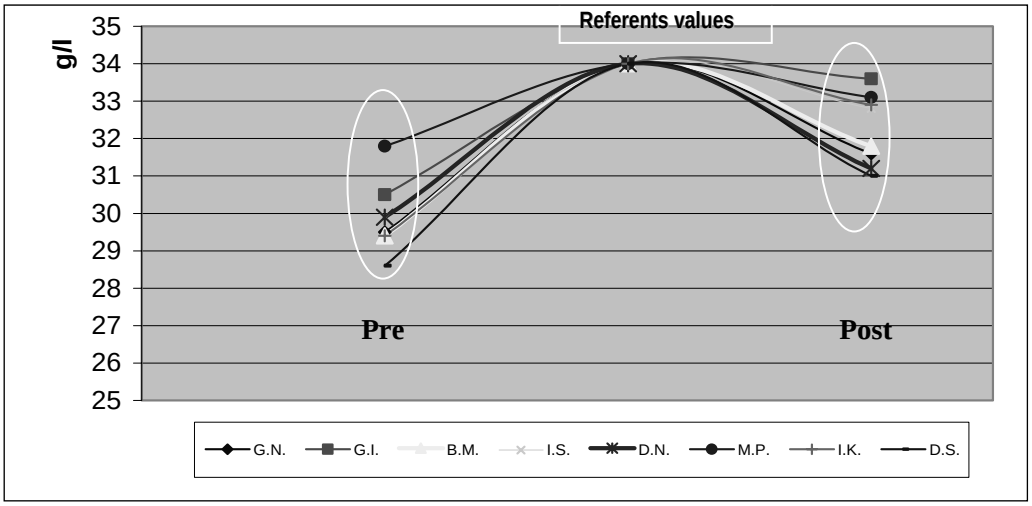


Figure 3. Individual hemoglobin values – HiHi.



Future 4. Individual MCV values – HiHi.

*Table 2. Changes in haematological parameters (means±standard deviation and comparative t-criteria) after 16 day live high – train low - (p0,05, * – statistically significant)*

Variables	Referents values	Pre		Post		t -test	P
		$\overline{X}$	S±	$\overline{X}$	S±		
Haemoglobin	111-168 g/l	150,20	17,64	154,75	10,05	2,31*	0,05
Erythrocytes	3,7 – 5,2 T/l	5,34	0,59	5,17	0,65	1,41	0,20
Leucocytes	4,4 – 12,5 G/l	6,15	1,25	7,20	1,19	3,83*	0,01
Haematocrit	31 – 45%	45,47	5,53	44,10	6,78	1,07	0,32
MCV	70 – 93fl	85,40	6,90	85,44	7,50	1,16	0,28
MCH	23-43 g/l	28,25	2,98	30,01	3,36	7,11*	0,00
MCHC	320 – 360 g/l	330,30	10,89	350,89	13,81	8,11*	0,00
Thrombocytes	154 – 521 x 10^9/l	256,80	81,68	288,11	92,32	2,48	0,38
Lymphocytes	20 – 40 %	33,76	6,53	34,87	8,57	0,30	0,77

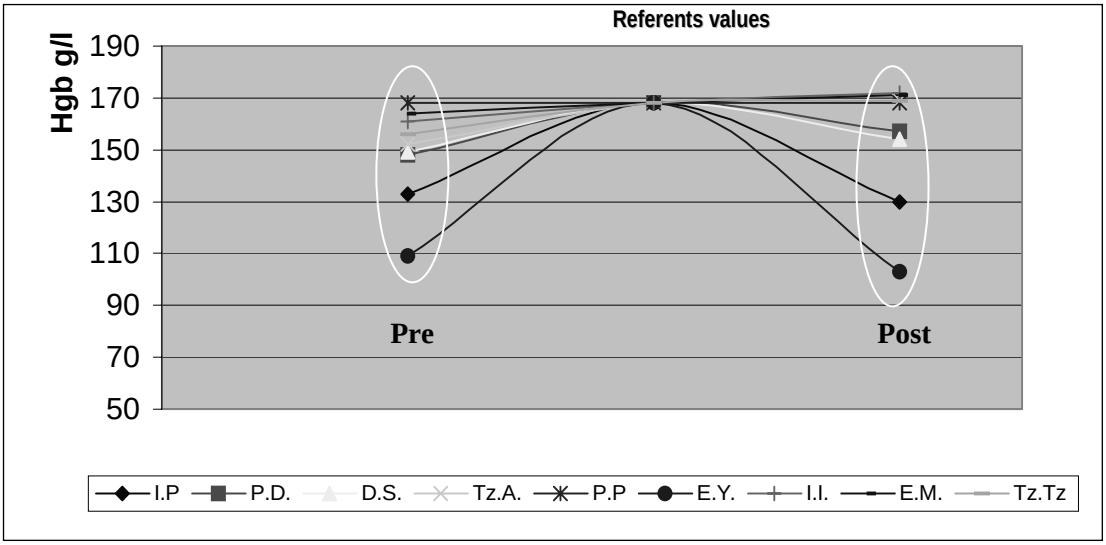
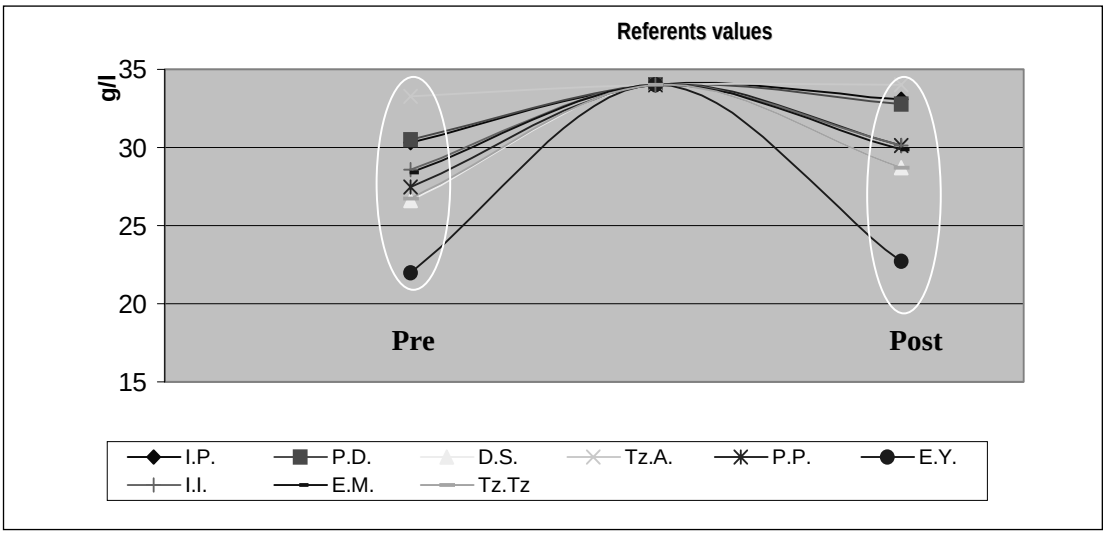


Figure 5. Individual hemoglobin values – HiLo.



Future 6. Individual MCHC values – HiLo.

*Table 3. Comparative analysis of the changes in haematological parameters between the two tested concepts (p≤0,05, * – statistically significant)*

Variables	HiHi		HiLo		Difference	Significance		
	$\overline{X}_1$	S_1	$\overline{X}_2$	S_2	$\overline{X}_2$ - $\overline{X}_1$	*temp*	*α*	***P%***
Hgb	154,8	15,25	154,75	10,05				
Erythrocytes	4,8	0,24	5,17	0,65	-0,37	1,52	0,150	84,97
Leucocytes	7,1	1,45	7,2	1,19	-0,1	0,16	0,878	12,20
Hct	43,13	2,48	44,1	6,78	-0,97	0,38	0,708	29,18
MCV	90	1,85	85,44	7,5	4,56	1,67	0,116	88,42
MCH	32,25	0,97	30,01	3,36	2,24	1,81	0,090	91,02
MCHC	358,5	4,78	350,89	13,81	7,61	1,48	0,160	83,97
Thrombocytes	262,8	49,34	288,11	92,32	-25,36	0,69	0,499	50,07
Lymphocytes	32,09	6,59	34,87	8,57	-2,78	0,74	0,469	53,05

*Table 4. Changes in some physiological parameters after 16 day living high – training high (p≤0,05, * – statistically significant)*

Variables	**Pre**		**Post**		**t**	**P**
	$\overline{X}$	±S	$\overline{X}$	±S		
BM %	14,99	4,98	14,87	4,62	0,315	0,76
Wmax/kg (W/kg)	4,33	0,65	4,59	0,50	1,64	0,16
VO2max/kg(ml/min/kg)	53,68	6,31	56,91	6,27	3,52*	0,02
HRmax (bit/min)	185,00	10,17	181,83	10,12	1,26	0,26
AT (bat/min)	173,16	8,97	172	9,18	2,90*	0,03

*Table 5. Changes in some physiological parameters after 16 day living high – training low (p≤0,05, * – statistically significant)*

Variables	**Pre**		**Post**		**t**	**P**
	$\overline{X}$	±S	$\overline{X}$	±S		
BM %	14,04	5,53	14,19	5,18	0,53	0,60
Wmax/kg (W/kg)	4,18	0,51	4,24	0,50	0,85	0,41
VO2max/kg(ml/min/kg)	50,62	8,25	54,20	7,71	2,71*	0,03
HRmax (bit/min)	185,11	8,43	180,77	6,30	2,13	0,06
AT (bat/min)	172,66	7,87	169,55	6,76	1,71	0,12

Discussion and conclusions

The 1720 m altitude can be accepted as a sufficient stimulus for a complete effect of altitude exposure. The duration of the stay in altitude conditions can be reduced to 15 days, but not less than 10 days (9).

There are at least some minimal advantages for HiLo, which can be explained with the positive effect of the altitude hypoxia on cardio-respiratory system in coordination with the lack of limitations from the oxygen depression in atmospheric air during the intensive training loads.

Our results provide clear evidence that the well-oriented training around individual anaerobic threshold (AT) during 16 day mesocycle and exposure to the moderate altitude (1720m) significantly changes some haematological parameters, mainly MCV, MCHC and leucocytes. This may lead to an improvement of the aerobic performance capacity of the athletes on sea level. The observed non-significant changes in Hgb can be related to the very high starting mean value, near to the referents and substantial individual variation in haematological response to altitude (6, 7, 14).

There also is some debate about the physiological limit of that increase in endurance athletes, like our subjects The significant changes in mean corpuscular volume (MCV); mean corpuscular haemoglobin (MCH), mean corpuscular Hgb content (MCHC) are characteristics of the long-lasting adaptation, so 16-days mesocycle remains sufficient to start the stable adaptation.

The magnitude and quantity of the effect on haematological and parameters of the option – live high/train high and live high/train low are not proven sufficiently. But it can be supposed that in HiLo cardio-respiratory the system works more economically and that fact allows athletes to train with higher intensity.

The time course of the individual adaptation reactions is more evident for live-high/train-low (HiLo). May be the contrast changes of the stimulus is the reason (high –low – high).

The positive changes in leucocytes in HiLo may be informative for their activation, respectively activation of the immune status of the athletes (non-clinical inflammation) and also the influence of the well-oriented training tools.

The current study indicates that "Live High-Train-Low" can significantly improve oxygen carrying capacity and performance of endurance athletes. Therefore, "Live High- Train-Low" is an ideal alternative training method for altitude training. Questions still remain regarding the optimal altitude for the high/low model and the mechanisms of high altitude training and the high/low model.

Training and living at an altitude allows a number of potentially beneficial physiological and haematological to occur. These adaptations are postulated to improve endurance performance at sea level. Therefore a new strategy has been introduced where the athletes live at altitude but train at sea level. This approach allows both the beneficial adaptations of acclimatization to develop, as well as provides an opportunity to train without reducing power output during exercise. The availability of HiLo however and scientific methods of application remain to be elucidated. Future investigations are necessary.

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THE ANALYSIS OF PREPARATION OF LEADING SWIMMERS OF UKRAINE IN 4-YEAR OLYMPIC CYCLES AT THE FINAL STAGES OF SPORTS PERFECTION

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Abstract

The purpose of our work is to analyze the modern features of preparation of highly skilled swimmers to the Olympic Games at the stage of results retention.

The analysis of special literature and scientific materials, theoretical generalization; the analysis of experience of domestic and world practice, documents of planning; interrogation of coaches and at hletes; the analysis of competition reports through the INTERNET system; questioning.

The analysis has shown that duration of athletes' performance at the level of top results in different sports and disciplines has considerably increased and makes from 1 up to 2-3 Olympic cycles and more, that assumes essential differences in the system of preparation of athletes in separate Olympic cycles.

Thus, as the results of researches show, for athlete preparing for the second and subsequent Games in their sports career a plenty of competitive starts can be recommended as an effective and basic means of preparation at the stage of results retention. At this the solution of the problems connected with integrated preparation, is carried out most effectively on a background of general lowered swimming volume without damage of basic preparation efficiency.

Key words: *4-years Olympic cycles, repeated participation in the Olympic Games, competitive activity of athletes*

Introduction

The problem of efficiency of athlete preparation to Olympic Games gets special importance at the present stage in the connection with their high prestige and popularity, and also their political importance in the world.

The aggravation of competitive struggle, increase of density of sports results in the majority of Olympic sports advance qualitatively new demands to the efficiency of process of preparation from the positions of final sports result.

The athletes' success and results at the Olympic Games will depend just on the degree of readiness for competitions and full objectivity of analyzing and generalizing of the previous experience and achievements of modern theory and practice of athlete preparation, and defining the most perspective directions of perfection in many respects.

The national team of Ukraine participated successfully enough in the latest Games of Olympiads, having taken the 5th position, following the teams of the USA, Australia, Japan and the Netherlands.

Practice testifies that now, at considering the duration of sports career of the qualified athletes, the following tendencies may be allocated: 1.) increase of quantity of athletes (swimmers), who repeatedly took part in the Olympic Games, 2.) problems of increase or preservation of sports result level.

At the same time, the leading experts in the field of the theory and practice of sports of top results note, that for highly skilled athletes the Olympic Games are the main, culmination competitions in their sports career. Hence, the major feature of sports of top results is to plan the athlete preparation within the limits of 4-year Olympic cycles.

The purpose of our work is to analyze the modern features of preparation of highly skilled swimmers to the Olympic Games at the stage of results retention.

Methods of researches

The analysis of special literature and scientific materials, theoretical generalization; the analysis of experience of domestic and world practice, documents of planning; interrogation of coaches and at hletes; the analysis of competition reports through the INTERNET system; questioning.

Results of researches

The analysis has shown that duration of athletes' performance at the level of top results in different sports and disciplines has considerably increased and makes from 1 up to 2-3 Olympic cycles and more, that assumes essential differences in the system of preparation of athletes in separate Olympic cycles.

So, if the contents of an Olympic cycle of preparation at the stage of maximal realization of individual opportunities is directed at the creation of conditions to achieve the highest sports results with use of means and methods capable to activate a rapid course of adaptation processes, and the planned total sizes of volumes and intensity of training work reach limited sizes, the competitive practice, volume of special mental, tactical and integrated preparation sharply increase, the contents of an Olympic cycle of preparation at the stage of result retention will be especially characterized by an individual approach. Inevitable decrease in functional potential of an organism and its adaptable opportunities caused in many respects by high level of loading at the previous stage, often not only does not allow to increase loading, but also complicates to keep them at an earlier achieved level. It demands efforts to find individual reserves for growth of sports skills, increase of qualitative characteristics of preparation process, use of nonspecific means stimulating working capacity and efficiency in performance of motor actions (V.N.Platonov, 2004, K.P.Sahnovsky, 2001).

Many athletes are successfully preparing and competing during 2-3 Olympic cycles and sometimes 4 cycles. In these cases Olympic cycles coincide not only with the stage of maximal realization of individual opportunities, but also cover stages of retention of supreme sports skill and gradual decrease of results.

In the next cycle not only the volume of training and competitive activity and dynamics of various loadings can be changed, but also the general strategy of preparation.

The majority of athletes, who have achieved outstanding results after the first 4-year Olympic cycles, during the first year of the coming 4 years essentially reduce the volume of training work and raise their attention to qualitative components of training process.

So, for example, after her successful performance at the Games-2000 in Sydney Y. Klochkova lowered the total volume of work by 15% (in hours) during the first year of the next Olympic cycle (2001-2004) , annual volume of swimming – by 20%, volume of work on land – by 15%.

The basic attention has been given to perfection of poorly performed elements of swimming techniques, starts, turns, etc. As if to various components of their functional readiness, there was being solved the task of their retention at an earlier achieved level substantially due to the base components of special preparedness.

During the 2nd year of a 4-year cycle the preparation was constructed in the same way. Within the next years the step-by-step increase of total amount of training work in water and on land as well as the volume of special preparation was planned and it was to become a stimulus for the next adaptable jump again. Such strategy of preparation construction during the IInd Olympic cycle allowed Yana Klochkova to continue her successful sports career, to perform well at the Olympic Games 2004 where, as it is known, she won 2 gold Olympic medals.

In the course of current researches, which we have conducted by means of questioning of leading swimmers of the national team of Ukraine, the analysis of reports of competitive activity (according to the INTERNET network) it has been revealed the following:

The contents of preparation of high class swimmers being at the stage of results retention have essential differences in comparison with previous stages. So, the swimmers, who in their competitive practice have participated in several world championships and at least in one of the Olympic Games, considerably change swimming volumes after the their first Games (fig. 1). Significant reduction of swimming volume was found out among all the contingent of surveyed athletes in the 1st year following their participating in the Olympic Games. The character of changes in swimming volumes of navigation had following features: before performance in their first Games the athlete swimming increased gradually, that to the greatest degree corresponded to the mechanisms of adequate adaptation to loadings and characterized the stage of maximal realization of athlete long-term preparation. In other athletes, for whom the participation in the Games-2000 (Sydney, Australia) or 2004 (Athens, Greece) was the second or third participation in the Olympic Games, the changes of swimming volume over years and a 4-year cycles had a wavy character that reflected the features of athlete preparation at the stage of results retention and to the greatest degree corresponded to adaptive features of athlete organism having participated in one or more Olympic Games.

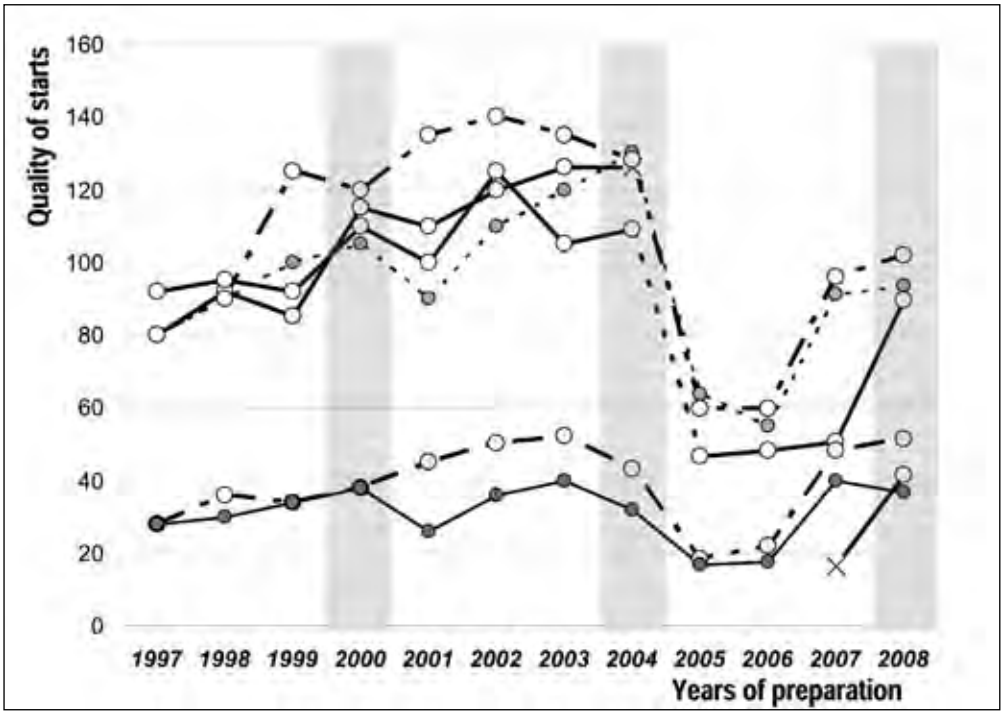

Fig. 1. Dynamics of competitive starts of leading swimmers Ukraine during 1997 - 2008.

The subsequent researches have shown, that during the specified period the competitive practice considerably increased, and it should be connected with the growth of number commercial and additional, but at the same time important starts for athletes in a year period. Nevertheless, as the practice of Ukrainian swimmers preparation shows, such quantity of starts not always renders negative influence on the basic athlete preparation to the main competitions of an Olympic cycle, and sometimes it is an additional stimulus of further prolongation of sports career at simultaneous decrease of swimming volumes and keeping up of general high tension of basic training process (fig. 2).

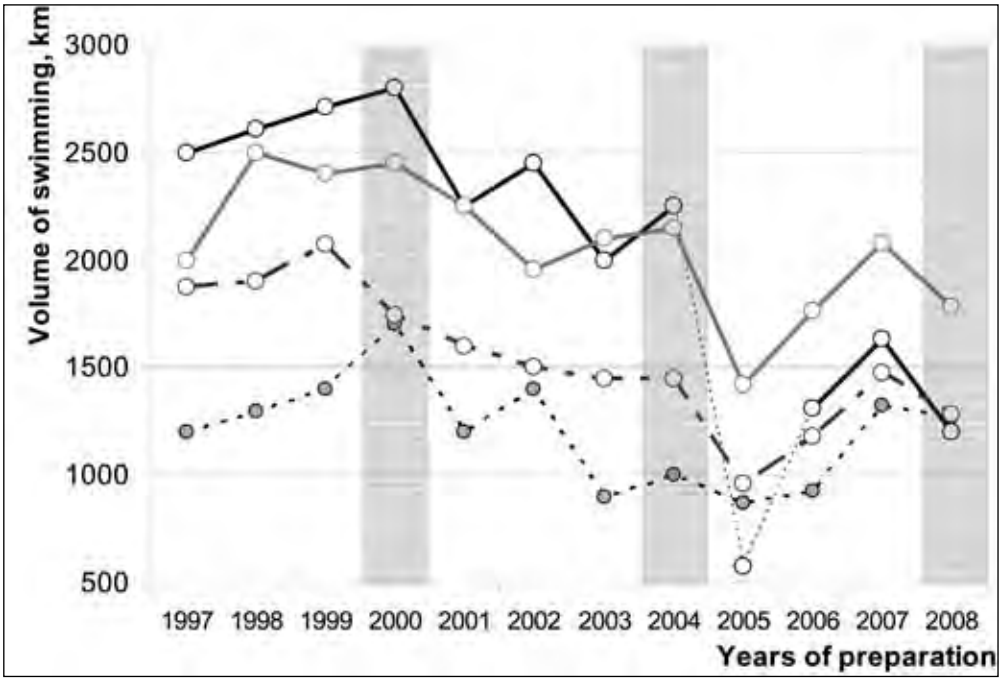

Fig. 2. Dynamics{Changes} of swimming volumes of leaders swimmers Ukraine during preparation for Games of Olympiads 1997 - 2008

Discussion of results

Thus, as the results of researches show, for athlete preparing for the second and subsequent Games in their sports career a plenty of competitive starts can be recommended as an effective and basic means of preparation at the stage of results retention. At this the solution of the problems connected with integrated preparation, is carried out most effectively on a background of general lowered swimming volume without damage of basic preparation efficiency.

Now the theory and technique of sports preparation has deficiency of developed theoretical and practical positions for optimization of preparation of high-skilled athlete in the Olympic cycles at the stage of supreme skill retention. Objective regularity of involutional process of changes in the structure of athlete preparedness providing an optimal preservation or regularity in the loss of the level of athlete productivity is not clear. There is no clearness in the description of contents of preparation and features of calculation in the individual plan for athletes of such technologies of preparation which provide protection of health, competitiveness and reliability of their performance at the competitions, and, naturally, desirable record achievements. Also, the questions, connected with the reasons and criteria of approaching of the stage of supreme skill retention by athletes, are considered in an insufficient degree.

It demands more detailed consideration of structure and contents of the final stage of swimmers' long-term preparation, and also the analysis of factors influencing the period of high skills retention by athletes.

Conclusions

1. Required development and scientific formation of the system for construction of 4-year cycles of Olympic preparation considering a stage of long-term preparation.
2. During long-term preparation of athletes at the stage of maximal realization of individual opportunities and at the stage of results retention it is expedient to plan different variants of construction of structure, contents and dynamics of training and competitive loadings. It can provide proof demonstration of high sports skill during several Olympic cycles.

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In the article the analysis of problems of preparation and reduction of athletes' high level of sports skill during several Olympic cycles is presented.

DIAGNOSTIC OF BALANCE ABILITIES

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Abstract

Balance boards are widely used in the objective measurement and testing of balance abilities.Its known, that tests of easier character with less feel have higher reliability then tests that are more complicated with more feel. And to these tests with more feel belong tests maintaining dynamic balance in different positions on a stabilographic board, which shows the level of development of dynamic balance. Balance abilities belongs to a structure of coordination abilities, and is characterized as an ability to maintain the body in a stable position or to renew this position if it is disturbed by outside interference.

The aim is to analyze reliability of the testing dynamic balance abilities on different balance boards.

Balance abilities were tested on 45 students of Faculty of physical education and sports, Comenius University in ages 21 – 23. Among them there were 26 males, 19 females. By using the paired correlation we calculated the correlation coefficient with intervals of reliability and testing errors.For testing the dynamic balance abilities we chose the test of balancing on diferent unstable boards. Reliability of test we verified method test – retest with time interval one week. Test and retest were accomplished in a standard laboratory conditions. The goal of the tested person was to balance him/herself in the longest balance standing position on the board. The attempt was finished at the time if any part of the board touches the ground. Everybody was tested three times. We tested in the same place, at the same time o f the day, on the same surface, with the same motivation and the same researchers

Relatively highly significant relationships was confirmed in the tests of dynamic balance. Test on Balance master r(corl.)=0,78 , Extrem balance boards r (corl.)=0,75 , Energetics board r (corl.)=0,73, Test of balancing on an unstable boards r (corl.)= 0,72

Tests of balancing on an unstable boards are good means for diagnostics of dynamic balance abilities in sport professions.

Key words: *dinamic balance, stabilographic board, balance test reliability*

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THE LEVEL OF DEVELOPMENT OF SOME BASIC AND SPECIAL MOTOR ABILITIES OF YOUNG FOREIGN AND SLOVENIAN FEMALE BASKETBALL PLAYERS

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Abstract

The study presents the results of some tests of basic and special motor abilities that were achieved by elite Slovenian female basketball players, aged 14 and 15, and by their counterparts from 15 European countries. The results show that young Slovenian basketball players on average achieve slightly lower results in all tests of basic and special motor abilities compared to their counterparts from other European countries. The differences identified in the tests of explosive strength of arms, take-off reaction and speed strength and elasticity of legs were statistically significant. The slightly lower motor potential of the Slovenian female basketball players demonstrates that the players should focus more attention on the development of their basic motor abilities in the future. These abilities are the foundation of special (basketball) motor abilities and demanding technical and tactical basketball structures.

Key words: *basketball, motor tests, differences*

Introduction

Basketball is a relatively multifaceted and complex team game combining cyclic and acyclic movement structures that mainly involve fast and dynamic movements with the ball and without it (Erčulj, 1998). The most frequent movements include short sprints, abrupt stops, fast changes in direction, acceleration, and different jumps, shots and passes of the ball.

The basic or fundamental basketball movements are typically executed without the ball, while special movements are executed either with the ball or without it. Special movements are typical of basketball. Most of the time they are more complex and demanding in terms of co-ordination, which is particularly true for movements executed with the ball. For the efficient and successful execution of these movements it is important that the athlete has highly developed special (basketball) motor abilities and a high level of technical knowledge. The basic movements are more of a general type and are usually less demanding in terms of co-ordination and technical knowledge. Therefore the efficiency of their execution depends less on technical knowledge and skills and more on basic motor abilities.

A very important motor element of the basketball play is vertical jump. A successful and efficient execution of thus type of jump depends on the ability called take-off power (Strojnik, 1998). In basketball, this ability manifests itself in various situations, mainly in jumps with the ball when a player shoots at the basket and without the ball in defensive and offensive rebounds after a missed shot (Erčulj, Dežman, & Vučković, 2004). The players mainly execute one- and two-leg countermovement jumps. The jumps must be fast (short take-off reaction time) and as high as possible (jump height) so that the player can catch the ball before her opponent and can execute a jump shot without hindrance.

The motor abilities, i.e. motor potential, of male and female basketball players are established and monitored by the use of tests of motor abilities. In broader basketball practice, motor tests are the most available and applicable as they are implemented under conditions that are similar to those of training or competition.

For several years now, at the Faculty of Sport in Ljubljana, we have systematically been monitoring the motor abilities of elite young Slovenian male and female basketball players. Until recently, the motor abilities of elite Slovenian male and female basketball players could not be compared to the motor abilities of their counterparts from other countries with highly developed basketball nor could they be evaluated on an international scale. This year the organisation of the FIBA International Basketball Camp in Slovenia for female players up to 15 years of age turned out to be a window of opportunity.

Methods

The sample consisted of 60 female basketball players who were tested during the FIBA International Basketball Camp which was organised by the Basketball Federation of Slovenia in Postojna (Slovenia) from 25 to 30 June 2007. The sample included players between 14 and 15 years of age from Slovenia and 15 other European countries. The subsample of foreign players consisted of 30 players from 15 countries (the Czech Republic, Slovakia, Greece, Belgium, Croatia,

Italy, Romania, Finland, Portugal, Germany, the Netherlands, Bulgaria, Austria, Wales and Scotland). Each country was represented by two players of the highest quality who were also members of the national team. Their average age was 14.73 (±0.45) years, body height 170.38 (±7.36) cm, body mass 61.88 (±7.28) kg, and number of playing years 4.83 (±1.66). The subsample of Slovenian players consisted of 30 elite Slovenian female basketball players, aged between 14 and 15, featuring on the broad list of national team players. Their average age was 14.10 (±0.30) years, body height 165.38 (±7.01) cm, body mass 55.02 (±8.86) kg, and number of playing years 3.73 (±1.91).

The sample of variables consisted of ten motor tests which were used for the evaluation of players' basic and also basketball specific motor abilities. The subjects performed each test three times and the best result was included in data processing. Table 1 shows the names of the selected tests and the abilities measured.

Table 1. Basic and basketball specific motor tests (a detailed description of tests and applied technology is provided in the article by Erčulj and Bračič, 2007)

CODE	TEST	ABILITY	UNIT
CMJH	Counter movement jump with hands	Speed strength and elasticity	cm
BBT	Basketball throw	Speed strength and acyclic speed	cm
MBT2	Medicine ball throw (2 kg)	Explosive strength	cm
DJ25	Drop jump – height 25 cm	Explosive strength and elasticity	cm
S20	20 m sprint – high start	Acceleration and cyclic speed	sec
TT5	T-test (5 + 5 m)	Agility and take-off reaction time	sec
S6x5	6 x 5 m sprint run	Agility (changing of direction by 180°)	sec
D20	20 m sprint dribbling	Acceleration and cyclic speed with a ball	sec
D6x5	6 x 5 m sprint dribbling	Agility in dribbling (changing of direction by 180°)	sec
RCTT5	Take-off reaction time of T-test	Take-off reaction	ms

The data were processed using SPSS 15.0 statistical software for Microsoft Windows (Chicago, IL). The following statistical data were calculated for all variables: mean value, standard deviation, and minimal and maximal results. The differences between the groups of foreign and Slovenian female players were established with the **T-test for independent samples**. The differences were verified at a 5% risk level.

Results

The basic parameters of descriptive statistics were used to establish the basic characteristics and abilities of the study subjects and the T-test was used to identify the differences between both groups of players.

Table 2. Descriptive statistics and T-test

Variable	Mean	S.D.	S.E.	Min	Max	T-test	Sig. T
CMJH							
foreign	32.65	6.09	1.112	24.5	51.6	.516	**.010**
Slovenians	31.97	3.87	.707	25.2	41.5		
DJ25							
foreign	25.22	3.27	.598	18.8	30.9	.509	.277
Slovenians	24.71	4.40	.804	14.9	34.8		
S20							
foreign	3.55	0.18	033	3.19	4.13	-1.770	.676
Slovenians	3.63	0.16	.029	3.36	4.06		
D20							
foreign	3.78	0.22	.041	3.27	4.26	-2.770	.931
Slovenians	3.94	0.23	.042	3.48	4.50		
S6x5							
foreign	9.67	0.47	.086	8.82	10.68	-.608	.657
Slovenians	9.74	0.48	.087	8.69	11.19		
D6x5							
foreign	10.08	0.57	.105	9.19	11.34	-1.277	.258
Slovenians	10.26	0.52	.096	9.00	11.60		
TT5							
foreign	3.22	0.18	.033	2.86	3.20	-1.468	.232
Slovenians	3.29	0.21	.040	2.85	3.81		

RCTT5							
foreign	0.271	0.173	.031	0.04	0.71	-.948	**.012**
Slovenians	0.328	0.282	.051	0.23	0.98		
BBT							
foreign	726.00	86.56	15.805	570	940	5.350	**.008**
Slovenians	630.33	45.82	8.366	540	710		
MBT2 f							
oreign	456.33	50.54	9.229	360	580	5.272	**.020**
Slovenians	399.33	30.84	5.631	330	450		

Table 2 shows that the selected foreign basketball players achieved better results on average in all tests of motor abilities. Statistically significant differences ($p<0.05$), were identified in the take-off reaction time of the T-test (RCTT5), countermovement jump with arm swing (CMJH) and both, basketball and medicine ball, throwing tests (BBT, MBT2).

Discussion and conclusion

The foreign players achieved slightly better results in both vertical jumps (CMJH, DJ25) (Table 2), while statistically significant differences between them and their Slovenian counterparts were recorded in the CMJH test. This is an important piece of information considering that nearly all basketball jumps are practically performed with countermovement and arm swing (e.g. rebounds in defence and offence, the jump ball, shot blocking, jump shots and lay-up shots).

As regards drop jump (DJ25), the foreign players' jumps were slightly higher, while their contact times were shorter by as much as 5 ms (foreign 279.7 ± 65.93 ms, Slovenian 284.8 ± 66.58 ms). The jump height and the contact times show that neither the foreign players nor their Slovenian counterparts are capable of bearing high eccentric-concentric loading at a high level or, in other words, of maximally exploiting the elastic energy accumulated during the eccentric phase of the jump. Bosco (1999) categorises drop jump contact times that exceed 190 ms as 'poor'.

The foreign players achieved better results in the basketball throw (BBT) and medicine ball throw (MBT2) (Table 2). These two tests differ from the others in terms of movement structure and measured abilities. It can be concluded that foreign basketball players are better in both tests because they are taller and heavier than their Slovenian counterparts. Body characteristics that facilitate the performance of this test include higher muscle mass and thus a larger cross-section of the extensor muscles of the arms, as well as a larger physiological cross-section of the muscles in general (Ušaj, 1996). Maximal and absolute arm strength and the length of upper extremities strongly influenced the results of both tests, particularly of the medicine ball throw (MBT2), as they both facilitate production of force on an object over a longer distance and thus a higher starting speed (Ušaj, 1996).

On the contrary, several studies (Erčulj, 1996; Erčulj, 1998, Erčulj, Dežman, Vučković, 2004) conducted with elite young Slovenian female basketball players show that shorter players, especially guards and forwards, achieve better results in the tests of acceleration, agility and jumping ability. However, this is obviously not true when the best Slovenian female basketball players are compared to their even better foreign counterparts. Irrespective of the fact that the latter are taller on average and that there are more guards among the Slovenian players, the foreign players achieved better results on average in all selected tests of motor abilities.

A common feature of the tests of acceleration (S20, D20), agility (S6X5, D6X5, TT5), take-off reaction (RCTT5) and jumping ability (CMJH, DJ25) is that their performance depends on eccentric-concentric contraction of the extensor muscles of the legs. One of the reasons for the foreign basketball players achieving better results in these tests is the better elastic potential of their muscles and tendons (muscle potentiation), as this is one of the mechanisms for efficient eccentric-concentric muscle contraction (Strojnik, 1998). This can to some extent be confirmed by the slightly shorter drop jump contact time of the foreign players. The better results of the foreign players could also stem from age difference and more playing years. If a consequence of the above is a higher mass of the active muscles, allowing a higher production of force on the surface, this may contribute to higher jumps or longer strides in running (Čoh, 1988).

Based on the available data, it can only be assumed that foreign coaches focus more attention on developing basic and special motor abilities. However, it is true that foreign players' number of training (playing) years is one year longer than that of their Slovenian counterparts, which can impact on qualitative differences in the development of their basic and special motor abilities. If the difference between the foreign and Slovenian players' ages is deducted from the number of their playing years, the result shows that foreign female basketball players start basketball training about a half-year earlier than their Slovenian counterparts.

The somewhat lower motor potential of the Slovenian female basketball players shows that the players should focus more attention on the development of their basic motor abilities in the future, as these abilities are the foundation of special motor abilities and demanding technical and tactical basketball structures. A higher level of development of these abilities is undoubtedly one of the factors which can contribute to the better playing efficiency of young Slovenian female basketball players, helping them to perform better in competitions with their counterparts from other European countries.

As regards higher age categories, a more accurate diagnosis of the individual abilities of basketball players calls for the laboratory measurement of jumps on tensiometric platforms (jump from semi-squat, CMJH, drop jumps from various heights, jumps with additional loading) and measurement of muscle activation levels.

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RELATIONSHIPS BETWEEN ANTHROPOMETRICS AND ESTIMATED OVERALL QUALITY IN FEMALE VOLLEYBALL PLAYERS

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Abstract

Using the sample of the national-level volleyball players (N = 40; females, members of the four best teams in Croatia for the season 2000/2001), we defined relationships between 12 anthropometric variables and overall quality. Factor analysis revealed three significant anthropometric factors; (1) longitudinal – body length dimensions, (2) voluminosity and transversal dimensions, and (3) subcutaneous fat. Multiple regression calculated between anthropometric dimensions and overall quality defined significant positive influence of the longitudinal dimensions on the overall quality.

Key words: *volleyball, senior players, morphological structures, playing quality, regression*

Introduction

Volleyball is a sport game played on the 18x9 meters field of. In the female volleyball two teams of six players are divided by a 224 cm high net. The net prevents contact between teams, but also requests considerable jumping-reach-height, since some of the most important volleyball elements are to be performed above the upper edge of the net (e.g. spike and block). It consequently penalizes shorter athletes. It is evidently supported in volleyball practice (e.g. volleyball players are manifestly tall), but also in most of the investigations done and published so far, where longitudinal dimensionality (in other words – body lengths) was found to be significant positive predictor of the situational efficacy and quality of the female volleyball athletes. On the other hand, ballast mass (mainly measured as the subcutaneous and/or body fat) negatively correlated to volleyball achievement regularly. For example, Gualdi - Russo and Zaccagni (2001) studied somatotype and performance in Italian volleyball players (N = 224), and found significant differences between the high-level players and the amateur players, where the later ones are found to be more endomorphic and mezomorphic. Also, the physique of higher class athletes is characterized by higher ectomorphy and lower endomorphy and mesomorphy.

Grgantov et al (1998) interviewed nine volleyball experts and found logitudinality, coordination and explosive strength as the most important positive predictors of the volleyball achievement. On the other hand, experts interviewed in the same study shared the opinion that the subcutaneous fat has to be considered as the most significant negative predictor of the volleyball performance.

However, it is evident that most of the studies performed so far dealt with heterogenous samples of subjects (see Gualdi - Russo and Zaccagni, 2001 for example) and therefore differences found were easily expectable.

Accordingly, the aim of the present study was to establish the relationships between the anthropometrics and overall quality in national-level female volleyball players.

Methods

The sample of subjects comprised 40 female volleyball players (mean age 20.3 years), members of the four best positioned teams in Croatian national championship in season 2000/2001. The sample of variables consisted of two sets: predictors and criteria. Predictors included 12 anthropometric measures; body height (BH), sitting height (SH), arm length (AL), forearm circumferences (FAC), thigh circumference (TC), calf circumference (CC), wrist diameter (WD), knee diameter (KD) ankle diameter (AD), thigh skinfold (TSF), triceps skinfold (TrSF) and suprailiocristal skinfold (SICSF). All measures were taken following the guidance of the IBP (according to Mišigoj – Duraković et al. 1995). All variables were normally distributed by means of KS test (max d for N = 40 is 0.21)

Criteria included combination of the two items (variables) of the overall quality: (1) quality of the team, and (2) quality of the each player. (1) The players were divided in three groups, according to the final placement of their team (A group: players of the team ranked 1st on the National Championship; B group: players of the 2nd and 3rd ; C group: players of the team ranked as 4th). (2) The coaches of each team divided their players into three groups. The A group consisted of 1-to-3 players coaches considered as the top players in their team. The B group consisted of (1) starting line players not included in the A group, but also of the (2) substitute players regularly involved in the game (and therefore contributing

to the overal team quality). The C group comprised players not included in the A and B group accordingly. By combining the previously specified criteria each player is finally scored from "1" to "5" where "1" defines lowest, and "5" defines highest-best score (Grgantov et al. 2006).

Data analysis included: descriptive statistics, factorization of the 12 anthropometric variables using the factor analysis with Varimax normalized rotation, and definition of the predictors – criterion relationship by multiple regression approach. All coefficienty considered significant at the $p < 0.05$.

Results

Table 1. Descriptive statistics for anthropometric variables

	Mean	Minimum	Maximum	Std Dev
BH (cm)	181,73	168,20	194,00	6,94
SH (cm)	94,53	87,40	102,50	3,76
AL (cm)	78,98	69,35	85,40	3,50
FAC (cm)	24,23	22,00	26,00	0,87
TC (cm)	58,81	53,00	67,25	3,33
CC (cm)	37,77	34,00	42,00	1,60
WD (cm)	5,39	4,46	5,93	0,29
KD (cm)	10,27	9,18	13,57	0,78
AD (cm)	6,68	5,58	7,39	0,37
TSF (mm)	11,19	5,80	17,50	2,85
TrSF (mm)	12,44	6,20	19,05	3,10
SICSF (mm)	14,08	8,13	25,30	4,53

In the Table 1 descriptive statistic parameters are presented including means, minimal and maximal results and standard deviations. Although the descriptive analysis was not within the objectives of the study, we presented it since the sample of subjects comprised best volleyball players in Croatia. Therefore, the presented data are highly applicable as a model values in volleyball selection, especially for those variables highly correlated with criteria (see following text and Table 2).

Table 2. Factor analysis of the anthropometric variables and multiple regression analysis results between anthropometric latent dimensions and overall quality criterion of volleyball players

Variables	F1	F2	F3
BH (cm)	0,98	0,13	0,11
SH (cm)	0,79	0,28	0,19
AL (cm)	0,73	0,11	-0,09
FAC (cm)	0,08	0,49	0,29
TC (cm)	0,35	0,61	0,57
CC (cm)	0,00	0,96	0,22
WD (cm)	0,31	0,52	-0,16
KD (cm)	0,22	0,63	0,27
AD (cm)	0,21	0,55	-0,41
TSF (mm)	0,03	-0,01	0,48
TrSF (mm)	0,04	0,21	0,87
SICSF (mm)	0,02	0,16	0,79
Expl Var	2,43	2,67	2,38
Prp Totl	0,20	0,22	0,20
BETA	0,46*	-0,00	-0,24
R	0,51*		

F1, F2, F3 - factor structure
Expl. Var - factor's variance
Prp Totl - proportion of the variance explained
R - multiple correlation coefficient
BETA - beta coefficients
* denotes significant coefficients ($p < 0.05$)

In the Table 2 results of the factor analysis calculated on 12 measured anthropometric variables are presented. Using the Guttmann Kaiser criterion, three significant factors are extracted. First factor can be identified as the factor of the body lengths – longitudinal dimensionality.. On the second one evident projections of the circumference and diameter measures are observable. Therefore, the F2 can be identified as a factor of the transversal skeleton dimensionality and body volumes (mainly of the lean body mass- muscle tissue). Evidently, the third factor (F3) is a factor of the subcutaneous fat.

Multiple regression analysis (Table 2) reveled significant multiple correlation between latent anthropometric dimensions (F1, F2 and F3), and volleyball overall quality criterion. Additionally, F1 (longitudinal dimensionality) is significantly partially correlated to criterion (e.g. Beta is significant).

Discussion and conclusions

Correlation of the morphological variables obtained by factor analysis points at existence of the three morphological types in the sample of subjects we studied. First factor explains ectomorphic type of the body build in the female volleyball players (apparent longitudinal dimensionality and under-average body fat). On the skeleton of such kind muscles are long and thin, while the body fat (including subcutaneous fat) in negligible. Such body build is evident for the 20% of the subjects studied. Mesomorphic type of the body build, with the expressed musculature and supportive base in the strong – transversally dimensional skeleton is a basis of the second factor (F2). Such type of the body build is evident in the 22% of the volleyball athletes included in here presented study. The third factor (F3) shows the existence of the endomorphic type of the body build in 20% of the subjects.

Positive correlation between longitudinal dimensionality (ectomorphic component of the body build) and estimated overall quality in volleyball players is natural and expected. It is easily connectable to positive correlation between longitudinal body sizes (body lengths) and maximal reach height, and maximal jumping reach height already established in previous studies. As stated in the Introduction, volleyball players with considerable reach-height are advanced in all elements played above the upper edge of the net (e.g. spike and block). Not to forget that those elements are particularly important since teams achieve most of the scores throughout it. The relationship of such kind is previously suggested (Gualdi - Russo and Zaccagni 2001, Grgantov et al. 1998, Grgantov et al. 2006), but at the same time authors regularly established negative influence of the body fat measures on the overall quality of the players. Although relationship of such kind can be recognized herein also (see multiple regression's Beta in the F3) it did not reach statistical significance which mainly relates to the fact that we studied athletes of high quality, and therefore – high homogeneity, which directly defines low variance of the predictor and criterion results. One can argue that in studies of such kind sample of subjects must be highly variable in the observed measures which will ensure a higher variance and consequently elegant reaching of the statistical significance, but authors will not share this opinion. Briefly, if the influence of the different anthropological predictors on the estimated quality (sport-achievement) is aimed in the study, the sample of subjects have to comprise highly skilled athletes exclusively, since it is elemental factor which will allow the investigator to define the true nature of the achievement-predictors (Sekulić et al. 2007). On the contrary, the calculated relationships will be banal (although statistically significant), and therefore not applicable in the sport-selection, and/or sport-training process.

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COMPARISON OF PHYSICAL CONDITIONING STATUS OF THE FIRST AND SECOND LEAGUE MALE HANDBALL PLAYERS

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Abstract

The main goal of this research was to determine general and partial differences in physical conditioning status between first and second league male handball players. Battery of 15 functional-motor tests was assessed on a sample of 13 First league and 21 Second league handball players. By analysis of variance statistically significant multivariate differences were determined (Wilks λ=0,03; p=0,00). The greatest statistically significant univariate differences in favour of first league players were determined in frontal agility (MAG9NN), explosive power of a throwing type (MESBML3), explosive power of a vertical jumping type (MESCMn; MESSJn), repetitive power of arms and shoulders (MRSBP7) and relative power of lower trunk (MRSPT6), and to a lower extent in reaction and explosive power of sprinting type (MESP05; MES20M). Statistically significant differences in favour of second league players were determined in flexibility of hamstrings and back (MFLSAR). Differences are not statistically significant in variables estimating lateral agility (MAGKUS), part of power of sprinting type (MESP10), variant of explosive power of jumping type (MESMAXn), flexibility of arms and shoulders (MFLIP), speed endurance (MBI300Y) and static power of the lower trunk (MSSEL).

Key words: *team handball, motor abilities, differences*

Introduction

Professional papers and research on differences in indicators of physical fitness of male and female handball players from different competitions (Milanović, Šimenc, Vuleta 1996., Milanović, Vuleta, Šimenc 1997., Milanović, Vuleta, Gruić 2003., Milanović et al. 2004., Jukić, Milanović 2002., Srhoj, Marinović, Rogulj 2002., Vuleta, Milanović, Gruić 2002, 2003., Vuleta, Prelčec, Gruić 2004., Vuleta et al. 2006., Gruić et al. 2007., Gruić, Ohnjec, Vuleta 2007., etc.), have direct or indirect contribution in accuracy of explanations of factors of success defined by different hypothetical structures of success in handball. Scored goal, final goal-difference, rank at the end of particular competition etc. are conventionally prescribed measures of successfulness in handball game. To the certain extent indicators of functional and motor abilities vary throughout competition season, mostly due to different length of competition cycles, two or more. Preliminary competition lot determines training process and agenda significantly. Purpose of positive effects of programmed training is to generate comparative advantages before the exact opponent and at exact date. Thereby, professional and innovative approach, up-to-date information, involvement and dedication of trainer and whole logistic as well, come to an end while considering well organized and optimized application of training loads. Frequency of inadequate timing for the particular match is mostly determined by not-controllable factors, but is not always the case. Therefore, handball players with poorer technical-tactical knowledge and manifestations may win the opponent which is considerably stronger by targeting peak of their physical fitness. Comparison of physical fitness of two handball teams competing in two different competition levels/divisions may reveal some answers which go beyond planning and timing. Main argument is that the sole attendance/presence in competition with particular quality level of competing determines the demand for specific minimums and maximums of indicators of conditioning status. Structure of factors that determine success have multicriterion/polihotomious/stochastic attributes that differ and are in interdependence of a large number of inputs generated by age and sex of competitors, type and qualitative level of competitions etc. The goal of this research and ones alike is to make contribution to determination of certain regularities which are the part of all hypothetical structures and experimentally calculated equations of success in handball. The main goal of this paper is to explore differences in physical conditioning status between two handball teams which have competed on two different national competition levels, i.e. First and Second Croatian Handball Leagues. Main hypothesis is that handball players from First national league have significantly higher general level of physical fitness compared to Second league players. Partial differences are partly images of patterns of demands of handball game and partly of selection procedures for players in exact teams etc. Thus, it is the goal to determine specificity of univariately manifested differences as well.

Methods

Sample of entities is comprised of 13 handball players of CH "Agram - Medveščak" from Zagreb which have competed in the First national league in the season 2005./2006., and 21 handball players of CH "Maksimir Princ" from Zagreb which have competed in the Second national league in the season 2006./2007.

Sample of variables is presented by a battery of 15 tests (table 1) estimating basic motor and functional-motor abilities.

Table 1. Battery of functional-motor tests

NAME	TEST	INTENTIONAL MEASUREMENT OBJECT
MAGKUS	side steps	agility- lateral
MAG9NN	frontal running - 9m3m6m3m9m	agility - frontal
MESP05	5m sprint	reaction, explosive power, power of a speed type
MESP10	10m sprint	power of a speed type
MES20M	20m sprint	power of a speed type
MESBML3	medicine ball throw (3kg)	explosive power – throwing ability
MESSJn	squat jump	explosive power – vertical jumping ability
MESCMn	counter movement	explosive power – vertical jumping ability
MESMAXn	bosc max	explosive power – vertical jumping ability
MFLSAR	seat and reach	flexibility of hamstrings and back
MFLIP		flexibility of arms and shoulders
MBI300Y	300 yards	speed endurance
MRSBP7	bench press - 70% body weight	repetitive power of arms and shoulders
MSSEL	Hyperextension withstand	static power of a trunk
MRSPT6	Sit-ups in 60 sec	relative power of a trunk

Data processing methods. Data obtained by testing procedures are processed by a statistical package Statistica 7.0. and presented in few tables. Statistical significance of differences between centroids of the groups (teams) was tested in multivariate space by the analysis of the variance, i.e. Wilk's test (Wilk's lambda), and statistical significance of the partial differences by the univariate analysis of the variance (F-test).

Results

Table 2. Descriptive statistics – CH "Agram – Medveščak", Zagreb

	Valid N	Mean	Minimum	Maximum	Range	Std.Dev.	Skewness	Kurtosis
MAGKUS	13	7,13	6,79	8,00	1,22	0,38	1,67	1,73
MAG9NN	13	7,53	6,95	8,24	1,29	0,45	0,51	-0,73
MESP05	13	1,33	1,20	1,47	0,28	0,09	0,15	-1,23
MESP10	13	2,07	1,94	2,20	0,27	0,08	0,02	-0,56
MES20M	13	3,30	3,12	3,64	0,52	0,14	1,38	2,25
MESBML3	13	101,39	87,25	119,50	32,25	8,62	0,99	1,30
MESSJn	13	44,88	34,67	52,10	17,43	5,17	-0,49	-0,40
MESCMn	13	48,74	40,83	55,43	14,60	4,62	-0,07	-1,15
MESMAXn	13	57,88	49,83	67,70	17,87	6,68	0,32	-1,45
MFLSAR	13	9,16	-19,00	20,83	39,83	11,71	-1,75	2,53
MFLIP	13	90,10	67,67	122,67	55,00	17,99	0,56	-0,62
MBI300Y	13	59,65	56,08	64,02	7,94	2,67	0,48	-1,27
MRSBP7	13	13,00	6,00	22,00	16,00	5,28	0,27	-1,26
MSSEL	13	90,22	60,86	124,00	63,14	24,31	0,54	-1,47
MRSPT6	13	65,38	50,00	75,00	25,00	7,37	-0,72	-0,09

Table 3. Descriptive statistics - HC "Maksimir", Zagreb

	Valid N	Mean	Minimum	Maximum	Range	Std.Dev.	Skewness	Kurtosis
MAGKUS	21	7,24	6,66	8,73	2,07	0,48	1,54	3,27
MAG9NN	21	8,08	7,35	9,58	2,23	0,54	1,27	1,97
MESP05	21	1,44	1,23	1,64	0,42	0,12	-0,40	-0,40
MESP10	21	2,14	1,94	2,37	0,43	0,12	0,00	-0,92
MES20M	21	3,40	3,21	3,70	0,49	0,13	0,53	-0,08
MESBML3	21	55,08	42,67	65,67	23,00	6,39	0,27	-0,42
MESSJn	21	39,52	22,13	48,15	26,02	5,70	-1,23	3,26
MESCMn	21	43,53	37,75	49,60	11,85	3,47	-0,11	-0,79
MESMAXn	21	54,34	43,25	62,65	19,40	5,18	-0,16	-0,24
MFLSAR	21	29,97	4,67	77,33	72,67	22,16	1,15	0,03
MFLIP	21	89,80	55,33	102,67	47,33	12,68	-1,54	2,28
MBI300Y	21	61,51	56,57	75,60	19,03	3,98	2,26	7,51
MRSBP7	21	6,14	0,00	15,00	15,00	4,16	0,81	0,31
MSSEL	21	78,33	35,00	105,00	70,00	18,32	-0,67	0,26
MRSPT6	21	56,33	43,00	70,00	27,00	6,70	-0,08	-0,36

Table 4. Multivariate Tests of Significance

	Test	Value	F	Effect	Error	p
grupa	Wilks	0,03	38,18	15	18	0,00

F - F-value; ***p*** - statistical significance

Table 5. Univariate Results for Each Dependant Variable

	F	p
MAGKUS	0,48	0,49
MAG9NN	9,43	0,00*
MESP05	8,66	0,01*
MESP10	3,27	0,08
MES20M	4,04	0,05**
MESBML3	322,68	0,00*
MESSJn	7,64	0,01*
MESCMn	13,99	0,00*
MESMAXn	3,00	0,09
MFLSAR	9,69	0,00*
MFLIP	0,00	0,95
MBI300Y	2,20	0,15
MRSBP7	17,75	0,00*
MSSEL	2,63	0,12
MRSPT6	13,58	0,00*

F - F-value; ***p*** - statistical significance

Discussion and conclusions

General differences in physical fitness between analysed teams are already recognizable in descriptive indicators (tables 2 and 3), especially in variables estimating repetitive (MRSBP7; mean_medveščak = 13,00; mean_maksimir = 6,14) and explosive (MESBML3; mean_medveščak = 101,39; mean_maksimir = 55,08) power of arms and shoulders, explosive power of jumping type (MESSJn; mean_medveščak = 44,88; mean_maksimir = 39,52), and flexibility of hamstrings and back (MFLSAR; mean_medveščak = 9,16; mean_maksimir = 29,97). Statistical significance (Wilks λ=0,03; p=0,00) of general differences in physical conditioning status between two teams is determined by the analysis of the variance (table 4.). Indicators of partial differences (table 5.) are determined by the univariate analysis of the variance, and the greatest statistically significant differences in favour of first league players were determined in frontal agility (MAG9NN: F = 9,43; p = 0,00*), explosive power of a throwing type (MESBML3: F = 322,68; p = 0,00*), explosive power of a vertical jumping type (MESCMn: F = 13,99; p = 0,00*; MESSJn: F = 7,64; p = 0,01*), repetitive power of arms and shoulders (MRSBP7: F = 17,75; p = 0,00*) and relative power of a lower trunk (MRSPT6: F = 13,58; p = 0,00*), and to a lower extent in the reaction and explosive power of a sprinting type (MESP05: F = 8,66; p = 0,01*; MES20M: F = 4,04; p = 0,05**). Statistically significant differences in favour of second league players were determined in flexibility of hamstrings and back (MFLSAR: F = 16,80; p = 0,00*). Although some differences in descriptive indicators are apparent, those are not statistically significant in variables estimating lateral agility, part of the power of a sprinting type, variant of explosive power of a jumping type, flexibility of arms and shoulders, speed endurance and the static power of a lower trunk. It is symptomatic that the comparison of indicators of physical fitness of Croatian national team and the team competing in First national league (example in paper of Vuleta et al., 2004) revealed greatest statistically significant differences in favour of Croatian national team exactly in frontal agility, explosive power of vertical jumping type, and power of a sprinting type (MFE30V). Results affirmed previously

nominated hypothesis that attendance itself determines differences in physical fitness in terms of some regularities presented in hypothetical structures of success proposed by some authors (Milanović et al. 1997, Vuleta et al. 2003). Indirectly, results reveal correlation among results in lower-number-of-factors variables and multifactor variables, e.g. in tests estimating explosive power of a jumping type on one side and of frontal agility and power of a sprinting type on the other. Results of previous analyses confirmed the fact that "high level of functional-motor abilities offers no guaranties for a top-level result, yet the level of their utilization trough technical-tactical problems in particular handball match"(Vuleta et al., 2004).

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THE RELATION BETWEEN SUCCESSFUL GAME ACTIVITY AND THE FINAL MATCH RESULT IN HANDBALL

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Abstract

The paper is dealing with the subject of team playing performances evaluation of the Slovak national team in Men`s Junior Handball World Championship. We evaluated of team activity in an important player`s game skill. We watched the team at their preliminary groups four matches. We compared the results of the playing performance evaluation with the performance of the team Denmark which is over in the WCh 3th place. We realized the team playing performances evaluation with the computer technique by Hianik (2007). On the basis of the relation of the monitored data of both teams with the match result, we note that the frequency of occurrences of unsuccessful game situations could have a significant influence on the match result, while the number of successful occurrences stayed at a relatively equal level. The Slovak team markedly differed from the Danish team in the number of unsuccessful offensive game situations in frequent faults during fast break (averaging SVK 18.5, DEN 3.5 per match), in unsuccessful shots at the goal from shorter distances in the centre in front of the goal area (SVK 8, DEN 2 on average per match), in the frequency of turnover (on average per match SVK 16, DEN 9), in the number of stoppages of an attacking player (averaging SVK 14, DEN 3 per match).

Key words: *handball, playing performances, evaluation of performances, attacking phase of the game, defensive phase of the game, unsuccessful game activity*

Introduction

A team's performance in sports games, specifically its identification and evaluation has been a long-term matter in the world of sports. The team is being monitored by their activity, which can have a substantial influence on the course of a match and especially on its final result. The evaluation of a team's playing performance is based on a method of evaluating crucial cases of successful and unsuccessful game situations. According to Slovík and Havlíček (1985), a crucial case is considered as one that markedly enables or prevents reaching an aim in the match. Even though a crucial case in handball is evaluated by a highly qualified specialist, it should be able to be monitored relatively easily and defined clearly.

The issue of evaluating a team's playing performance in handball is included in the works of many authors: Slovík (1979), Táborský (1989), Langhof (1996), Zaťková, Hianik (1996), Hianik (2002), Hianik (2005), and Hianik (2007).

Hianik (2002) monitored the relation between successful defensive game activity and the final match result. In his work a criterion for success was stated as depending upon either a successful or unsuccessful solution of defensive game action. To process and evaluate the final results, the author used a frequency analysis of defensive game action occurrence (contingency tables) and the testing of the level of interactive association of successful defensive game action to the match result. One of Hianik's findings (2002) was a higher partial influence of unsuccessful defensive game actions in the final match result.

Methods

The monitored group consisted of a men's national junior handball team up to 21 years of age, which placed 14th at the World Handball Championships in Macedonia in 2007.

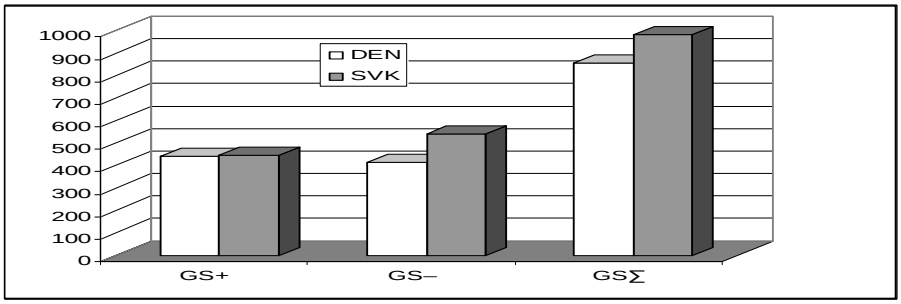
We chose the Danish national team as our control team as they won bronze medals at the 2007 Championships. This team has ranked among the best teams at the European and World Championships in recent years. We monitored the Slovak team during four matches in which they lost in the preliminary group (Brazil, Korea, Spain, Denmark). We monitored the Danish team in four victorious matches in the same group.

To fulfill the tasks of this work we used the computer program "The evaluation of playing performance in handball" by Hianik (2007). We indirectly recorded the frequency and success rate of crucial game situations – by analysing a DVD recording. To rate the criterion of success we recorded the successful (+) or unsuccessful (–) solving of a game situation. We used the methods of logical and factual analysis and synthesis to obtain overall results and final findings.

Results and discussion

The number of occurrences and success rate of crucial game situations

When monitoring the playing performance of the Slovak national team, we registered 984 crucial game situations. In the Danish team 855 were recorded. (Fig.1). It was interesting to note that in spite of the different final match results, the two teams differed only minimally in the number of occurrences of successful game situations (SVK 444, DEN 440). However, we recorded a significant difference in the number of occurrences of unsuccessful game situations (SVK 540, DEN 415). Based on the relation of the monitored data of both teams and the final match result, we can state that the final match result could be significantly influenced by the number of occurrences of unsuccessful game situations, while the number of the successful ones remained at a relatively equal level.

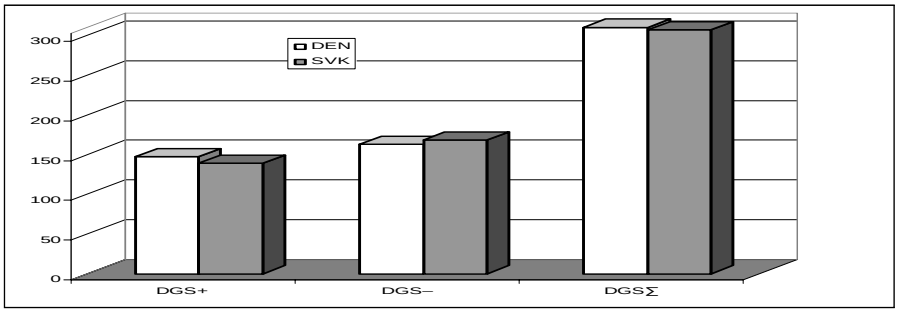


Note: DEN Denmark, SVK Slovakia, GS+ successful game situations, GS– unsuccessful game situations, GS∑ game situations in total.

Fig. 1. The number of occurrences and success rate of crucial game situations in both teams' matches.

The number of occurrences and success rate of crucial game situations during the defensive phase of the game

We recorded 307 crucial game situations during the defensive phase of the game in the Slovak team, while in the Danish team 300 were recorded (Fig. 2). We did not record any significant differences in successful game situations (SVK 168, DEN 147), nor in unsuccessful defensive game situations (SVK 168, DEN 163). Based on the relation of the two teams' data and the match results, we may state that the number of occurrences and success rate of defensive game situations only marginally influenced the match result.



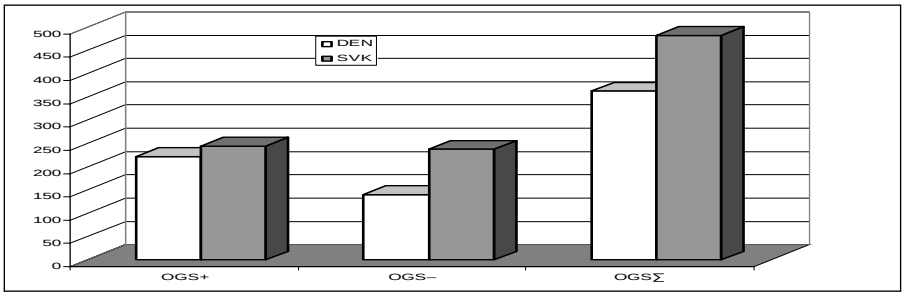
Note: DEN Denmark, SVK Slovakia, DGS+ successful defensive game situations, DGS– unsuccessful defensive game situations, DGS∑ defensive game situations in total.

Fig. 2. The number of occurrences and success rate of crucial defensive game situations in both team's matches.

The number of occurrences and success rate of crucial game situations during the offensive phase of the game

We recorded 487 crucial game situations during the offensive phase of the game in the Slovak team, while 363 were recorded in the Danish team (Fig 3). We did not register any significant differences in successful crucial situations (SVK 245, DEN 222); however, there was a marked difference in the number of occurrences of unsuccessful game situations (SVK 238, DEN 141).

In practical terms, this meant that in the offensive phase of the game, the Slovak team made 97 more faults than the Danish team. Overall, there were a total of 24 unsuccessful offensive game situations in each match. Taking into consideration the number of the current offensive phases (60-70), this is a significant factor concerning the final match result. On the basis of the relation of the two teams' data to the match result, we may conclude that the number of occurrences of unsuccessful offensive game situations can be a great influence on the match result.



Note: DEN Denmark, SVK Slovakia, OGS+ successful offensive game situations, OGS- unsuccessful offensive game situations, OGS∑ offensive game situations in total.

Fig. 3. The number of occurrences and success rate of crucial offensive game situations in both teams' matches.

Unsuccessful crucial game situations during basic types of attack and during attack systems in a player minority and a player majority

The program "The evaluation of a team's playing performance" by Hianik (2007) enabled us to compare both teams' unsuccessful game situations during basic types of attack and attack systems in a player minority and player majority (Fig. 4). We noted a most significant difference in fast break situations (SVK74, DEN 14) while during the organised attack the difference was less striking (SVK 137, DEN 95), and in player minority situations (SVK 18, DEN 16) and in player majority (SVK 9, DEN 10) the difference was only minimal.

On the basis of monitoring the number of occurrences of unsuccessful crucial game situations in both teams' matches we may state that the Slovak team differed considerably from the Danish team in the number of frequent faults during fast break (on average per a match SVK 18.5, DEN 3.5).

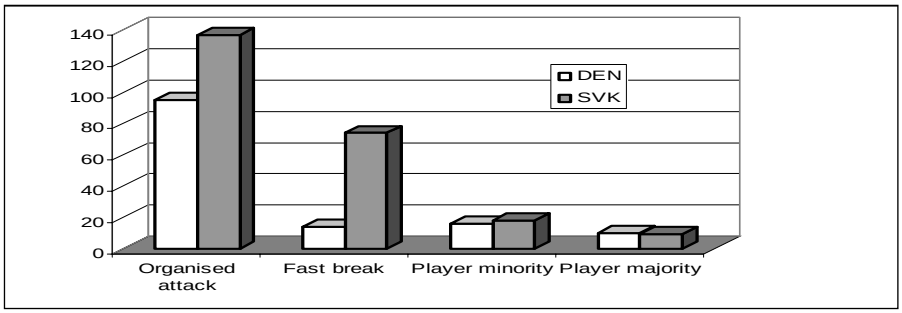


Fig. 4. Unsuccessful crucial game situations during the basic types of attack and attack situations in a player minority and a player majority.

Unsuccessful crucial game situations while taking shots at the goal from various areas in front of the goal area

Each evaluation of the playing performance in handball is based on the frequency of unsuccessful shots at the goal from various areas in front of the goal area.

We recorded a significant difference between both teams' unsuccessful shots at the goal from shorter distances in the centre of the goal area (Fig. 5). Unsuccessful 6m shots (from the pivot position): SVK 12, DEN 7; unsuccessful breakthroughs shots: SVK 12, DEN 2, unsuccessful shots from the fast breaks: SVK 8, DEN 0. There were 32 unsuccessful shots at the goal by the Slovak team and 32 by the Danish team, altogether.

We noted almost no difference in the number of unsuccessful 9m Shots (SVK 66, DEN 63) but the Danish team was markedly better at the number of goals scored (SVK 32, DEN 53).

On the basis of the number of occurrences of unsuccessful shots at the goal from various areas in front of the goal area in both teams' matches, we may conclude that the Slovak team differed significantly from the Danish team, mainly in the number of unsuccessful shots from shorter distances from the centre of the goal area. It is necessary to note that the shooting effectiveness of the Danish team from the back players area (9m shots) was 46% while Slovakia demonstrated the effectiveness of only 33%.

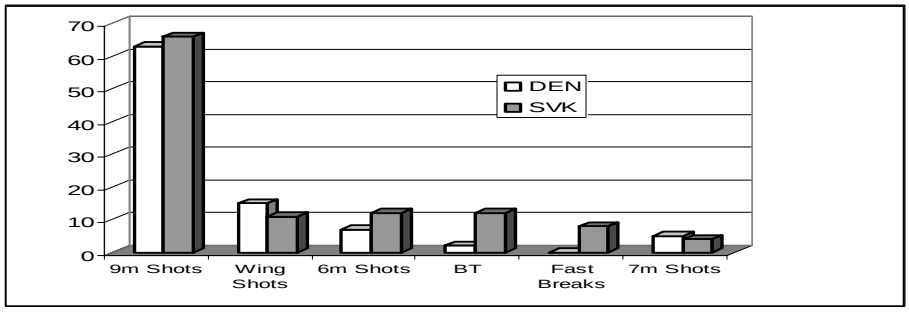


Fig. 5 Unsuccessful crucial game situations in shooting at the goal from various areas in front of the goal area.

The frequency of technical fault occurrences in the match and the stopping of a player during the offensive phase of the game

In our evaluation of game performance not only the number of faults was important, but also the stopping of an attacking player. This concerns a player who allowed himself to be stopped by an opponent, which goes against successful game tactics. In both cases, we recorded marked differences between the two observed teams (Fig. 6).

The frequency of technical fault occurrences (turnover): SVK 65, DEN 36. On average the Slovak team lost 16 balls in one match, while the Danish team lost only 9.

The frequency of the stopping of an attacking player : SVK 55, DEN 10. On average, there were 14 stoppages in the Slovak team, while the Danish team had only 3.

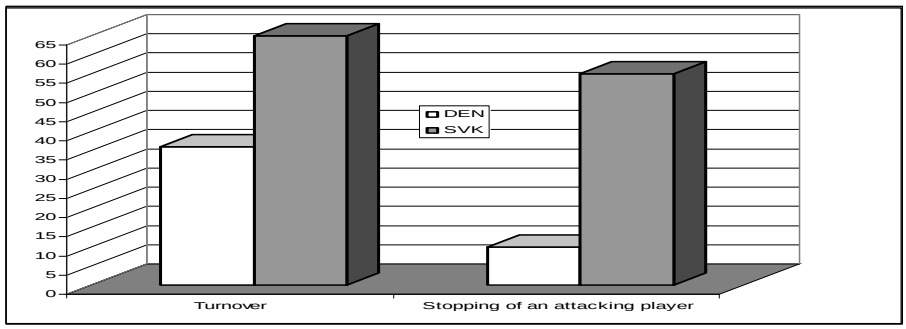


Fig. 6. The frequency of technical fault occurrences in the match and the number of stoppages of the attacking player during the offensive phase of the game.

Conclusion

On the basis of the relation of the monitored data of both teams with the match result, we note that the frequency of occurrences of unsuccessful game situations could have a significant influence on the match result, while the number of successful occurrences stayed at a relatively equal level.

The Slovak team markedly differed from the Danish team in the number of unsuccessful offensive game situations:

- in frequent faults during the fast break (averaging SVK 18.5, DEN 3.5 per match)

- in unsuccessful shots at the goal from shorter distances in the centre in front of the goal area (SVK 8, DEN 2 on average per match)
- in the frequency of turnover (on average per match SVK 16, DEN 9)
- in the number of stoppages of an attacking player (averaging SVK 14, DEN 3 per match)

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RELATION IN SOLVING 1-ON-1 GAME SITUATIONS DURING MATCHES AND WITHIN TRAINING SESSIONS IN ICE-HOCKEY JUNIOR U18 CATHEGORY

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Abstract

The aim of this paper is to analyze whether there is a significant relation in solving a typical 1 on 1 game situation during matches and within training sessions. The research was carried out with the ice-hockey team HK 99 Ružinov Bratislava, which is a member of the Slovak U 18 ice-hockey extra league. The successfulness of solving game situations was evaluated by analyzing 60 games during the regular season using a 2-point scale system (successful or unsuccessful solution). The relation between successful and unsuccessful solutions was assessed by the X^2-test. The relation was determined by utilizing 4 equal periods (26 one-week sessions) during the regular season. Based on these results indications suggest that there is a significant relation ($p < 0.01$) between 1 on 1 game situations and the fact that these situations were solved either during matches or within training sessions.

Key words: *sports games, ice hockey, game situations, training process, match*

Introduction

The term situation occurs in sports games in various forms, including match situations, game situations, power play situations, short-handed situations and situations with the same number of players, potentially advantageous or disadvantageous game situations. From these terms further terms are derived, for example standard game situations, decisive situations, the change of situation, critical situations, signs of situations, training of situations and the like.

There is a vast number of game situations in ice-hockey games, and each of them has an infinite number of solutions. From simplest situations, which solution is relatively clear, up to the most complicated situations, which solution is demanding, variable, requiring long-time practical experience and high level of players' performance. The course of some situations can be anticipated, however, the development of the game brings many unpredictable moments.

According to Peráček (2003), game situations can be divided as follows:

- *Standard game situations* that are defined by rules.
- *Typical game situations*, which tend to be repeated during the game and occur several times (for example 1 on 1, 2 on 1, 3 on 2, etc. game situations). Their solution is still limited, however, participating players can choose from among several game activities; these situations have alternative solutions.
- *Complex game situations* – all other game situations, which are limited by the largest number of factors. Their solution is determined not only by reaction of the opponent but also by activity of team-mates. They can have several possible, optimal solutions. Each solution can be tactically correct, however, not the most efficient one. Effectiveness of the solution depends on tactical maturity of players and their successfulness is dependent on current performance of players.

Classification of game situations based on the number of players participating in their solution (Tóth, Peráček 2006):

- *With the same number of players:* 1 on 1, 2 on 2, 3 on 3, 4 on 4, 5 on 5, etc. The number of defending and attacking players is the same. The character of the game situation is determined by the number of players involved in it.
- *With a different number of players:*
  a) *Attacking players outnumber defending players:* 1 on 0, 2 on 1, 3 on 2, 4 on 3, 5 on 4, and the like. The solution of the game situation in the offensive game phase based on greater number of attacking players.
  b) *Defending players outnumber attacking players:* 1 on 2, 2 on 3, 3 on 4, 4 on 5, 5 on 6, and the like. The solution of the game situation in the defensive game phase based on greater number of defending players.

Aim of the study

Ice-hockey is typical of the fact that there is a big number of variously complicated game situations. From simplest situations, which solution is relatively clear, up to the most complicated situations, which solution is demanding, variable,

requiring long-time practical experience and high level of players' performance. Within the training process we copy game situations occurring during matches and thus they become important adaptation impulses for ice-hockey players.

The goal of our paper is to find out the relation between successfulness of solving typical 1 on 1 game situations during championship matches and the same game situations in the offensive game phase during training sessions of junior ice-hockey players.

Hypothesis of the paper

We suppose that there is a significant relation between successfulness of solving typical 1 on 1 game situations and the fact whether they are solved during championship matches or within training sessions.

The tasks of the paper

The following tasks arise from the goal of the paper:

1. To record successfulness of solving typical 1 on 1 game situations during championship matches and within training sessions of the extra league junior team HK Ružinov 99 Bratislava in the 2006/07 ice-hockey season from to point of view of the offensive game phase.
2. To find out whether there is a significant relation between successfulness of solving typical 1 on 1 game situations and the fact whether they are solved during championship matches or within training sessions.

Methods

Determining the research situation

We carry out the research paper through a research of the ex-post-facto type with a defined object of monitoring, selection and organization of variables. The object of the research monitoring are select typical game situations during championship matches of HK Ružinov `99 a.s. junior team and within training sessions during the 2006/07 ice-hockey season. The research observation has longitudinal character.

Characteristics of the set

The research set was represented by the extra league junior team HK Ružinov 99` a.s., which played 60 championship matches (each team played two matches at home and two matches away with every other team) and 3 preparation matches during the monitored competition year. Of the total number of 60 championship matches, the team won 21 games, drew 11 games and lost 28 games with 53 points (in the total evaluation). The team shot 207 and collected 224 goals, and ended up at 11th place.

Table 1. Characteristics of the research set

No.	Name and surname	Date of birth	Player post	Years of active sporting activity
1	P.K.	Feb 11, 1990	center forward	11
2	J.S.	Feb 02, 1989	right defenseman	12
3	T.Z.	Aug 24, 1990	right defenseman	10
4	M.K.	Jan 27, 1990	left defenseman	11
5	P.P.	Nov 21, 1990	right defenseman	11
6	F.S.	Jan 31, 1990	left wing	11
7	A.C.	Mar 13, 1990	left defenseman	10
8	R.J.	Jul 08, 1990	left wing	12
9	L.V.	Jun 21, 1989	right defenseman	12
10	R.V.	Aug 27, 1990	right wing	10
11	L.B.	Jul 17, 1989	right wing	12
12	P.K	Oct 07, 1990	center forward	11
13	P.B.	Apr 07, 1989	left wing	12
14	F.K.	Nov 29, 1990	left wing	10
15	M.V.	Mar 15, 1989	left defenseman	11
16	P.S.	May 18, 1989	left defenseman	11
17	L.B.	Mar 08, 1991	left defenseman	9
18	T.M.	Aug 26, 1990	center forward	10
19	A.H.	Jan 15, 1989	right wing	12
20	B.G.	Jun 07, 1990	center forward	10
21	M.F.	Jan 18, 1990	right defenseman	10
22	J.O.	Jan 08, 1990	right defenseman	10
23	M.A.	Jul 15, 1989	center forward	11
24	J.V.	Apr 11, 1991	left defenseman	10
25	M.M.	Mar 27, 1991	center forward	9

The competition period started September 3, 2006 and ended April 1, 2007. During this period the team had 141 training units on ice – 148.75 hours of special preparation and 78.5 hours of general preparation (exercise room, gymnasium, playground and the like.)

Matches of the Slovak junior extra league (the highest Slovak ice-hockey league in this age category – 16 teams) were played regularly on Saturdays and Sundays (some matches were rarely played in advance on Wednesdays). During November, December and February there were several representation breaks.

The team was composed of 28 ice-hockey players (3 goaltenders are not included in Table 1) during the 2006/07 ice-hockey season. The average age of players was 16.4 years thus making the youngest team in the extra league (only 4 boys born in 1989 played regularly). Despite this, the team had quite a high number of shots on goal – 1,872, however only 207 goals were shot (11.05 percent successfulness of shots) and scored the highest number of short-handed goals of all teams in the competition.

The team was less successful in the defensive game phase because they collected 224 goals, of which 70 short-handed ones and 12 during power play. Two team players, P.B. and M.A., placed 4th and 9th in productivity (the number of goals and passes) of players in the whole junior extra league.

Methods of obtaining and processing research data

In order to observe select typical game situations we used a combination of *direct and indirect observation* and evaluation of game performance of players and group of players. During the training process we used the method of *direct observation* under natural conditions.

During championship matches we used the method of *indirect observation* with the help of Sony video camera. The camera was placed approximately ten meters over the level of ice area (on the stands) so that the whole playground could be shot. Its position was constant.

To record evaluation of select typical game situations we created a record sheet. We evaluated only the offensive game phase on the offensive half of the team. Every match was documented on an independent record sheet. Video recordings of all matches were converted to the .avi format, which was then easier to analyze on the computer (we used BS Player PRO).

While solving typical game situations of the team in the training process and within championship matches, the subject matter of our evaluation using the record sheet was *the individual game performance of players* – successfulness of players in a typical 1 on 1 game situation from the point of view of attack (the number of successful/unsuccessful solutions of game situations in the offensive game phase).

After every match and training unit we processed and evaluated the data. During this phase we obtained summary values of monitored indicators. This processed data was then recorded to a computer where we further modified it using Microsoft Office Excel.

While processing and evaluating obtained empirical data we not only applied basic logical methods but also analyses, syntheses, inductive and deductive procedures, heuristic and relevant standard mathematical-statistical methods.

In the first part of the successfulness analysis of solving select typical game situations we calculated the basic statistics – frequency of occurrence and its percentage expression, and, if necessary, also arithmetic average, extreme values and the like.

The actual analysis of relations was evaluated by the chi - square (x^2) in a table and graphical implementation. In case of significant results we tried to find out whether the total value of x^2 was influenced more by the frequency of occurrence of successful or unsuccessful solutions of game situations (contribution to x^2), which we marked as x^2_c.

Results

The relation between successfulness of solving a typical 1 on 1 game situation during championship matches and within the training process

We discovered a significant relation between successfulness of solving select typical 1 on 1 game situations during championship matches and within the training process in all 4 monitored meso cycles.

During the first competitive meso cycle, August 28 to October 15, 2006, successfulness of solving this game situation is significantly connected with the fact whether it was solved within trainings or during matches ($x^2 = 32.091$; $p < 0.01$). Successfulness of solving 1 on 1 game situations within trainings was significantly higher than during matches (68 percent to 56 percent). Difference between successfulness of solving 1 on 1 game situations within trainings and during matches thus represented 12 percent. While during trainings the proportion between successful and unsuccessful solutions was 2 to 1, during matches it was 1.3 to 1. The discovered significant relation was mostly caused by the relative occurrence of unsuccessful and successful solutions of the game situation in matches $x^2_c = 14.492$; $x^2_c = 8.043$ (Figures 1 and 2, Tables 1 and 2).

The analysis of the given relation in the second competitive meso cycle, October 16 to December 10, 2006, also pointed to a statistically important relation ($x^2 = 27.809$; $p < 0.01$) between successfulness of solutions and the fact whether this game situation is solved within trainings or during matches. During trainings successfulness of 1 on 1 game situations was significantly higher than in matches. The difference was 10 percent. While during trainings the proportion between successful and unsuccessful solution was 2.3 to 1, it was 1.5 to 1 during matches. In a more detailed analysis we discovered that unsuccessfully solved game situations during matches have relatively the highest share in the total value of this relation $x^2_c = 11.237$ (Figures 3 and 4, Tables 3 and 4).

In the third meso cycle, January 1 to February 25, 2007, we also confirmed the significant relation ($x^2 = 33.717$; $p < 0.01$). Also in this meso cycle players were more successful in solving 1 on 1 game situations within training sessions than during matches. Difference between successfulness of solving game situations within training sessions and during matches was 11 percent. While the proportion between successful and unsuccessful solution was 1.9 to 1, it was only 1.2 to 1 during matches. Results of the analysis show that the frequency of occurrence of unsuccessfully solved 1 on 1 game situations during matches had the greatest influence on the discovered significant relation $x^2_c = 12.306$ (Figures 5 and 6, Tables 5 and 6).

During the last competition meso cycle, February 26 to April 1, 2007, we also discovered a statistically significant relation ($x^2 = 24.824$; $p < 0.01$) between successfulness of solving the game situation and the fact whether this game situation is solved within training sessions or during matches. Within training sessions successfulness of solving the 1 on 1 game situation was higher than during matches. The difference was 12 percent. The proportion between successful and unsuccessful solutions was 2.9 to 1 within training sessions and 1.6 to 1 during matches. Results of a detailed statistical analysis show that unsuccessful solutions of the game situation during matches $x^2_c = 9.491$ and within trainings $x^2_c = 7.610$ have the relatively highest share in the total value of the relation (Figures 7 and 8, Tables 7 and 8).

We approached the analysis of the relation between successfulness of solving a typical 1 on 1 game situation and the fact whether this game situation is solved during championship matches or within training sessions also from the point of view of individual micro cycles (Annex B, Table 21). We tried to find out whether the immediate consequence of matches and trainings within one micro cycle will bring different results than during the analysis of meso cycles. The relation between successfulness of solving the 1 on 1 game situation and the fact, whether this game situation was solved during matches or within training sessions, was statistically significant in 19 of 26 micro cycles (in 13 micro cycles at the level of $p < 0.05$ and in 6 micro cycles at the level of $p < 0.01$). This means that in overwhelming majority of micro cycles players couldn't achieve successfulness of solving this game situation during matches which would be comparable with successfulness of its solving within training sessions. On average, differences between successful solving of 1 on 1 game situations within training sessions and during matches represented 12 percent in particular micro cycles.

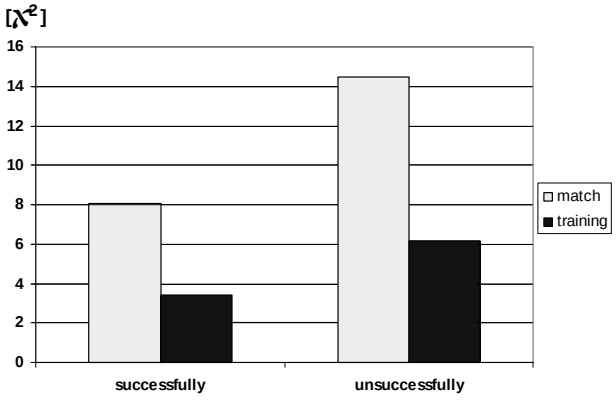

Figure 1. Share in the relation between successfulness of solving a typical 1 on 1 game situation during matches and within training sessions – 1st meso cycle.

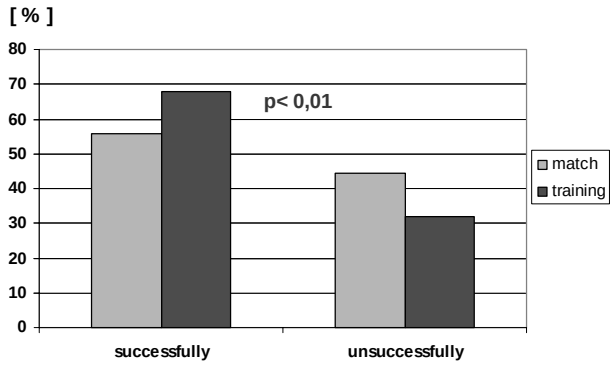

Figure 2. Difference between successfulness of solving a typical 1 on 1 game situation during matches and within training sessions – 1st meso cycle

Table 1. Frequency of occurrence of 1 on 1 GS

Quantity	Solution of game situation		Total
	Successfully	Unsuccessfully	
Match	387	308	695
Training	1,184	525	1,639
Total	1,501	833	**2,334**

Table 2. Share in the total x^2

Chi	Solution of game situation		Total
	Successfully	Unsuccessfully	
Match	8.403	14.492	22.535
Training	3.410	6.145	9.556
Total	11.453	20.637	**32.091**

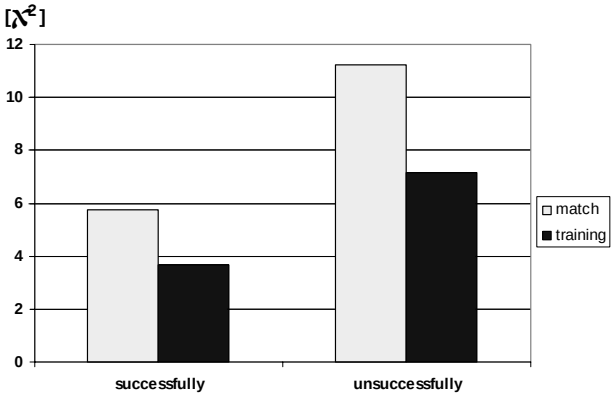

Figure 3. Share in the relation between successfulness of solving a typical 1 on 1 game situation during matches and within training sessions – 2nd meso cycle

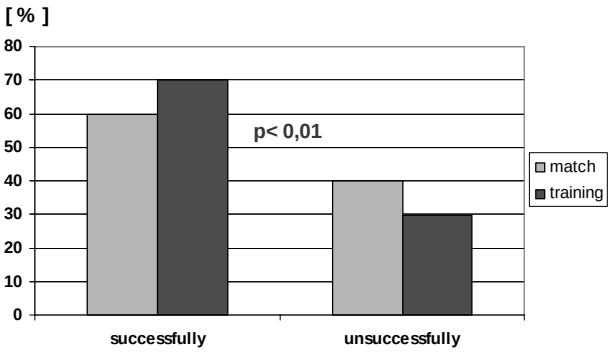

Figure 4. Difference between successfulness of solving a typical 1 on 1 game situation during matches and within training sessions – 2nd meso cycle

Table 3.Frequency of occurrence of 1 on 1 GS

Quantity	Solution of game situation		Total
	Successfully	Unsuccessfully	
Match	575	386	961
Training	1,059	451	1,510
Total	1,634	837	**2,471**

Table 4. Share in the total x^2

Chi	Solution of game situation		Total
	Successfully	Unsuccessfully	
Match	5.756	11.237	16.994
Training	3.663	7.152	10.815
Total	9.420	18.389	**27.809**

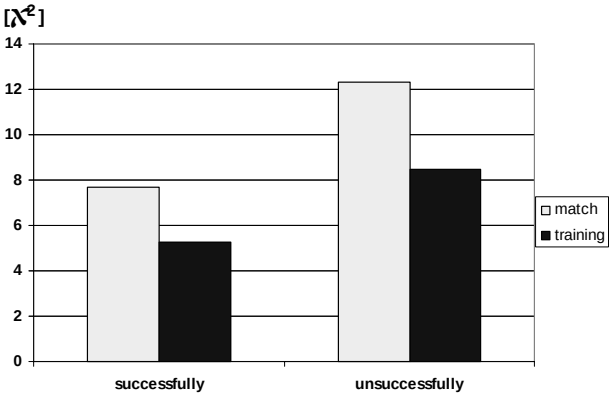

Figure 5. Share in the relation between successfulness of solving a typical 1 on 1 game situation during matches and within training sessions – 3rd meso cycle

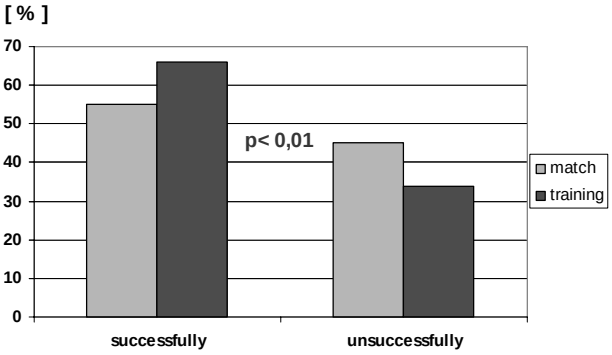

Figure 6. Difference between successfulness of solving a typical 1 on 1 game situation during matches and within training sessions – 3rd meso cycle

Table 5. Frequency of occurrence of 1 on 1 GS

Quantity	Solution of game situation		Total
	Successfully	Unsuccessfully	
Match	585	480	1,065
Training	1,025	524	1,549
Total	1,610	1,004	**2,614**

Table 6. Share in the total x^2

Chi	Solution of game situation		Total
	Successfully	Unsuccessfully	
Match	7.674	12.306	19.980
Training	5.276	8.461	13.737
Total	12.950	20.767	**33.717**

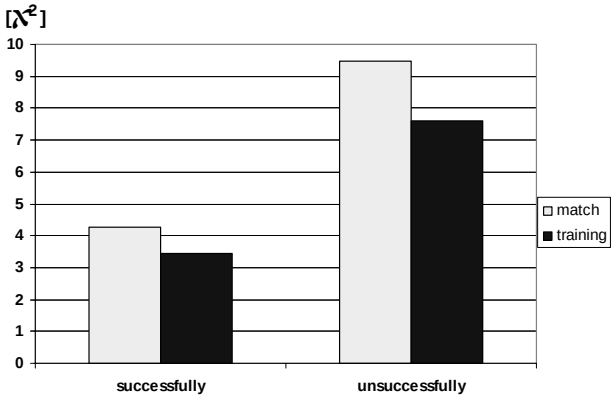

Figure 7. Share in the relation between successfulness of solving a typical 1 on 1 game situation during matches and within training sessions – 4th meso cycle

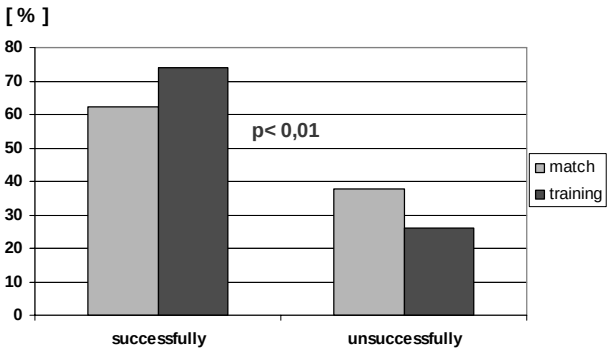

Figure 8. Difference between successfulness of solving a typical 1 on 1 game situation during matches and within training sessions – 4th meso cycle

Table 7. Frequency of occurrence of 1 on 1 GS

Quantity	Solution of game situation		Total
	Successfully	Unsuccessfully	
Match	442	266	708
Training	654	229	883
Total	1,096	495	**1,591**

Table 8. Share in the total x^2

Chi	Solution of game situation		Total
	Successfully	Unsuccessfully	
Match	4.287	9.491	13.777
Training	3.437	7.610	11.047
Total	7.723	17.101	**24.824**

Discussion and conclusions

From the point of view of successfulness of solving 1-on-1 game situations in particular meso cycles and micro cycles we can state that there are several explanations why players did not solve the above-mentioned typical game situations during championship matches as successfully as within training sessions:

- In case of 1 on 1 game situations, the first reason can be little technical stability of game activities of individuals, which players applied when solving game situations. We carried out our paper in the junior category in the team of HK 99 Ružinov, where the average age was 16.4 years. Even though players in this age category have developed game activities at quite a high level, however, under complicated conditions of matches, mainly due to psychical pressure, they are rather less stable than during training sessions.
- One of other reasons is the age of players and the related technical-tactical maturity. The observed team ranked among the youngest ones in the junior competition. This category includes two years. This team had regularly only 4 players, who played for this team also during the previous competitive period, which is in comparison with other teams (for example the team of the town of Topoľčany – 2nd place in the competition), where there were regularly 12 such players, quite a big disproportion. Players, who already played one competitive period in this category, gained invaluable game experience thanks to the great number of played matches. Their experience is evident in self-confidence, which is supported by higher technical-tactical maturity. During matches this can be seen in situations when they take responsibility for the solution of game situations, where they are less limited regarding technical as well as tactical sides, and in the given moment they choose the most effective way of solving the game situation. If a team does not have such players or their number is limited, it is reflected in successfulness of solving game situations.
- Complexity of load during the training process can be one of other reasons why players in this age category do not solve game situations during championship matches as successfully as within training sessions. According to Peráček (2003), application of methodological-organizational forms of exercises in the training process is closely related to outer load of players, namely with its complexity. Under conditions of differently complicated game situations, players not only learn to analyze situation factors but they are also trained to pay less attention to technique and more to solution of tactical tasks. In our opinion, which we obtained through observation of the training process, game exercises were little complex, their level of complexity did not often get close to conditions of matches.
- Another factor from the point of view of methodological-organizational forms was the fact that the coach spent little time leading preparation games during trainings. Even though preparation games were included in trainings,

players did not solve these situations as they would during matches. From this point of view, trainings were little consistent.

- Another reason might have been the content and proportional side of the training process. Not all game activities are equally significant for successfulness of solving game situations. Therefore it is necessary to distinguish their suitability within technical-tactical preparation and accordingly make their selection and adjust proportionality. Not only should the frequency of occurrence but also contribution to successfulness of individual or collective solution of the given game situation decide about the scope, which particular game activities are to occupy in the training process.
- One of the last reasons why players did not solve the above-mentioned typical game situations during championship matches as successfully as within training sessions could be the different quality of opponents that changed during particular monitored micro and meso cycles. Despite the fact that our team played 4 matches with every opponent (two matches at home and two matches away), successfulness of solution of individual game situations in matches varied.

In rationalization of the training process:

- Dominant attention in the offensive game phase should be paid to solving a typical 1 on 1 game situation. From the point of view of results of championship matches, it is a critical game situation. A successfully solved 1 on 1 game situation in the offensive game phase means outnumbering, winning space, better position of players towards opponents' goal cage and many times an individual penetration.
- Proportionality of particular typical game situations within training sessions should be derived from the frequency of occurrence of these game situations in championship matches. For the junior category we basically recommend 1 on 1 game situations (45 percent), 2 on 1 game situations (35 percent) and 1 on 2 game situations (10 percent).
- While improving offensive game activities of individuals in typical 1 on 1 game situations, game exercises and preparation games should be applied under conditions similar to matches.

While evaluating game performance (successfulness of solving typical game situations):

- Solution evaluation of game situations with a 2-point scale system (successful – unsuccessful) can be used in various levels of players' performance and also for different age categories (pupils, juniors, seniors).
- While evaluating successfulness of solving game situations, our recording sheet (match – training) should be used.
- We recommend carrying out evaluation of the game performance (successfulness of solving game situations) not only during matches but also in select micro cycles within training sessions in order to obtain fast and return information.
- We recommend interpreting obtained results individually for each evaluated typical game situation during matches but also within training sessions.
- From the point of view of evaluation of successfulness of game situations in the training process and during championship matches it turned out that it was appropriate to evaluate individual micro and macro cycles of the monitored period.

From the point of view of the game strategy and while leading the team during matches we recommend coaches:

- To take into account the fact that the result of the match is significantly dependent on successfulness of solving a typical 1 on 1 game situation.

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THE FACTOR STRUCTURE OF SELECTED MORPHOLOGICAL VARIABLES OF SKI JUMPERS

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Abstract

The aim of the study was to establish the morphological factor structures that determine the achievement of top results in ski jumping. The sample was comprised of 85 ski jumpers competing as junior and senior category athletes at international level. Seventeen morphological parameters were used in accordance with the methodology presented in the International Biological Program (IBP). The factor analysis of 17 manifest morphological variables revealed the presence of four major factors - the *factor of the basic morphological status, morphological factor of aerodynamics*, the *morphological factor of the take-off* and the *morphological factor of angular velocity.* On the basis of the obtained anthropometric data it may be concluded that the athletes who choose ski jumping and are to be selected to join the best athletes have to be of specific body build.

Key words: *morphological status, ski jumpers, manifest and latent structures, factor analysis*

Introduction

Being a high elite ski jumper is an extremely demanding activity in terms of specific motor abilities. To set up an appropriate system of the morphological factors involved in performance in ski jumping is not an easy task, especially if we also want to penetrate to the depth of this system. The construction and supplementing of the system of performance morphological factors is especially productive if it is carried out by modelling the optimal ski jumping technique. However, here we can very quickly encounter the dangers and traps of such modelling. The models are and will always be the reflections of the viewpoints of their authors and they need to be scientifically evaluated. Our efforts have resulted in the construction of one of the possible performance structure models in ski jumping, which is based on the factor analysis of anthropometric morphological characteristics.

The need for anthropometric treatment of ski jumpers is important in order to deal with numerous essential issues related to practical problems of the ski jumping technique or long-term maintenance of the ski jumpers' capacity for sporting performance. The results of this morphological study provide the basis for dealing with the following problems:

- to find out the manifest and latent structure of morphological characteristics of ski jumpers;
- to provide an appropriate ski jumping profile of specific morphological factors from the aspect of the ski jumping technique or the individual take-off and flight style;
- to help design the special ski jumping equipment: clothes, skies, boots, helmets, etc, and
- to identify the influence that special morphological characteristics have on the optimal ski jumping technique.

The aim of the study was to identify the latent morphological structures that determine the achievement of top-level results in ski jumping. The performance in ski jumping depends on the optimal realisation of the ski jumping technique which is determined by the mechanical factors, the factors of bio-psycho-somatic status of ski jumpers and by the special ski jumping equipment. The morphological factors are essential for the body position and together with the equipment features they determine the individual style of the ski jumping technique (Schmolzer & Muller, 2004). Elite athletes are able to adapt their flight style to thin-air conditions in order to maximise the jump length and to get the biggest possible number of style points. For that goal the jumpers need a good specific morphological profile which is the object of this study.

Methods

The research was conducted on a sample of 84 ski jumpers, members of the Slovene men's junior and senior teams. The sample included almost all elite Slovene ski jumpers aged between 16 and 29 years. The basic descriptive statistical parameters for all morphological characteristics are presented in Table 1. The analysis of 17 anthropometric variables was done to determine both the manifest and the latent morphological structure of ski jumpers. Table 1 contains the list of all anthropometric measures applied in this study as well as the corresponding codes, which will be consistently used

in the text further on. Anthropometric measures were chosen and their measuring was carried out in accordance with the methodology presented in the International Biological Program recommendations (IBP).

The factor analysis (principal components analysis) was used to determine the latent ski jumping morphological structure. The algorithm (the oblimin rotation method with Kaiser normalisation) consisted of the oblimin transformation of latent dimensions obtained by the orthoblique transformation of the characteristic vectors (rotation converged in 9 iterations) of the correlation matrix of variables. The correlation analysis was done to find out the dependency between latent vectors.

Results

The results of the basic statistical data for somatic characteristics are presented in Table 1. When compared with the general population, the ski jumpers are characterised by a considerably greater homogeneity of the morphological measures applied than the general population, i.e. the variability is less pronounced, especially in the body mass index (BMI).

Table 1. Descriptive statistical characteristics of morphological variables

CODE Variable	Min	Max	Mean	Std. Dev
ADG Tibial length (cm)	37.8	48.5	42.6	2.15
ADN Leg length (cm)	80.5	102.8	90.1	4.08
ADR Arm length (cm)	69.6	89.9	79.4	3.64
ADS Upper leg length (cm)	37.0	47.9	41.8	2.21
ADT Trunk length (cm)	45.0	61.9	54.8	3.02
ADV Total arm extended overhead & body height (cm)	200.5	250.0	225.1	9.01
AOS Upper leg circumference (cm)	44.6	59.3	52.8	2.98
ASM Bicristal diameter (cm)	27.3	34.6	31.5	1.59
ASR Biacromial diameter (cm)	32.2	44.4	38.7	2.05
AT Body weight (kg)	45.9	75.7	61.5	6.06
AV Body height (cm)	162.3	194.5	176.0	6.37
BMI Body mass index	16.9	23.3	19.8	1.38
MIH Morphological index of angular velocity	94	118	101.8	4.77
MIO Morphological index of the take-off	183	207	195.5	4.82
MIP Morphological index of aerodynamics	901	1207	1011.8	59.98
MIR Morphological index of rotation	102	158	131.1	9.06
MIV Morphological index of the lift force	47	74	60.8	3.76

The factor analysis (using the principal components model) of the morphological space revealed the existence of four major factors (Table 2).

The first factor (GENERAL MORPHOLOGICAL FACTOR) was the basic morphological factor defined by high projections of the measures longitudionality (*body height* and *total arm extended overhead & body height, tibial length, leg length, arm length* and *upper leg length*), projections of transversality measures (*bicristal diameter* and *biacromial diameter*) and the high projection of body mass (*body weight*).

The second factor (MORPHOLOGICAL FACTOR OF THE TAKE-OFF) included the highest factor projections, i.e. the *morphological index of the lift force*, the *morphological index of rotation, trunk length* and the *morphological index of the take-off.* This factor is responsible for the potential performance of a ski jumper in the take-off phase.

The third factor was determined by the highest projections of the variables *body mass index*, the *morphological index of aerodynamics* and the *upper leg circumference*, and could therefore be interpreted as the MORPHOLOGICAL FACTOR OF FLIGHT AERODYNAMICS.

The fourth factor - MORPHOLOGICAL FACTOR OF ANGULAR VELOCITY - was defined by the initial variable *morphological index of angular velocity.*

Table 2. Factor analysis of the morphological variables of ski jumpers

The name of the factors and of the initial manifest variables	Orthogonal projections of manifest variables on the oblimin factors				Cumul.
	1	2	3	4	
F1: General morphological factor	1.00	-.01	-.14	.02	
Total arm extended overhead & body height - adv	**.97**	-.01	.02	-.02	.93
Body height - AV	**.96**	.10	-.00	-.05	.94
Tibial length - ADG	**.91**	-.21	.11	-.32	.94
Leg length - ADN	**.91**	-.32	.04	.04	.96
Arm length - ADR	**.89**	-.11	-.01	.04	.82
Upper leg length - ADS	**.75**	-.25	.00	**.50**	.97
Bicristal diameter - ASM	**.64**	.37	-.05	.14	.56
Biacromial diameter - ASR	**.57**	.15	-.35	-.24	.62
Body weight - AT	**.59**	.07	-.68	.00	.98
F2: Morphological factor of the take-off	-.01	1.00	-.30	-.23	
Morphological index of the lift force - MIV	-.17	**.95**	-.05	.05	.95
Morphological index of rotation - MIR	-.12	**.82**	-.01	-.33	.95
Body length - ADT	**.56**	**.79**	.00	.08	.92
Morphological index of the take-off - MIO	-.25	**.77**	-.11	-.14	.79
F3: Morphological factor of aerodynamics	-.14	**-.30**	1.00	-.07	
Body mass index - BMI	-.14	.01	**-.98**	.04	.96
Morphological index of aerodynamics - MIP	.09	.15	**.98**	-.06	.89
Upper leg circumference - AOS	.10	.15	**-.84**	-.01	.85
F4: Morphological factor of angular velocity	.02	-.23	-.07	1.00	
Morphological index of angular velocity - MIH	.12	.05	.10	**-.96**	.97
LAMBDA – initial eigenvalues	6.8	4.7	2.5	1.0	15.0
Variance %	40.1	27.7	14.7	5.9	88.6

*P(.01) = .283

Discussion and conclusion

The results of the factor analysis made on the sample of 84 Slovene ski jumpers, aged 15 years and more, showed that the manifest structure of 17 morphological variables was reduced to four morphological factors. The results are interesting primarily because they reflect the specificity in expressing the ski jumping factors, as it is conditioned by ski jumps, i.e. their specific movement technique.

On the first factor which may with good reason be called the GENERAL MORPHOLOGICAL FACTOR the projections of morphological variables of longitudinal dimensions of the body were dominant. The success rate in ski jumps is only partly affected by the general morphological factor (Jošt, Pustovrh, & Dolenec, 1998). All other three specific morphological factors of ski jumpers had a bigger impact on the success of ski jumping technique.

The second factor MORPHOLOGICAL FACTOR OF THE TAKE-OFF is responsible for the potential performance of a ski jumper in the take-off phase. It plays an important role in achieving of rapid transition to flight from the aspect of aerodynamics (minimisation of the air resistance and maximisation of the lift force during the take-off). For that action the jumper needs a better quality of the take-off which produces an appropriate angular momentum. During the take-off phase, the athletes lean forwards in order to obtain an advantageous flight position as soon as possible after the take-off. The jumper with a good value of morphological factor of the take-off will anticipate better the torque that will act on him due to the distribution of aerodynamic forces on the body and the skis in the first phase of the flight. The torque, due to the air flow, has to accurately compensate for the forward angular momentum generated during the take-off.

The third MORPHOLOGICAL FACTOR OF FLIGHT AERODYNAMICS plays an important aerodynamic role in the central and the last phase of the flight. Ski jumpers with a higher aerodynamic index show a higher potential capacity for a successful execution of the jump in the flight phase. Body mass index (BMI) is important in that factor. It is defined as the individual's body weight divided by the square of one's height. From the aerodynamics point of view, in ski jumping the lower values of BMI are more desirable than the higher ones. The BMI of 18.5 to 25 may in normal population indicate optimal weight. The best ski jumpers have the BMI nearer to the value of 18.5, which is the borderline value of being underweight. The Fédération Internationale de Ski (FIS) has regulated this extreme negative BMI trend with the shortened ski length which represents the possible way to deal with the problem of being underweight in ski

jumping. The configuration of the athlete's body defined by the aforementioned factor and the skis largely influences the aerodynamic forces (the lift and drag forces acting during the flight) and thus ultimately the performance.

The structure of the fourth MORPHOLOGICAL FACTOR OF THE ANGULAR VELOCITY defines the potential performance from the aspect of the angular velocity of the knee in the take-off phase in the ski jumping technique. The take–off force is produced by joint movement. Most of the power from the initial action until the take-off is produced by two joints - the hip and the knee (Virmavirta & Komi, 1993). The knee joint power is important for the achievement of the optimum level of angular momentum in the forward direction (Virmavirta & Komi, 1994). There are two important factors that determine how much knee inertia a leaning ski jumper will have - the mass of the ski jumper and the radial distribution of body mass. The term *radial distribution of body mass* refers to how the mass of a ski jumper is distributed, or positioned, relative to the knee axis around which it rotates. The ski jumpers with a high level of the morphological factor of the knee angular velocity has a better potential to reach a higher knee extension velocity and that is the evidence of this factor being responsible for successfulness in the ski jumping technique (Komi & Virmavirta, 1997).

By means of a representative sample which covered 84 best Slovene ski jumpers we could establish that in the space of 17 manifest morphological variables it was possible to identify 4 latent morphological factors which explain 88.6% of total variance. These research findings are of great importance for the selection of talented jumpers and their longitudinally-oriented training based on the anthropometric criteria. The optimisation of the ski jumping technique requires an appropriate morphologically functional body structure of ski jumpers – such a technique is more and more specifically oriented according to the criterion of the optimal technique realisation. The research has thus shown that for the performance of ski jumpers a suitable degree of profiling the morphological variables is of paramount importance. The aforementioned realisation has both its anthropological theoretical value and its kinesiological applicative value for the development of the field of sports training. However, the study still leaves many theoretical methodological issues on the suitability of the applied methods of work open. This issue will have to be solved in the future by new methodological approaches.

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A COMPARISON ANALYSIS OF SITUATIONAL EFFICIENCY BETWEEN SEVEN WEIGHT CATEGORIES FOR MALE SENIORS AT THE EUROPEAN JUDO CHAMPIONSHIPS

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Abstract

Main goal of this research is to define differences of the indicators of the situation 's efficiency among senior male participants between seven weight categories at the European Judo Championships, held 2003 & 2004 years. Analysis has been done based on video scripts of 491 fights for senior's male in all seven categories. Matches have been monitored with 17 variables of situation's efficiency in Judo. For defining differences of indicators of situation's efficiency it has been used χ^2 (Chi Square) test. The results of the χ^2 tests show that there no differences between applied throwing techniques and grappling techniques, between subgroups judo techniques and between combat quantitative parameters applied by between seven weight categories for male senior competitions. In all categories of the examined were more efficient with throwing techniques comparing to the grappling techniques. Analysis of individual throwing techniques and grappling judo techniques used by male seniors in all weight categories show that most efficient techniques that seniors - male used in all weight categories are: Sukui Nage, Kata Guruma, Uchi Mata and O Uchi Gari.

Key words: *judo, situational efficiency, seven weight categories, male competitors*

Introduction

Judo for male competitors involves dynamic conditions of activity performance, including constant exchange of attacks and defensive actions, includes breaking and re-establishing of balance, realisation or not realisation of counterattacks, readiness, preparatory actions and avoidance of opponent's actions. Also, in judo training an indispensable segment is physiological preparation which includes different types and forms of thinking, meditation, philosophy and concentration. In this way, judo many times overgrows pure usage of energetic and informational humane resources with an aim to destroy the opponent. One could even say that judo in many ways is a special life philosophy and a certain spiritual development. Fighting in judo demands the competitor to automatically apply judo elements to right and left side, in the standing position and on floor, as well as the possibility to combine these techniques. The importance of quantification of situational efficiency for male competitots in each weight categoriesis in the fact that they are gathered under the conditions of real fight during the biggest competitions, among which there are European championships as well. The situational efficiency of individual technical elements in judo is important if we focus on more aspects of preparation for competition, as well as on adequate choice of application of technique during the competition, optimal approach to the usage of these techniques through exercise in situational conditions of judo fight, application of adequate training technology and if all this is adapted to our opponent and his way of fight. The research of ability, characteristics and knowledge of athletes focused on technical and tactical indicators for situational efficiency realised by the competitors during the competition (Milanović, 1999) represents a good basis for application of research results in the judo training technology for male competitors in all weight categories. Analysis of situational efficiency indicators based on standard aspects of situation efficiency of judo fight was a subject of research of many judo experts, such as (Sterkowicz and Franchini, 2000; Sterkowicz and Blach, 2001; Kajmović et al., 2005; Kajmović et al., 2007). Aims of the research is to use a relevant sample in judo fight and made comparasion analysis of situational efficiency between seven weight categories for male seniors at the European judo Championships.

Methods

Sample of the examined

This research was based on video analysis as sample of entities 491 fights in seven weight categories of senior male judo competitors (-60kg=66; -66kg =79; -73kg =82; -81kg =79; -90kg =67; -100kg =66 and +100kg =52) at the European Championships held 2003. & 2004. years.

Sample of variables

The sample of variables is based on analysis of situational efficiency parameters between seven weight categories for male senior competitors was based on classification of judo techniques (Kano, 1994; IJF - Waza list, 2003) according to 17 situational efficiency indicators, namely:

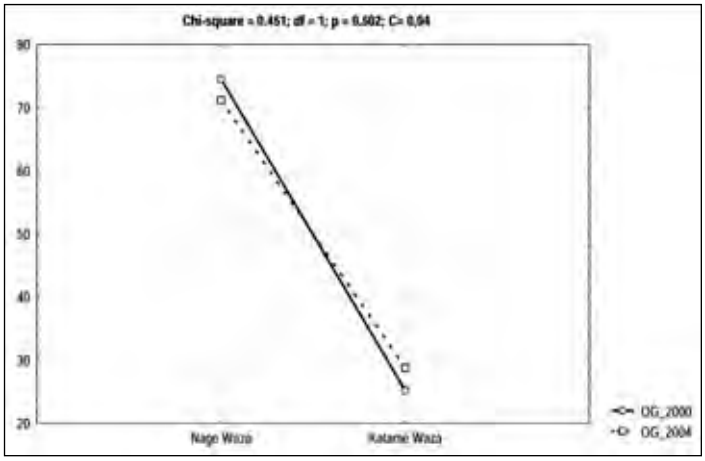
JUDO TECHNIQUE GROUPS: **1.** Nage-Waza (throwing technique); **2.** Katame-Waza (controlling techniques); ***JUDO TECHNIQUES SUBGROUPS:*** **3.** Te-Waza (hand techniques); **4.** Koshi-Waza (rear techniques); **5.** Ashi-Waza (leg techniques); **6.** Ma-Sutemi-Waza (back sacrifice techniques); **7.** Yoko-Sutemi-Waza (rear sacrifice techniques); **8.** Osae-Komi-Waza (holding techniques); **9.** Shime-Waza (stranglers techniques); 10. Kansetsu-Waza (Lever techniques); ***TECHNICAL POINTS:*** **11.** Ippon(10 points); **12.** Waza-ari (7 points); **13.** Yuko (5 points); **14.** Koka (3 points); ***PENALTIES:*** **15.** Shido; **16.** Hansokumake (disqualification); ***QUANTITATIVE INDICATORS OF SUCCESSFULNESS OF*** **17.** Individual throwing and grappling judo techniques.

Data processing methods

The analysis applied to those variables are non-parametric statistics. Calculation of frequencies and percentual values was performed for all included variables. For establishment of comparasion between the frequencies the χ^2 – test was used (Chi square test) at the level of statistical importance ($p<0,05$) with contingency tables (Thomas & Nelson, 2001). For testing the importance of correlations between the used variables (Petz, 1997), the coefficient of contingency was used (C).

Results and discussion

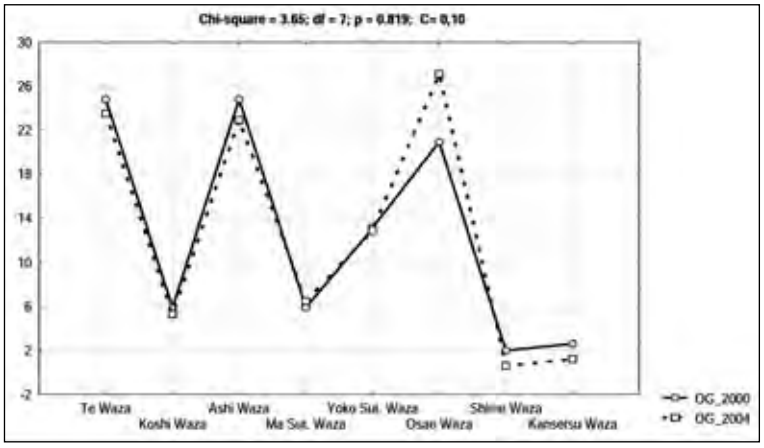
At European championships for male held in 2003 & 2004, there were 813 totally applied judo techniques (Figure 1.). The techniques from nage-waza group had a dominant role (92,6 %), whereas there was a very small number of techniques from the katame-waza group (7,4%). The results of χ^2 – test (χ^2= 7,49), with six degree of freedom (df=6), show that there no differences (p= 0.278) between applied throwing techniques and grappling techniques applied by between seven weight categories for male senior competitions. The contingency coefficient (C= *0,09*) does not show the correlation between the monitored variables.



Chi-square = 7.49; Df = 6; p = 0.278; C= 0,09

Figure 1. Situation's efficiency of the groups judo techniques

In analysing the application of subgroups (Figure 2.) of judo techniques it is notable that out of 813 techniques, were 34,3% of performed technical actions were related to hand (te) throwing techniques, while 30,3% actions were applied by leg (ashi) throwing techniques. The results of chi square test (χ^2= 57,0), with degrees of freedom (df=42) show that there no differences (p= 0.061) between the frequencies of situational efficiency between subgroups of judo techniques in all seven weight categories. Contingency coefficient was (C=0,25), which means that they are not highly correlated. The results show that in all categories dominated hand (te) techniques, except category +100kg where competitors prefer leg (ashi) techniques ._In all categories efficiency of holding techniques (Osae-Komi-Waza) has dominant, second group is lever (kansetsu) techniques and on the end with wery lou efficiency is stranglers (shime) techniques.

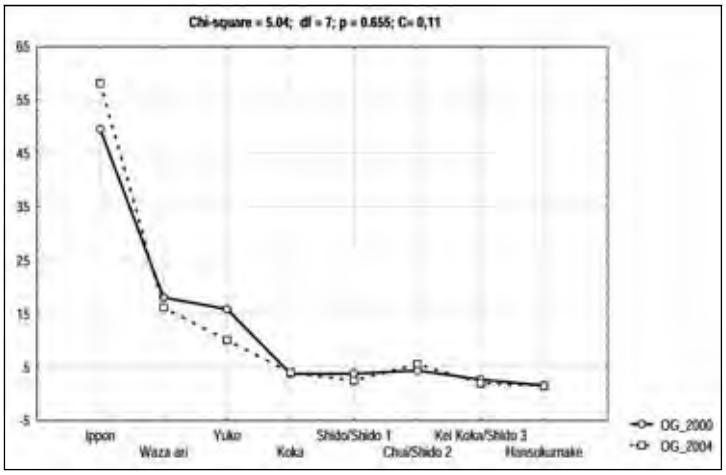


Chi-square = 57.0; Df = 42; p = 0.061; C=0,25

Figure 2. Situation's efficiency of the subgroups judo techniques

By analysing the distribution of frequencies 2156 of scored points and penalties (Figure 3.), the highest percent has the penalty shido 36,1%, yuko 19,7%, koka 19,4%, ippon 13,4%,waza-ari 10,6%. The worst penalty i.e. disqualification (hansokumake) was applied (0,8%) in all categories. The results of chi square test (χ^2=21,6), with degree freedom (df=30), indicate hat is no differences (p=0.867) between the frequency of scored points and penalties.

Contingency coefficient (C= 0,10) does not indicate the existence of correlation between the monitored variables. In all categories for male competitors dominate in number of applied penalty shido and as a result of passiveness in fight, fake attacks and exiting the fighting area.



Chi-square = 21.6; Df = 30; p = 0.867; C= 0,10

Figure 3. Judo combat quantitative parameters between male

By analysing the quantitative indicators of successfulness of individual throwing and grappling judo techniques (Table 1.), the most efficient techniques used in all weight categories by senior male competitors is leg (ashi) were techniques O-uchi-gari, Uchi-Mata dominated, hand (te) techniques Sukui Nage, Seoi Nage and Kata-Guruma. Tani-Otoshi, Seoi-Nage, etc. The most efficient grapplimg in first ten techniques were Kata-Gatame in category +100 kg.

Table 1. Quantitative indicators of successfulness of individual throwing techniques and controlling judo techniques used by male seniors

SYDNEY OLYMPIC GAMES 2000.			Rank	ATHENS OLYMPIC GAMES 2004.		
Persent	Frekvency	Techniques		Techniques	Frekvency	Persent
6,7	14	OUG	1	P29	18	9,1
6,7	14	P29	2	YSG	15	7,6
5,7	12	SON	3	ISN	14	7,1
5,2	11	KKE	4	UMA	14	7,1
4,8	10	UMA	5	TNO	9	4,5
4,3	9	TNO	6	KKE	8	4,0
3,8	8	YSG	7	OUG	7	3,5
3,3	7	UNA	8	KTA	7	3,5
2,8	6	KKS	9	UNA	6	3,0
2,8	6	SUK	10	KEG	6	3,0

Table 1. Continue

Conclusion

The sample used were 491 fights of senior male competitors from the European championships in Düsseldorf (GER)-2003 and Bucharest (ROM)-2004. The topic was comparasion analysis of situational efficiency between seven weight categories for male competitors. Situational indicators of judo fights are represented with seventeen variables which were registered by video analyses. Basic frequency and percentual value parameters were determined, and the differences between the monitored frequencies were established by Chi square test. The results of χ^2 test show that there no differences between applied throwing techniques and grappling techniques, subgroups of judo techniques and between combat quantitative parameters. In all weight categories, male competitors had dominated in hand throving techniques.

Based on the results, one can really establish that judo fight is in fact constant movement in a very narrow circular area which allows enough space for one fighter only, where the other one has to lose the fight; lose not only the fight, but face a whole series of other sensations which push him to the abyss of defeat. Through this the research involves interpretability and repetitiveness, as well as the possibility to compare the results with other patterns and populations. Finally, the applicability of this paper is shown through the possibility to use proposed research results for the needs of direct operational practice which gives this research usefulness without which this and similar research would just be another model with unreliable indicators of objective existence.

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DIFFERENCES IN WINNING TECHNIQUES AND TIME DURATION BETWEEN OLYMPIC GAMES 2000 AND 2004 FOR FEMALE JUDO COMPETITORS

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Abstract

The Olympic games is the greatest competition in judo for female judo competitors. In judo, scoring with throw is the ultimate determinant of asuccessful competitors and has subsequently received considerable attention in notation research. Efficiency of judo sports will be completed by wining techniques, penalties an time duration and each of this components has its own specific characteristics. The aim of this study was to analyse differences in winning techniques and time duration beetween Olympic games 2000. – 2004. for female judo cempetitors. The differences have been analysed Chi squere test at the sample of 211 fight on OG 2000 and 198 fight on OG 2004. Matches have been monitored trough six main variables: Groups of judo techniques; Subgroups of judo techniques; Technical points and penalties; individual throwing techniques and grappling techniques, time duration of fight, winer descided by the referees' vote and win by "Golden score". Only differences has found in time duration of fight in minute, beetwen win descided by the referees' vote and win by "Golden score". The most effective winning techniques from 2000 Olympic games is: O-uchi-gari (OUG), penalty (P29), Seoi-nage (SON). The most effective winning techniques from 2004 Olympic games is: penalty (P29), Yoko Shiho Gatame (YSG), Ippon Seoi Nage (ISN).

Key words: *judo, female, wining techniques, Olympic games*

Introduction

Registration of applied fighting techniques, general indicators etc. in specific fights for female competitors can certainly provide useful information on activities and persons practicing those activities. It is impossible to avoid a fact that spatial and physical special features of Judo as a sport are unique and unambiguous, and that a set of standard actions, although large, is a recognizable standard in both groups. Thus the approach which analyzes differences in winning techniques, points, penalties and time of fight, impact of judges on winning and the competitors themselves through "golden score" in the context of understanding of the logic of the sport is fully justifiable. Another often forgotten but extremely important fact must be kept in mind. Namely, mere differentiation according to numbers of performed actions can easily be implemented and conclusions of it easily explained. True comparison starts when we throw ourselves into analysis of comparison of superimposed mechanisms (in this case situation), which may have differential character in different samples, which essentially labels each such chosen sample. Let us (as it usually is in Judo) follow "all" important classified actions which are contents of Judo. Then we must get results which in their essence contain key information on Judo or differences and similarities between the two Olympic competitions for female senior competitors, especially when each of them occur, or it may even contain everything mentioned. But for the understanding of those comparisons, we firstly need to have a detailed and studious approach to each individual analysis in order to competently describe, i.e. understand all the differences and be able to put them at disposal of others. Researcs about technical aspects of judo which techniques applied in competition (Sterkowicz & Franchini, 2000; Kajmović et al, 2007; Kajmović et al., 2007) analysed different aspects of judo competition. In this context it is important to mention the change of rules between the two Olympic competitions through which the time of each fight was increased from 4 to 5 minutes, and the time for holding in osae komi waza was decreased, and the ruling by judges in case of a tie was replaced with "golden score". The aim of this study was to analyse differences in winning techniques and time duration beetween Olympic games 2000. – 2004. for female judo cempetitors.

Methods

Subjects

The investigation has been conducted on sample of 211 fights from the Sydney Olympic games 2000 and sample of 198 fights from the Athens Olympic games 2004 in all seven weight categories for female (-48kg, -52 kg, -57 kg, -63 kg, -70 kg, -78 kg and +78 kg) based in official Olympic statistics (Ijf, 2000.; Athens Olympic Games Statistics, 2004).

Sample of variables

The sample of variables of judo fights were monitored trough six main variables: 1.Groups of judo techniques; 2.Subgroups of judo techniques; 3.Technical points and penalties; 4.Individual throwing and grappling winning techniques; 5.Time duration of fight, 6. Win descided by the referees' vote (OI 2000) and win by "Golden score". (OI 2004).

Statistical analysic

For establishment of differences between the frequencies the χ^2 – test was used (Chi square test) at the level of statistical importance ($p<0,05$) with contingency tables (Thomas & Nelson, 2001). For testing the importance of correlations between the used variables (Petz, 1997), the coefficient of contingency was used (C).

Results and discussion

The analysis of winning throwing and grappling techniques (Figure 1) show that on bouth Olympic games throwing techniques is dominated on OG 2000 (74,5%) and OG 2004 (71,2%), while winning with graplling techniques is in low level on bouth Olympic games 2000 (25,5%) and 2004 (28,8%). The Chi-square was 0.451 ($p = 0.502$) and contingency coefficient is low which means no correlation between winning techniques (C= 0,04).

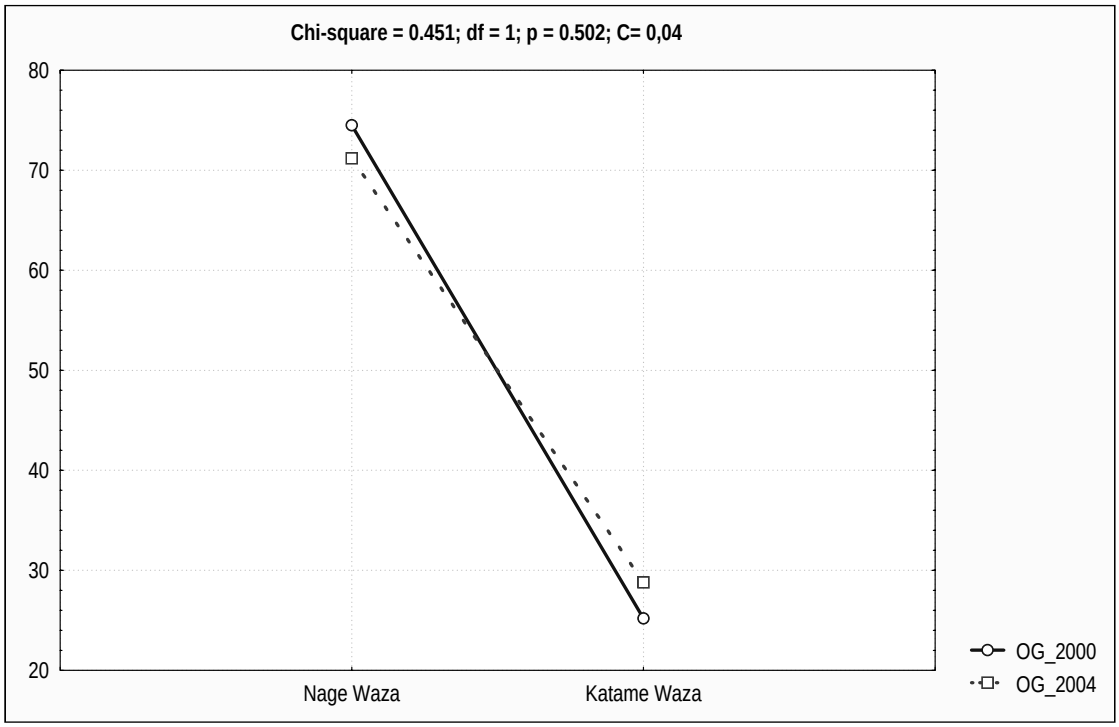

Figure 1. Situation's efficiency of the winning groups' judo techniques

Comparing the efficiency of the applied judo subgroups winning techniques among female seniors (Figure 2.) from 323 presented techniques, to the group of Te Waza (hands) belongs 24,8% and Ashi Waza (legs) 24,8% from OG 2000. Osae Komi Waza (holdings) is presented by 20,9%, Yoko Sutemi Waza (sacreficing) is presented by 13,1%, while Koshi Waza (side) was presented by 5,9%, Kansetsu (lever) by 3,3% and Shime (struggling) by 1,3% of the applying efficiency in combats. Monitoring efficiency female seniors from OG 2004 showed that they dominates with hand techniques by 23,5%, leg throwing techniques of 22,9%. The χ^2 is not significant ($p=,0.819$) and coefficient of contingency ($C= ,10$) among monitored variables is low, which means no correlation between efficiency of the winning subgroups judo techniques.

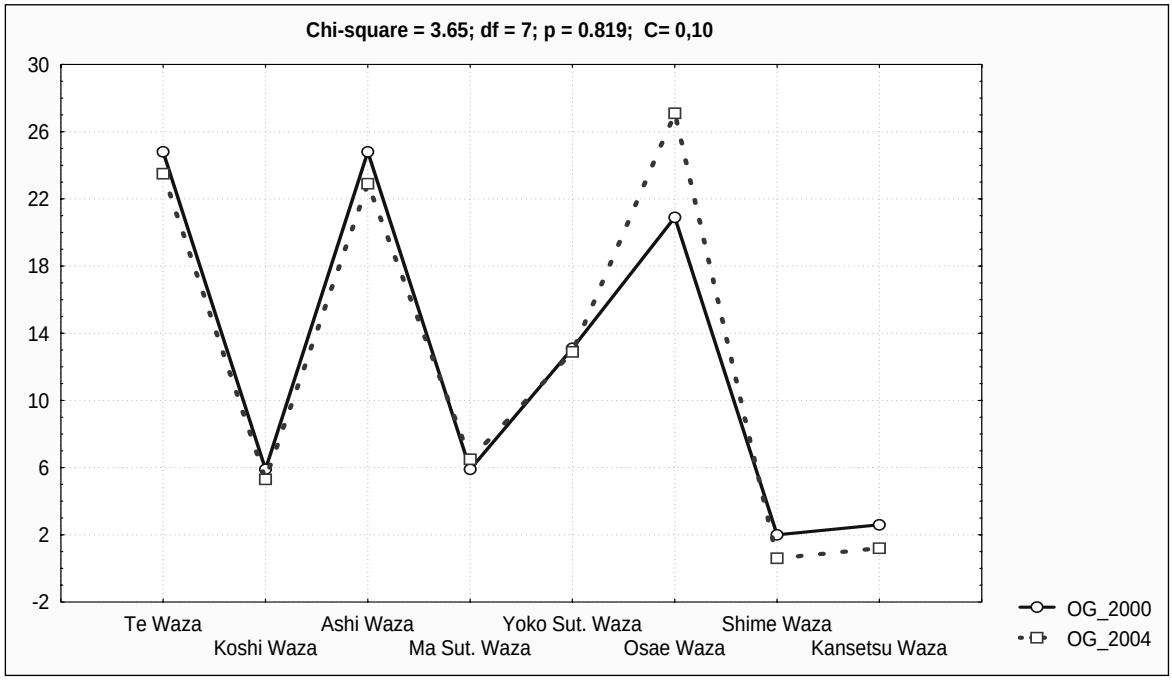

Figure 2. Efficiency of the winning subgroups' judo techniques

Analyzing 380 realized quantity winning parameters of Judo points and penalties (Figure 3.), from OG 2000 49,5% was realized by Ippon, 18,1% Waza-ari, 15,9% by Yuko, 15,2% with penalty Shido2 4,4% and 1,6% with Hansokumake. OG 2004 showed better efficiency with 58,1 Ippons, 16,2% was realized by Waza-ari, 10,1% by Yuko, 4,0 by Koka. Winning by penalty was on low level comparing with OG 2000. Results of χ^2 tests show that there no statistically important differences (p= ,655) in frequency of the realized quantity parameters between OG, and coefficient of the contingency (C = ,11) appoints that correlation among monitored variables no exists.

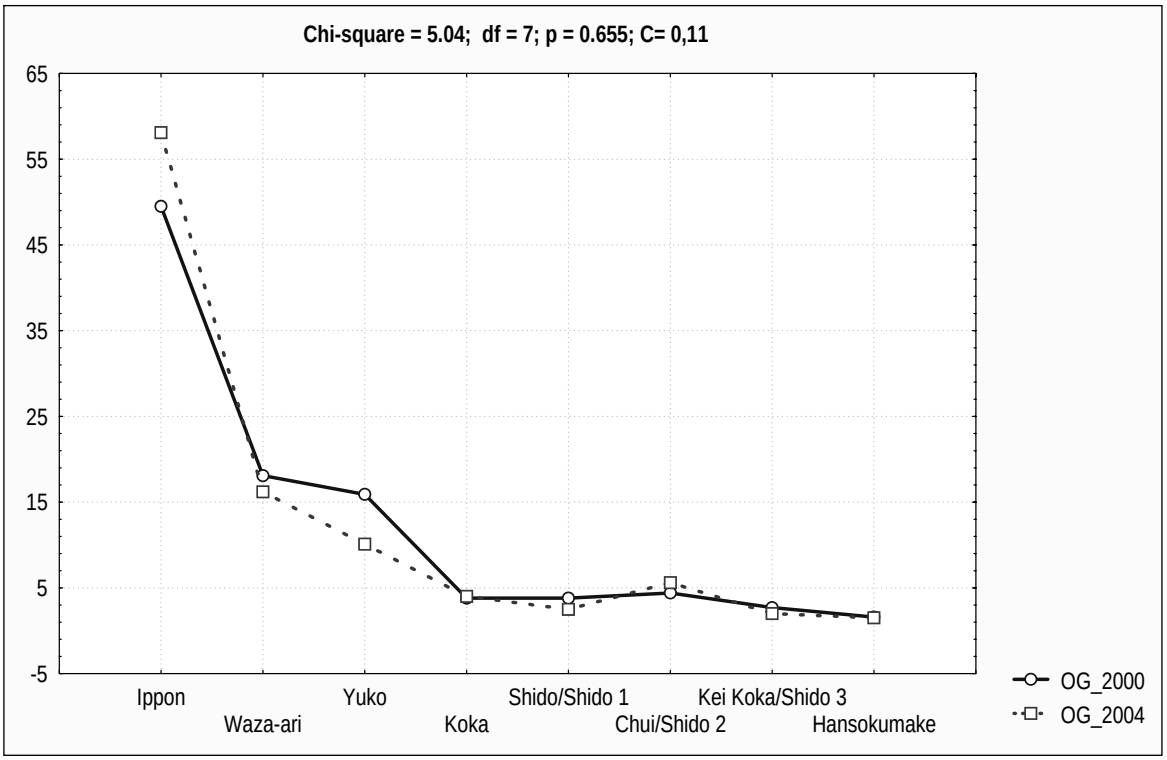

Figure 3. Winning judo combat quantitative parameters for female

During the Olympic Games in Sydney the following techniques used by the female contestants proved to be the most effective winning techniques is: O-uchi-gari (OUG), penalty (P29), Seoi-nage (SON), Kuzure Kesa Gatame (KKE), Uchi-mata (UMA), Tani Otoshi (TNO) etc. The most effective winning techniques from 2004 Olympic Games in Athens is: penalty (P29), Yoko Shiho Gatame (YSG), Ippon Seoi Nage (ISN), Uchi-mata (UMA), Tani Otoshi (TNO), Kuzure Kesa Gatame (KKE), O-uchi-gari (OUG), Kuchiki-taoshi (KTA) etc (Table 1).

Table 1. Most successful Individual throwing and grappling winning techniques

SYDNEY OLYMPIC GAMES 2000.			Rank	ATHENS OLYMPIC GAMES 2004.		
Persent	Frekvency	Techniques		Techniques	Frekvency	Persent
6,7	14	OUG	**1**	P29	18	9,1
6,7	14	P29	**2**	YSG	15	7,6
5,7	12	SON	**3**	ISN	14	7,1
5,2	11	KKE	**4**	UMA	14	7,1
4,8	10	UMA	**5**	TNO	9	4,5
4,3	9	TNO	**6**	KKE	8	4,0
3,8	8	YSG	**7**	OUG	7	3,5
3,3	7	UNA	**8**	KTA	7	3,5
2,8	6	KKS	**9**	UNA	6	3,0
2,8	6	SUK	**10**	KEG	6	3,0

The differences between time duration in judo fights per minute, Chi squere were statistically significant (p = 0.000), an important point an increase full time duration of judo fights in IV minute (64,4%) from Olympic games 2000, and 21,1% finished fights in II minute and full time duration of judo fights in V minute (43,8%) from Olympic games 2004 as results changes judo rules. Contingency coefficient between time duration in judo fights per minute was (C= 0,55), which means that they correlated.

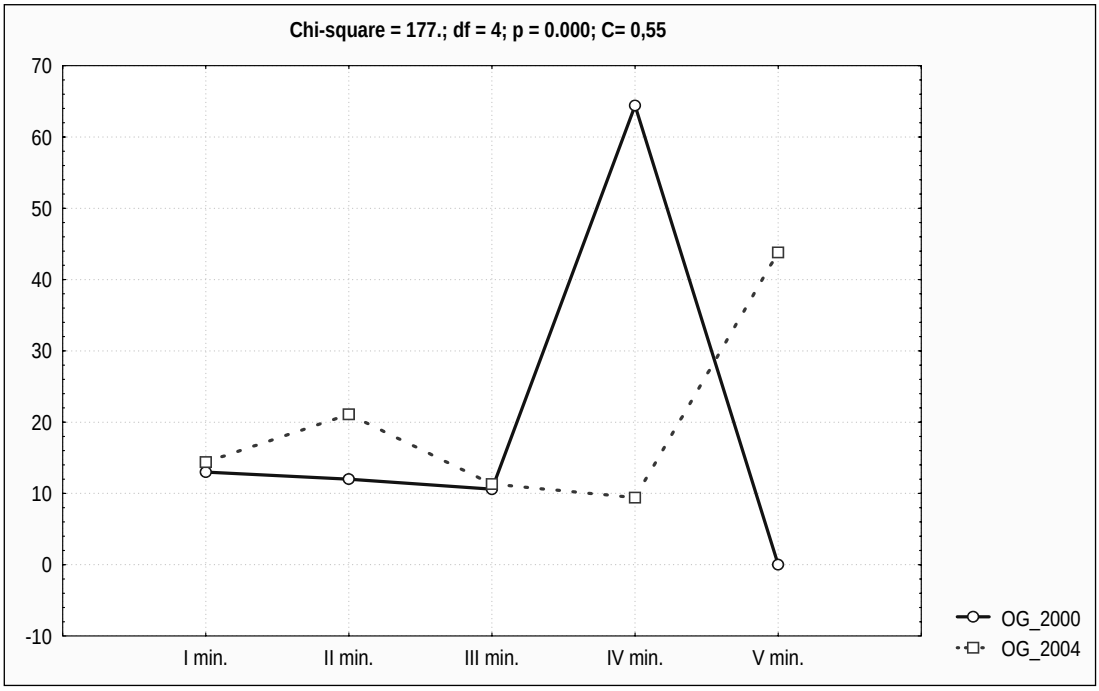

Figure 4. Time duration in judo fights per minute

Based on the analysis 37 fights from Olympic games 2000 & 2004, (Figure 5) in 67,6% matches from 2000 Sydney Olympic games, the winer was descided by the referees· vote and 32,4%, the winer was descided by the "Golden score" from the 2004 Athens Olympic games, which the rule change 2003 years make positive effect in winning of judo fight for female judo competitors.

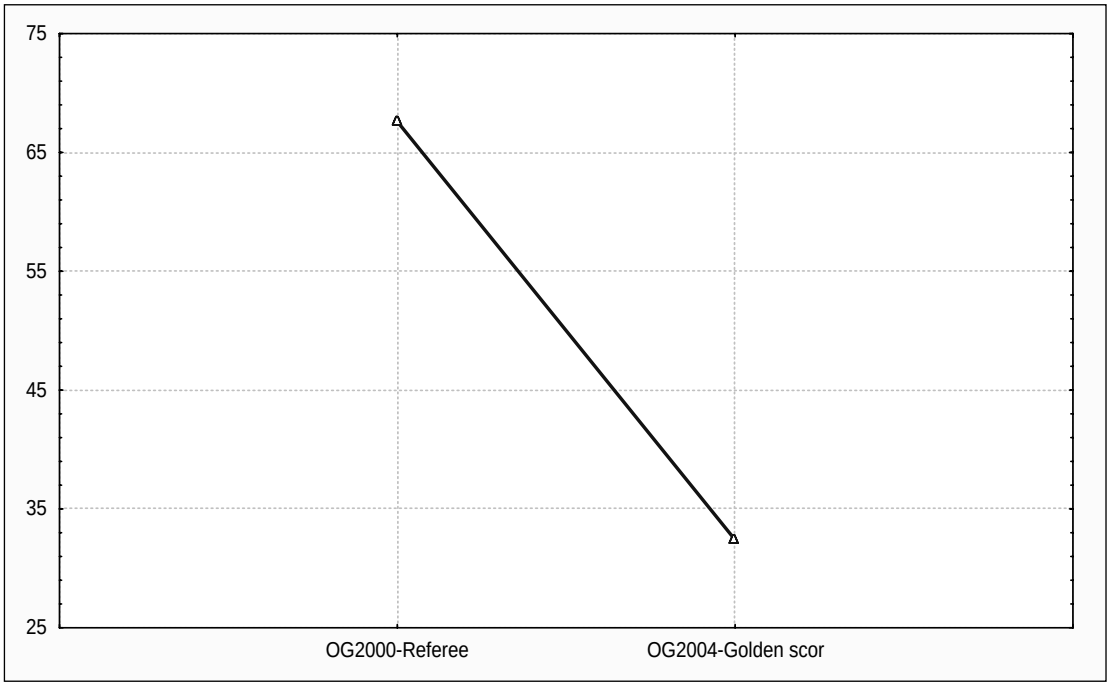

Figure 5. Winner decided by the "Referee vote" and "Golden score"

Conclusions

The diffeerences in winning techniques an timeduration between Olympic games 2000 and 2004 for female competitors have been analysed on the sample of 211 fights from the Olympic games 2000 and 198 fights from the Olympic games 2004. Judo fights were monitored trough six main variables. Parameter's difference of situation's efficiency has been tested by Chi-Square test, and results appoint to the existence of important differences between Winer descided by the "Referee vote" and "Golden score" and time duration in judo fights per minute. The most effective winning techniques from 2000 OG is: O-uchi-gari (OUG), penalty (P29), Seoi-nage (SON). The most effective winning techniques from 2004 Olympic Games is: penalty (P29), Yoko Shiho Gatame (YSG), Ippon Seoi Nage (ISN) as results of positive changes judo rules (Ijf, 2003). The results obtained are directly applicable to the training process in judo for female seniors.

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TREND OF APPLICATION OF KICKS IN FINAL K-1 TOURNAMENTS IN THE PERIOD 1993–2004

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Abstract

This research has been carried out on a sample of 96 top level super heavyweight (over 91 kg) male fighters participating in final K-1 tournaments in Japan from 1993 to 2004 (in 84 matches and 205 rounds). The objective of the research was the evaluation of application of kicks by the most successful K-1 fighters in the world, during the competitions. This provided us a thorough sectional view of the most successful fighters, helping to determine an absolute criterion for defining what a quality fighter is, as only the 8 best fighters in the world reach the final tournament. It follows therefore that the examinees in this paper were the most able K-1 fighters in the world. By means of trend analysis, we examined the development trends in the application of leg technical elements in terms of their increase and decrease in the period of 12 years, as to obtain data on the average application of technical elements. The analysis of trend indicates tendency to increase the application of the variables of lower and upper spin kicks, as well as the knee kicks.

Key words: *K-1, top-level fighters, super heavyweight category, video recording*

Introduction

As the technical preparedness is usually evaluated according to the efficiency of executing the technique in a K-1 fight, this research will be valuable, both in theoretical and practical terms. Various observations and analyses of fights (both live and on video recordings) by the experts of different profiles (coaches, analysts, researchers, methodologists and other sport experts) have resulted in broadening and strengthening the knowledge and skills concerning different possibilities for applying and making technical components of K-1 sport more concrete (Valera,1973., Kapo, 2006; Kapo et al., 2007). Therefore, when speaking of K-1 sport, one must bear in mind its complexity and constant targeting to attain strong cohesive factors, which will merge the requirements of various aspects and approaches towards martial arts in general, comprised in K-1 sport. For that very reason, this research was designed in such way to collect information during the competitions of top-level K-1 fighters in final tournaments in Tokiyo Dome in Japan. The fighter whose technique is weak and at low level, does not have any odds to achieve his aim and be victorious, because one will be, literaly, outmanouvered by his opponent's technical arsenal and brough into inferior position which leads to defeat. The objective of this research is the analysis of trend in application of kicks by the most successful K-1 fighters in the world, during the competition.

Methods

Sample of subjects. The situational aspect has been provided through video recordings of all fights held in the last 12 years (1993-2004) at the final Grand-prix tournament in Japan. This resulted in a thorough sectional view of the most successful fighters, helping to determine an absolute criterion for defining what a quality fighter is, as each year only the eight indeed top fighters in the world reach the final tournament. This research has been carried out on a sample of 96 top level super heavyweight (over 91 kg) male fighters participating in final K-1 tournaments in Japan from 1993 to 2004 (in 84 matches and 205 rounds.

Sample of variables. 1. LIJNNAPR - left kick forward; 2. DESNNAPR - right kick forward; 3. LIJBNAPR - left side kick forward; 4. DESBNAPR - right side kick forward; 5. LIJKAKAT - left kakato geri; 6. DESKAKAT - right kakato geri; 7. LIJNKRUD - left circle strike; 8. DESNKRUD - right circle strike; 9. LIJVKRUD - left high circle strike; 10. DESVKRUD - right high circle strike; 11. LIJUSGER - left back strike ushiro geri; 12. DESUSIRG - right back strike ushiro geri; 13. LIJUSMAV - left ushiro mavashi geri; 14. DESUSMAV - right ushiro mavashi geri; 15. LIJUKOLJ - left knee kick; 16. DESUKOLJ - right knee kick

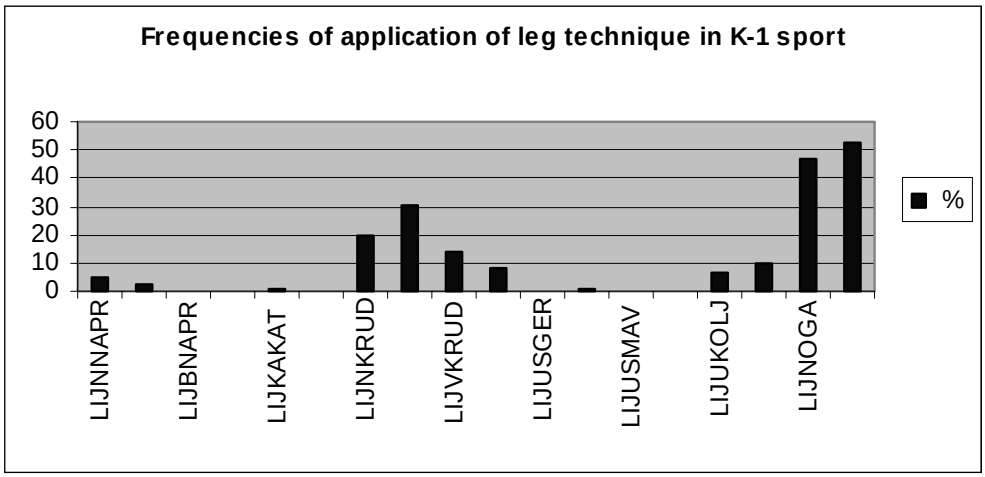
Data processing methods. The collected data on technical elements have been processed by using descriptive statistic method and presented according to the total frequencies. By means of trend analysis, we examined the development trends in the application of leg technical elements in terms of their increase and decrease in the period of 12 years, as to obtain data on the average application of technical elements.

Results and discussion

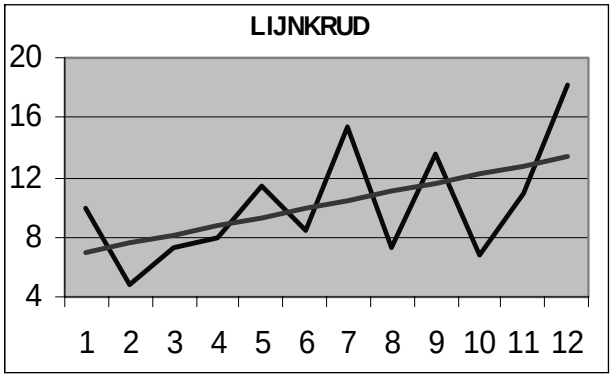
Through analysis of the fights of top-level K-1 fighters in final K-1 tournament GP Tokoy Dome (using DVD and video recordings) the competent experts classified various aspects of K-1 technique necessary for success in K-1 sport. The obtained information indicate the leg techniques frequently used in K-1 (lower and upper spin kicks, knee kicks and direct forward kicks), and some which are rarely used (uširo mavaši, uširo geri, kakato geri). These information are very important for they not only indicate the arsenal of efficient technical weapon and its hierarchy, but also because trainers can use them as a guidance to choose the correct methodical way in teaching K-1 technique for the purpose of fight. According to table and graph 8 it is obvious that the right lower circular kick (DESNKRUD) is represented with the frequency of 1306 or 30,5 % while the left lower circular kick (LIJNKRUD) has the frequency of 862 or 20,1 % comparing to all other types kicks. The high level of application of lower circular kicks indicates that these types of kicks are very efficient and they are not energy consuming. In addition, when combined with hand technique they constitute one of the most important techniques applied in K-1 sport. Upper circular kicks show lower frequency, which makes sense, because in technical and tactical terms they are featured by a higher level of complexity then the lower kicks. Therefore, the left upper kick (LIJVKRUD) shows the frequency of 585 or 13, 7, while the right upper kick (DESVKRUD) shows the frequency of 355 or 8, 3 %. The circular kicks prevail in K-1 sport, most probably because, in general, these are the most powerful kicks, which can be delivered in all parts of the body during the attack. Since the mentioned kicks represent. In addition to circular kicks, right knee kicks are heavily represented as the most powerful weapon in close-quarter fighting and K-1 fighters use it whenever possible. It is evident that the right knee kick (DESUKOLJ) shows higher frequency- 421 or 9,8 % then the left knee kick (LIJUKOLJ), which has the frequency of 284 or 6,7 %. The left kick forward (LIJNNAPR) has the frequency of 224 or 5,2 % , while the right kick forward (DESNNAPR) has the frequency of 112 or 2,6 %, indicating the significance of this kick, particularly of (LIJNNAPR), which is usually delivered to make opponent nervous, to block the attack or as a counter-kick, while the right kick forward, (left leg in rear position / DESNNAPR) is applied by K-1 fighters if they want to deliver a kick which is more powerful, when they are sure that the opponent will not evade. The other kicks show low frequency, indicating the following – that K-1 fighters have to invest their efforts to improve their leg technique, which requires more time and training, and that the techniques we have mentioned and which are used in competitions are inefficient, and should be covered only as a piece of information during the trainings, thus leaving more space to improve applicable and efficient techniques. The percentage value of the prevalence of left kicks (LIJNOGA) accounts for 47 %, and for the right kicks (DESNOGA) 53 %, indicating the prevalence of the right leg against the left. Such score concerning the left and right leg most probably stems from the higher frequency of the left hand, which provided space to deliver the right kicks.

Table 1.

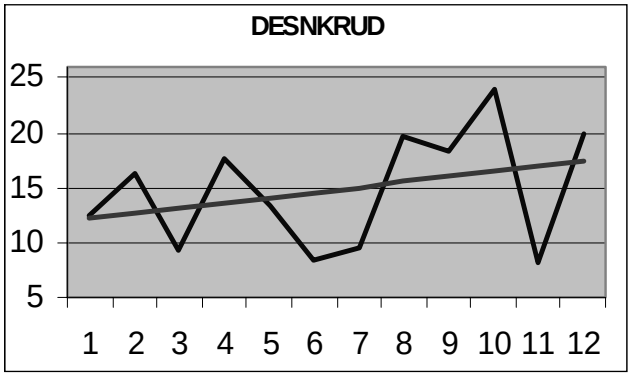
VARIABLES	FREQUENCY	%
LIJNNAPR	224	5,2
DESNNAPR	112	2,6
LIJBNAPR	15	0,3
DESBNAPR	12	0,3
LIJKAKAT	21	0,5
DESKAKAT	3	0,1
LIJNKRUD	862	20,1
DESNKRUD	1306	30,5
LIJVKRUD	585	13,7
DESVKRUD	355	8,3
LIJUSGER	7	0,1
DESUSIRG	43	1
LIJUSMAV	18	0,4
DESUSMAV	19	0,4
LIJUKOLJ	284	6,7
DESUKOLJ	421	9,8
LIJNOGA	2016	47
DESNOGA	2271	53



Graph 1.



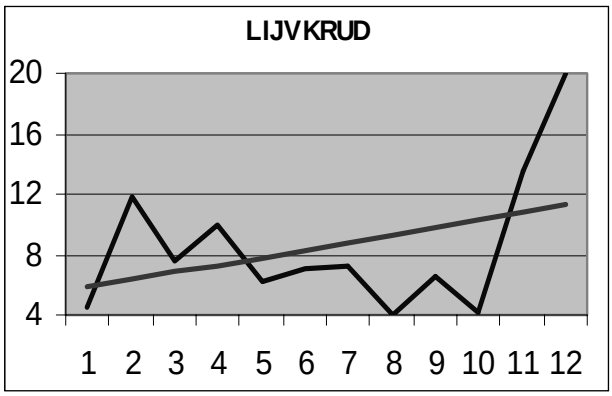
Graph 2.



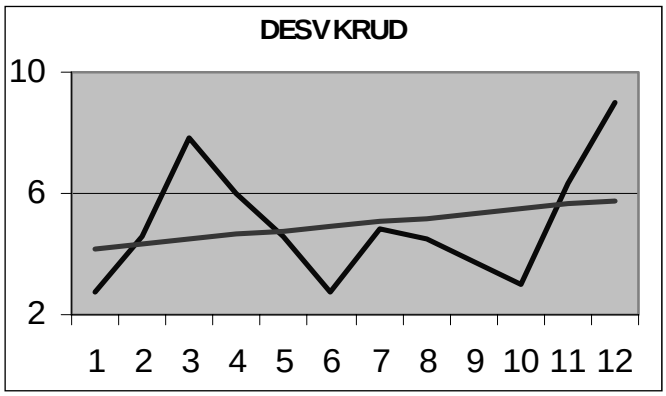
Graph 3.

The trend of increase in application of the kicks in the period 1993- 2004 clearly indicates increase in application of lower circular kicks (LIJNKRUD and DESNKRUD), most probably due to their technical advantages, because these kicks are very efficient and not very energy consuming, thus constituting one of the most important techniques applied in K-1 sport, which immensely contribute to winning in the final K-1, because one has to defeat three opponents in one night. The increase of apllication of lower circualr kicks is presented in the graphs of trend analysis (graphs 2 and 3).

Concerning the trend of application of upper circular kicks (LIJVKRUD and DESVKRUD) in the period (1997, 1998, 2001 and 2004), we may observe the increased application of upper circular kicks (graphs 4 and 5). The most probable reason is that, in general, the circular kicks in K-1 sport are the most powerful kicks, which may be delivered in all parts of the body during the attack.

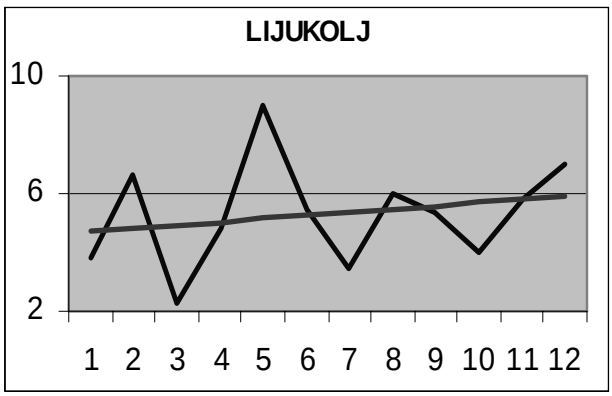


Graph 4.

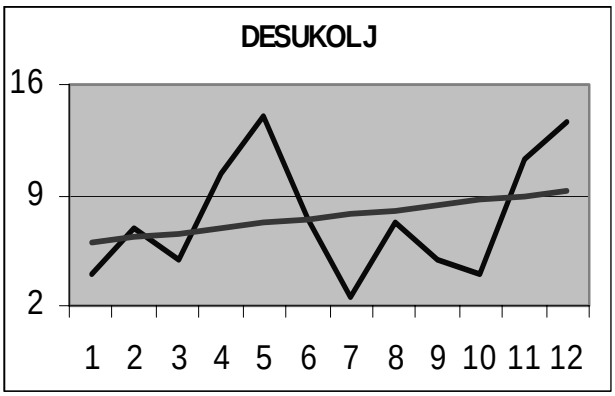


Graph 5.

The knee kicks as well demonstrated the trend of application in the analysed period of time, when it comes to the category of kicks (graph 6 and 7), most probably because the mentioned kicks represent Thai-boxing and in addition to boxing, this sport also considerably contribute to the efficient practice of K-1 sport.



Graph 4.



Graph 5.

Conclusion

These information enable to reduce the time necessary to develop a good-quality K-1 fighter (in addition, we are aware of the fact that the in martial arts, and in K-1 as well, exactly when the fighter should demonstrate his optimum and maximum, the years take their toll and one must retire) in the way that inefficient techniques would be delivered only as an information. The most efficient techniques in K-1 sport are the upper and lower circular kicks, knee kicks and direct forward kicks. We observed the heavier representation of the right leg against the left one during the competitions. Such score concerning the left and right leg most probably stems from the higher frequency of the left hand, which provided space to deliver the right kicks. Only in upper kicks, the left leg prevails, most probably because it is closer to he opponent (leg in the front position), due to which the (LIJNOGA) was more applied, and, in combination with hand and leg techniques this leg is very efficient, but it requires longer period of improvement. The high level of application of lower circular kicks indicates that these types of kicks are very efficient and they are not energy consuming. In addition, when combined with hand technique they constitute one of the most important techniques applied in K-1 sport. The lower and upper circular kicks as well as in knee kicks showed important trend of increase in this research as one of the most efficient technical elements most commonly applied in Thai boxing and kick boxing. Thus, the fact that, in addition to boxing, these two sports constitutes a basis for efficient pursuit of K-1 sport.

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COMPARATIVE ANALYSIS OF SOME MORPHOLOGICAL CHARACTERISTICS AND AGE OF PARTICIPANTS IN FINAL K-1 TOURNAMENTS IN PERIOD 1993–2004

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Abstract

The objective of the research was comparative analysis of the trend of morphological features and age of the most successful K-1 fighters. The research has been carried out on a sample of 96 top level super heavyweight (over 91 kg) male fighters participating in final K-1 tournaments in Japan from 1993 to 2004 (in 84 matches and 205 rounds). The gathered data on morphological features have been processed using descriptive statistic method and presented in total values per age and in mean value for all fighters – participants in final tournament. By the means of trend analysis we examined development of morphological characteristics and age in terms of their increase and decrease in the period of 12 years as to obtain data on the average height and age of K-1 fighters. Through analysis of morphological features of K-1 fighters during the final K-1 tournament GP Tokoy Dome, we obtained information on mean values on weight, which accounts for 102,6 kg, height , which accounts for 188 cm and age of 29. Trend analysis indicates that the application of following variables tends to increase – height and age. The obtained indicators indicate that, concerning efficient pursuit of K-1 sport, the given morphological features play important role in development of universal K-1 fighter.

Key words: *K-1, morphological and age characteristics*

Introduction

As the technical preparedness is usually evaluated according to the efficiency of executing the technique in a K-1 fight, this research will be valuable, both in theoretical and practical terms. Various observations and analyses of fights (both live and on video recordings) by the experts of different profiles (coaches, analysts, researchers, methodologists and other sport experts) have resulted in broadening and strengthening the knowledge and skills concerning different possibilities for applying and making technical components of K-1 sport more concrete (Valera, 1973; Kajmović 2007.). Therefore, when speaking of K-1 sport, one must bear in mind its complexity and constant targeting to attain strong cohesive factors, which will merge the requirements of various aspects and approaches towards martial arts in general, comprised in K-1 sport. Certainly, this is already far from the practice in narrower terms, because integration of notions concerning various fields is simply inevitable. For that very reason, this research was designed in such way to collect information (morphological and those concerning age), which may have an impact on efficient pursuit of K-1 sport, particularly on selection of K-1 fighters and obtaining of information to reduce the average age of K-1 fighters in final tournaments. The objective of this research is comparative analysis of morphological features and ages of the most successful K-1 fighters.

Methods

Sample of the examined. The situational aspect has been provided through video recordings of all fights held in the last 12 years (1993-2004) at the final Grand-prix tournament in Japan. This resulted in a thorough sectional view of the most successful fighters, helping to determine an absolute criterion for defining what a quality fighter is, as each year the final tournament gathers only the eight indeed top fighters in the world. The ages and morphological features presented on the official K-1 websites and on video recordings and DVD were thoroughly reviewed and all K-1 fighters were accurately registered in registration protocol. This research has been carried out on a sample of 96 top level super heavyweight (over 91 kg) male fighters participating in final K-1 tournaments in Japan from 1993 to 2004 (in 84 matches and 205 rounds. The age of the examinees ranges from 21 to 39 years. *Sample of variables.* Variables for registering morphological characteristics 1. MORVISIN – height; 2. MORFTEZI – weight. Variables for registering age is 1. STDOBKB - age in the period of the match.

Data processing methods. The gathered data on morphological features have been processed using descriptive statistic method and presented in total values per age and in mean value for all fighters – participants in final tournament. By means of trend analysis, we examined the development trends in morphological features and age in terms of their growth and decrease in the period of 12 years, as to obtain the average measure of growth or decline trend of weight, height, and age variables in K-1 fighters.

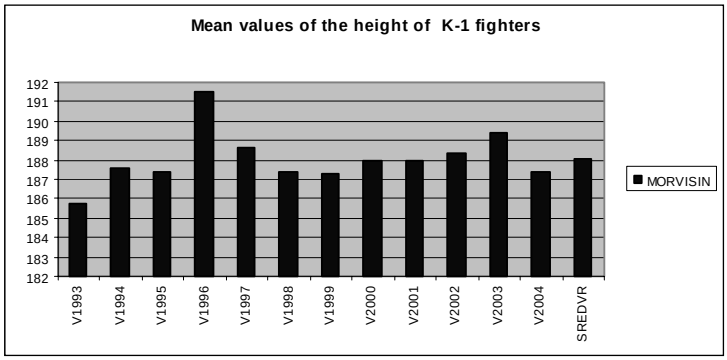
Results and discussion

Two anthropometric measures, namely, MORFVIS and MORFTEZ were used as the first set of variables for the purpose of this research, covering the dimensions of height and weight of the body. According to table and graph 1 one may notice that the height parameters of K-1 fighters have the maximum values (1996 and 2003), while the mean values of the participants in final K-1 GP tournaments in Japan accounted for 188 cm. This clearly indicates that, in average, we are talking about tall and corpulent fighters, compared against entire population, and, therefore height constitutes an important morphological factor in successful practice of K-1 sport. The very nature of K-1 sport seems to cause spontaneous selection of precisely those whose morphological dimensions are such to favour the combination of height and extreme strength in competitors.

Table 1. Descriptive Statistics (MORFVIS K-1 1993 – 2004)

VARIJABLE	V1993	V1994	V1995	V1996	V1997	V1998
MORVISIN	185,75	187,625	187,375	191,5	188,625	187,375

V1999	V2000	V2001	V2002	V2003	V2004	SREDVR
187,25	188	188	188,375	189,375	187,375	188,054



Graph 1.

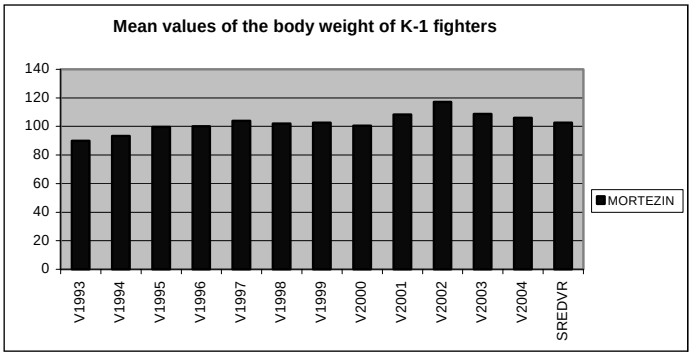
In table 1. and graph 2. we may observe obvious oscillations in the mean (average) values of participants in K-1 GP tournament, particularly in 2002 and 2003, where the maximum values of both the body weight and height were registered. It makes sense to expect that taller K-1 fighters will weight more.

However, this is not always necessarily true, as for example in 1996 when the average height of fighters was 191.5 cm, and their average weight accounted for 100.038 kg. The minimum values of body weight were registered in the first historical tournament in 1993 (89.93 kg). The average height and weight (mean values) of all K-1 GP competitors per tournaments years accounts for 102, 6 kg.

Table 2. Descriptive Statistics MORTEZIN (K-1 1993 – 2004.)

VARIABLES	V1993	V1994	V1995	V1996	V1997	V1998
MORTEZIN	89,925	93,25	99,75	100,038	103,875	102

V1999	V2000	V2001	V2002	V2003	V2004	SREDVR
102,625	100,5	108,313	117,113	108,663	105,925	**102,664**



Graph 1.

Table 3.

1993-2004 K-1 GP	Valid N	Mean
HEIGHT	96	188,054
WEIGHT	96	102,664

Table 3.

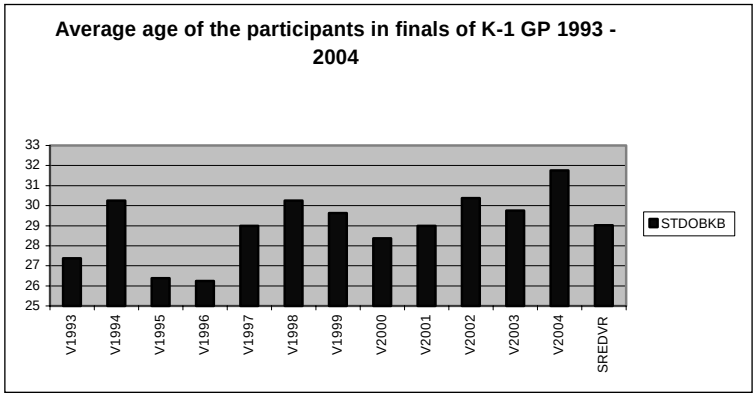
2003. K-1 BiH N.T	Valid N	Mean
HEIGHT	8	189,7500
WEIGHT	8	105,7500

Average values of the morphological characteristics of K-1 fighters competing in final K-1 tournaments with those of the fighters competing in qualifying tournament for the South-East Europe in Novi Travnik (charts 3 and 4), it is evident that the mean values of MORFVIS and MORFTEZ variables demonstrate insignificant discrepancies, thus indicating that, when it comes to successful pursuing of K-1 sport, stated morphological features participate considerably in development of universal K-1 fighter. This should be given special attention when selecting K-1 fighters, where we have to bear in mind that certain anthropometric characteristics are genetically determined and not subject to significant changes during the training (height), while the other characteristics are highly mutable and demonstrate rapid respond under the influence of training (in this case, the weight). According to table 5. and chart 3, it is evident that the age values are quite similar and the average age of the fighters is 29, which indicate that pursuit of top K-1 sport and necessary qualification to participate in the final K-1 GP tournament in Japan require immense experience acquired in competitions and the years of experience in practicing K-1 sport or sports which are represented in it.

Table 5. Descriptive Statistics (STDOBKB K-1 1993 - 2004)

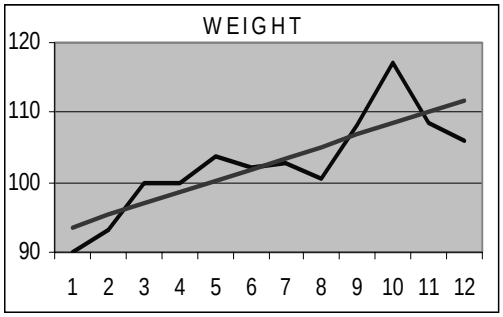
VARIABLES	V1993	V1994	V1995	V1996	V1997	V1998
STDOBKB	27,375	30,25	26,375	26,25	29	30,25

V1999	V2000	V2001	V2002	V2003	V2004	SREDVR
29,625	28,375	29	30,375	29,75	31,75	29,031

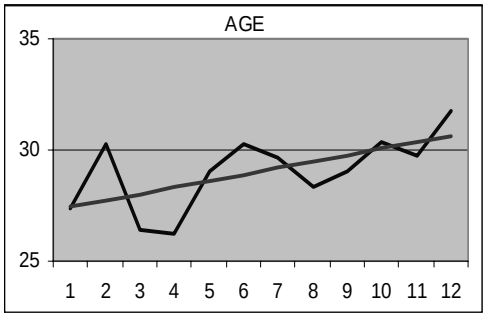


Graph 3.

Trend of development of morphological characteristic – weight, in K-1 fighters is increasing, most probably because the fighters are aging and because they were increasing their impact power and thus the opportunity to finish the match before the end of the regular time (graph 4). Trend of development of age of the K-1 tournament participants is also increasing, most probably because some K-1 fighters, who qualified for the finals several time (Peter Aerts and Ernesto Hust) as well as the fighters who would qualify for the final K-1 tournament, had considerable years of sport service and career, therefore considerable age as well, which led to growth of the trend of this variable (graph 5).



Graph 4.



Graph 5.

Conclusion

The results indicated that such approach accurately identified the most successful fighters in the analysed time, for which the data on morphological characteristic and age were collected. Two anthropometric measures were used this in this research - weight and body height. The mean (average) value of the height of the finalists in K-1 GP in Japan accounted that, in average, we are talking about tall and corpulent fighters, comparing to the entire population and therefore the height constitutes an important morphological factor in successful pursuing of K-1 sport. The very nature of K-1 sport seems to cause spontaneous selection of precisely those whose morphological dimensions are such to favour the combination of height and extreme strength in competitors. It makes sense to expect that taller K-1 fighters will weight more. However, this is not always necessarily true, as for example in 1996, when the average height was 191, 5 cm, while average weight accounted for100, 038 kg. It was confirmed in this research, so that the mean value for all participants of K-1 GP, in terms of the years when competitions were held, accounts for 102, 6 kg of active mass, indicating the large portion of active tissue (musculature) participates in overall mass. Trend of development of morphological characteristic (weight) in K-1 fighters is increasing, most probably because the fighters are in advanced age and because they were increasing their impact power and thus the opportunity to finish the match before the end of the regular time. Trend of advanced age is increasing, which is not good because the generation of the fighters which contributed immensely is being retired, while the next generation has nit matured yet to continue promotion of this most complex martial art of today, which may affect the quality of K-1 sport.

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PHYSICAL FITNESS AND ANTHROPOMETRIC PROFILE OF THE CROATIAN GRAECO-ROMAN WRESTLING TEAM

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Abstract

In this paper we described some morphological, strength and physiological features of the elite male Croatian Greco-Roman wrestlers. Also, we compared the A team (N = 6; age 21.2 ± 2.3 years) and B team (N = 6; age 20.1 ± 1.6) in studied variables. All subjects were tested on the 12 morphological variables; and eight fitness variables (muscular endurance, maximal strength and cardiovascular endurance). Apart from the descriptive statistics, the differences between the A and B team were calculated using the one-way analysis of variance and co-variance.

In conclusion, the best Croatian wrestlers are comparable to the world leading wrestlers in most of the morphological and fitness variables. The A and B team differed significantly only in the abdominal strength endurance (sit-up test).

Key words: *classical style, strength, morphological characteristics*

Introduction

The wrestling sport can be described as the high intensity martial art with the main goal to overwhelm the rival using one of the numerous combat techniques in standing and/or parter position. There is no doubt that the highly skilled and well conditioned athletes are in clear advantage (Callan et al. 2000.). Since 2005 wrestling matches are consisted of 3x3min intensive rounds (excepting the situation where one athlete wins in the first two rounds), with the 30-second rest between the rounds. Therefore, high anaerobic, but also aerobic demands of the wrestling match are evident. During the wrestling match different strength types are required (i.e. absolute and relative strength and power, as well as the maximal strength, power and muscular endurance). Thus, stronger wrestlers are clearly advantageous over their opponents of comparable technical skills. It is desirable that total body mass is predominated by muscle tissue. An excess of subcutaneous adipose tissue implies greater total body mass, leading to a higher category, which generally diminishes the chances for success at contest. Therefore, it can be emphasized that the wrestling is a highly complex sport, where a considerable number of different anthropological dimensions plays an important role in the final sport result. Thus, if a top result is aimed at, accurate data of the characteristic anthropologic influence on the final result/outcome are required. Naturally, it implies a precise and consecutive analysis of the athlete's anthropological status, including fitness and morphological components.

It is evident that there is a lack of studies dealing with anthropological features in wrestlers. It is especially noticeable in wrestlers of the Greco-Roman (G-R) style, since most of the studies performed so far studied free-style wrestlers and their physiological parameters (Callan et al. 2000, Kraemer et al. 2001.). In one of the rare papers where high-level G-R wrestlers were included, Baić et al. (2007) defined differences between the free-style and G-R wrestlers using the relatively large number of the specific and basic motor variables.

Therefore, the aim of the present study was to describe some morphological, strength and physiological features of the male G-R wrestlers and compare two qualitative groups of the G-R wrestlers in variables studied.

Methods

Subjects: Twelve G-R wrestlers, with more than 7 years of systematic wrestling training, participated in this study. According to their National ranking, 12 wrestlers were studied. More precisely the sample of subjects included two top placed wrestlers in weight categories of the -60 kg, -66 kg, and -74 kg; and three top-placed in the -84 kg and -96 kg weight categories. Six of them were Croatian national team members (A-team; mean age 21.2 ± 2.3), while others (N = 6) were their first substitutes in the Croatian national team (B-team; mean age 20.1 ± 1.6). All subjects voluntarily participated in the study.

Variables: The following anthropometric measures measured and calculated: body weight (BW; measured in kg), femur breadth (FB; cm), epicondial diameter (ED; cm), upper arm circumference relaxed and contracted (UAC; UAC-C;

cm), calf circumference (CC; cm), subscapular skinfold (SSSF; mm), triceps skinfold (TrSF; mm), calf skinfold (CaSF; mm), adominal skinfold (AbSF; mm) and body height (BH; cm). Body fat was measured using the BF681W "TANITA" scale, and somatotype variables were calculated using the Heath-Carter method (Carter and Heath 1990.).

Motor variables included; three muscular endurance variables: (1) maximal number of pull ups (CHIN), (2) push ups on dip-bars (PUSH-UP), and (3) sit-ups in 30 seconds (SIT-UP); four maximal strength variables: one repetitium maximum in (1) bench press (BENCH), (2) weightlifting clean (CLEAN), (3) weightlifting snatch (SNATCH), (4) and lifting of the maximum load from the chest (FRENCH PRESS).

Maximal oxygen consumption (VO2max) was measured using the Bruce treadmill protocol in the diagnostic center Diomed - Split.

All variables were measured using the standard measuring technique by experienced evaluators. All subjects were tested at the very beginning of their competitive season of 2006 and very in top form.

Data processing: Descriptive statistics (means and standard deviations) was calculated for all variables. Comparison between A team and B team was performed using the one-way analysis of co-variance while statistically controlling differences in body weight. The analysis of variance was used for those variables where BW was already included in test performance (e.g. pull ups, push-ups, sit-ups).

The 5 % was adopted as the significance level, and Statsoft's Statistica (ver. 7.0) was used for all the calculations and statistical procedures.

Results

Table 1. The descriptive statistics (mean ± standard deviation) of the morphological variables; the significance of the differences between groups ([a] $p < 0.05$)

VARIABLE	A team	B team
ANTHROPOMETRIC		
BH (cm)	173.7± 8.1	180.0±11.2
BW (kg)	83.5±15.6	81.3±10.2
FB (cm)	9.8±0.4	10.0±0.5
ED (cm)	7.3±0.3	7.3±0.3
UAC (cm)	33.8±2.6	34.3±2.0
UAC-C (cm)	36.1±2.5	35.9±1.7
CC (cm)	42.6±12.4	37.2±1.0
TrSF (cm)	6.8±1.4	7.1±0.9
SSSF (mm)	10.2±2.6	8.5±1.3
AbSF (mm)	8.5±1.8	7.2±2.5
CaSF (mm)	7.5±2.5	6.0±1.0
Body fat (%)	10.9±1.4	11.1±3.4
Endomorphic componente	2.55±0.5	2.26±0.5
Mesomorphic componente	5.62±1.8	5.78±0.6
Ectomorphic componente	1.53±0.9	1.72±0.6

Table 2. The descriptive statistics (mean ± standard deviation) of the fitness variables; significance of the differences between groups ([a] $p < 0.05$)

VARIABLE	A team	B team
RELATIVE STRENGTH – MUSCULAR ENDURANCE		
CHIN (repetition)	24.1±8.3	23.5±3.9
SIT-UP (repetition)	59.5±8.6 [a]	53.3±6.2
PUSH-UP (repetition)	31.3±3.3	26.3±5.4
ABSOLUTE STRENGTH (measured and BW normalized values)		
BENCH (kg)	111.7±19.2	103.3±16.0
CLEAN (kg)	105.3±20.7	94.2±14.6
SNATCH (kg)	74.5±14.1	68.3±9.8
FRENCH PRESS (kg)	71.7±11.7	68.3±7.5
BENCH (kg/kg of BW)	1.3±0.2	1.3±0.1
CLEAN (kg/kg of BW)	1.3±0.1	1.2±0.1
SNATCH (kg/kg of BW)	0.9±0.1	0.8±0.1
FRENCH PRESS (kg/kg of BW)	0.9±0.1	0.8±0.1
AEROBIC POWER		
VO2max (ml/kg/min)	52.9±5.3	52.3±3.5

The descriptive statistics of variables measured and calculated are presented in the table 1 and table 2. No significant differences were found between somatotype characteristics of the A and B team. However, relatively low values in the endomorphic and ectomorphic component are observable, leading to conclusion that the high-level wrestlers are dominantly mesomorphic. Although A-team achieved higher scores in most of the motor and endurance variables studied, the appropriate level of the significance is achieved only for the SIT-UP test.

Discussion and conclusions

Despite there being no difference between the groups in anthropometrical characteristics, it is important to note that skinfold values were low and circumferences values were relatively high for both groups. It is interesting, although somewhat contradictory, that A-team members were somewhat (although not significantly) taller, and at the same time – heavier than their B-team peers. It can be explained by somewhat higher values in circumferences and skinfolds of the A-team. Finally, since we found no significant differences between the A and B team in anthropometric measures it is clear why no significant differences were found in somatotype components.

When comparing herein observed values with those results previously reported for high-level martial arts' athletes, it is evident that top-level judoists (studied by Franchini et al. 2007) have higher values in body fat (11.4 comparing to 10.9 mm) and circumference measure (35.5 comparing to 33.8 cm in forearm circumference). However, such differences are easy to explain observing the differences in BW (90.6 comparing to 83.5 kg, all for judoists and wrestlers respectively).

Contrary to anthropometric features, where no significant differences were found between the and B–team members, the A-team members are significantly dominant in abdominal muscular endurance (table 2.). The importance of the muscular endurance of the trunk is suggested in most of the martial arts studied so far (Franchini et al. 2007., Baić et al. 2007.). Therefore, significant differences we found can be considered as expected. Briefly, highly developed muscular endurance in general, allows wrestler to repeatedly perform efficiently in different situations during the match. While muscular endurance of the upper extremities which we also studied is highly dependent on several muscular and strength capacities (e.g. static strength of the forearm in pull-ups; shoulder stabilization in push-ups performed on dips; etc.) abdominal muscular endurance is found as the only one which significantly differentiated the top-quality wrestlers (A-team) from their less successful peers (B-team).

Although A-team achieved somewhat better results than the B Team in most of the motor and endurance tests studied herein, the differences were not significant. We can suppose that the reason can be found in (1) small sample of subjects which did not allow reaching the appropriate level of the significance (note that N is directly related to p-level); and (2) the fact that we studied two groups of the wrestlers of the extraordinary quality and fitness level (National A and B teams). Therefore in some future studies the characteristics of the G-R wrestlers should be studied using the specific wrestling-skill-variables and technical quality of wrestlers.

When comparing results of the maximal strength qualities obtained herein, and in the already mentioned study where Baić and his associates studied best Polish G-R wrestlers (Baić et al. 2007) it is evident that Croatian wrestlers achieved markedly higher scores than their Polish colleagues in bench press (111.7 comparing to 92.6 kg), and snatch (74.5 comparing to 58.3 kg). On the contrary, Polish wrestlers performed better on the French press (82.5 comparing to 71.7).

The VO2 max values found in Croatian G-R wrestlers are comparable to values already reported for elite wrestlers in USA (Callan et al. 2000.).

In conclusion

- The anthropometric and fitness characteristics of the best G-R Croatian wrestlers are comparable to values previously reported for the top-level G-R wrestlers
- Values and data presented are easily obtainable in a wrestling training as a certain model-characteristics and target-values for the fitness and anthropometric status of the wrestlers.
- Although we can recognize the high importance of the muscular endurance for G-R wrestling, in some future studies the characteristics of the G-R wrestlers should be studied using the specific wrestling-skill-variables and technical quality of wrestlers.

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BIOMECHANICAL TECHNOLOGIES IN CONTEMPORARY SPORT

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Abstract

The use of special mechanical egrogenic aids in sport is based not only on the applied physical laws, but on the contemporary technologies of sports training as well. To enhance sports performance in athletes, specialists simultaneously apply the knowledge of gravitation forces, laws of resistance and inertia, they consider the biomechanical features of the human motion system and tactical-technical peculiarities of competitive and training processes. To distinguish different trends in using mechanical egrogenic aids in sport, one should know the peculiarities of the spatial body orientation according to different coordination systems and also the underlying reasons, resulting in certain types of human movements. Such reasons, as we know, are different forces in their interaction – forces of resistance, resilience, friction, gravitation and other. Analyzing certain types of movement in athletes, one should know the arrangement peculiarities of numerous anatomic levers and the features of skeletal muscles work. Developing modern biomechanical technologies, as a rule, specialists pay much attention to constructing and advancing sports clothing and equipment, gravitational biomechanical stimulators, devices and sports vehicles. All the modern egrogenic aids normally also get "armed" with advanced computer software and automated monitoring systems, which allow to process large amounts of information, locating optimal and rational subsystems. Within the last twenty years specialists from all over the world have been researching optimal ways of developing mechanical ergogenic aids enhancing sports performance.

Key words: *sports performance, biomechanical features, mechanical egrogenic aids*

Introduction

There could be distinguished several basic trends in enhancing sports performance and strength and power in athletes. First of all, it is the rational use of laws of biochemistry, physiology, physics, mechanics and different technical sciences in the training and competitive process. These also include the information about mechanical ergogenic aids used in sport, sports clothing, footwear and equipment, sports facilities, automated systems, monitoring training process, gravitational biomechanical stimulators and devices in particular.

The use of special mechanical egrogenic aids in sport is based not only on the applied physical laws, but on the contemporary technologies of sports training as well. To enhance sports performance in athletes, specialists simultaneously apply the knowledge of gravitation forces, laws of resistance and inertia, they consider the biomechanical features of the human motion system and tactical-technical peculiarities of competitive and training processes.

To distinguish different trends in using mechanical egrogenic aids in sport, one should know the peculiarities of the spatial body orientation according to different coordination systems and also the underlying reasons, resulting in certain types of human movements.

Such reasons, as we know, are different forces in their interaction – forces of resistance, resilience, friction, gravitation and other.

Analyzing certain types of movement in athletes, one should know the arrangement peculiarities of numerous anatomic levers and the features of skeletal muscles work.

Developing modern biomechanical technologies, as a rule, specialists pay much attention to constructing and advancing sports clothing and equipment, gravitational biomechanical stimulators, devices and sports vehicles. All the modern egrogenic aids normally also get "armed" with advanced computer software and automated monitoring systems, which allow to process large amounts of information, locating optimal and rational subsystems.

Directions of the use of mechanical ergogenic aids

Within the last twenty years specialists from all over the world have been researching optimal ways of developing mechanical ergogenic aids enhancing sports performance [1-4].

Mechanical egrogenic aids used in sport could be classified as means of direct and postponed effect (table 1).

Table 1. Classification of mechanical ergogenic aids in sport

Mechanical ergogenic aids in sport	
Direct effect	**Postponed effect**
Sports equipment Sports clothing Sports facilities	Technical devices: automated systems, monitoring training process; gravitational biomechanical stimulators and devices

At present there are two mainstream directions of the use of mechanical ergogenic aids to enhance sports performance.

First direction – to decrease the negative influence of negative environmental factors on athletes during their sports performance. The process of forming and advancing the technical skills is secured by decreasing the environmental resistance and mechanical load on the muscular-skeletal apparatus with the help of better quality sports clothing and equipment.

Second direction implies that the training process should be organized to allow the invironment to gain new qualities, not only optimal for different physical factors but also stimulating certain rational direction of technical improvement.

It allows ground from the biomechanical point of view and create new training devices, variable gravitational biomechanical stimulators and automated systems, monitoring training process, resulting in a complex influence on different sides of training.

Discussion and conclusions

Considering mechanical ergogenic aids in view of contemporary pedagogical technologies in sport, we would like to point out certain methodological complications with their analyses and discussion. These complications derive from a large variety of data, substantial differences within scientific, medical, biological approaches and fundamental knowledge of natural laws and the laws of human motion.

Developing the knowledge of ergogenic mechanical aids in sport would allow to solve this problem and fill in the gaps in its treatment.

It has been proved that achieving high results and successful performance at different large international competitions, as a rule, result from athletes using cutting edge, technologically advanced mechanical ergogenic aids. No doubt, that the progress made in this field correlates with the contemporary technical revolution in science, engineering and production technologies.

Introduction of modern technical ergogenic investigations into practice has allowed not only to change the technique of the sports struggle in different sports, but to substantially intensify performance in athletes under competitive circumstances as well.

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ASSOCIATIONS BETWEEN PERFORMANCE INDICATORS AND SET'S RESULT IN MALE VOLLEYBALL

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Abstract

The present study examines the associations between performance indicators (number of spike points, spike errors, spike continuity, block points, block errors, block continuity, serve points, serve errors, serve continuity, dig excellent, dig errors, dig continuity, set excellent, set errors, set continuity, reception excellent, reception errors and reception continuity) and performance in Volleyball, concerning set result (set win and set loose). For this 65.949 actions from 550 sets of Men's Senior World League (2005) were analyzed. Multivariable logistic regression was used in data analysis. The results show that serve point (OR:16.1, 95%CI: 5.7-45.9), serve continuity (OR:4.6, 95%CI:2.8-7.5) and spike point (OR:4.1, 95%CI:2.2-7.6) are the performance indicators more associated with the success in Volleyball.

Key words: *volleyball, notational analysis, performance indicators*

Introduction

Volleyball is a team game and depends on many external and unanticipated factors that coaching process attempts to control in order to brig success. Within coaching process, great emphasis is placed on the coach's ability to observe and recall all discrete incidents from a competitive sport performance (Borrie, Jonsson, & Magnusson, 2002). However, not all game actions seem to be crucial for team's success. The research in Volleyball game-related statistics seek out what game actions are most associated with the competitive success. Cox (Cox, 1974) used multivariate variances analysis and discriminate analysis to study the relationship between skills performances and victory in the game. The author found that there are significant relationships between predictors variables (game actions) and response variable (game result) and the spike was the best indicator of success in the game. Eom and Schutz (Eom & Schutz, 1992) extracted, from among the selected technical-tactical components, the best predictor or a group of predictors that determined the success of a team in a game. The study has shown that the differences between the matches won and the matches lost are more expressed in those technical-tactical elements that are executed while organizing a counterattack: block, defense, setting and spike. The discriminate analysis has shown that block and spike are the most important elements for determining the success of a team. Marelic and colleagues (N; Marelic, Zufar, & Omrcen, 1998) researched the characteristics of junior volleyball international quality team play on the basis of the sets won and lost, according to volleyball phases. The results show that the variables *spike in the phase of attack* and *setting in the phase of counterattack* had the highest projection on the discriminate function, whereas the block, court defense and *setting in the phase of attack* and *spike in the phase of counterattack* had a small projection. Palao (Palao, Santos, & Ureña, 2004) studied the game actions performance according to teams levels. Analyzing 33 male matches from 2000 Olympic Games in Sydney, the study shows that the performance of serve, reception, spike and block differentiated the teams levels (higher vs. lower). More recently Marelic (N. Marelic, Resetar, & Jankovic, 2004) studying the Italian men's A1 league through discriminate analysis concluded that the *spike in the phase of attack* is the variable with the highest projection on the set result. The *spike in the phase of counterattack*, serve reception, block and serve had lower projections.

The present study aimed to examine the associations between performance indicators (number of spike points, spike errors, spike continuity, block points, block errors, block continuity, serve points, serve errors, serve continuity, dig excellent, dig errors, dig continuity, set excellent, set errors, set continuity, reception excellent, reception errors and reception continuity) and performance in Volleyball, concerning set's result (set win and set loose).

Methods

The sample was composed by 65.949 actions from 550 sets of Men's Senior World League, 2005. The variables registered were serve performance, reception performance, spike performance, block performance, set performance, dig performance and Set's result (win/loss). Game actions performance was evaluated in relation to the success and options that the actions gave to own team and the opponent's team. Data were obtained through official FIVB software "Volleyball Information System" (VIS). We differentiated two types of actions to categorize the performance: a) *Terminal Actions* (serve, spike and block). We distinguished three levels to categorize the performance: *Point* – action was a success and

gave point for the team; *Continuity* – the ball was defended by opponent's team and still in game; *Error* – failed action or action that did not allow the option to continue (point for the opponent). b) *Continuity Actions* (reception, set and dig). We distinguished three levels to categorize the performance: *Excellent* – the actions give all attack options; *Continuity* - the actions don't give all attack options; *Error* – failed action or action that did not allow the option to continue (point for the opponent). To test the reliability, an independent observer of the VIS, observed 34 sets, corresponding to 12.36% of the total sets analyzed. Kappa of Cohen analysis and percentage of agreement demonstrated good inter-observer reliability which confirmed the accuracy of observations. Descriptive statistics were used to provide information about different aspects of the sample. Multivariable logistic regression models were used to study the influence of performance indicators values on Set result. Odds ratios (OR) at their 95% confidence intervals (IC) for each factor were adjusted for all other factors in the model. SPSS 14.0 was used for analyses.

Results

The means of each game's action in the set are detailed in Table 1. The spike is the only game action where teams make more points than errors and it is through the dig that teams lose more points. In the dig there are the highest values of standard deviation.

Table 2 shows the factors that are associated with set result. After adjustment, the variables that remained associated with the set result were: spike point, spike error, spike continuity, block point, block error, block continuity, serve point, serve error, serve continuity, dig excellent, dig error, set continuity, reception excellent, reception error and reception continuity. No difference in set result was detected when analyzing block continuity (OR: 1.1; 95%CI: 0.9-1.4), dig continuity (OR: 0.9; 95%CI: 0.7-1.1), set excellent (OR: 0.9; 95%CI: 0.6-1.2) and set error (OR: 1.0; 95%CI: 0.3-3.2).

The number of points of all terminal actions showed a positive influence in the victory of the set. When the teams increased the numbers of points by terminal actions (spike, block and serve) they were much more likely to win the set (ORspike_point: 4.1; 95%CI: 2.2-7.6; ORblock_point: 3.2; 95%CI: 1.9-5.2; ORserve_point: 16.1; 95%CI: 5.7-45.9). Concerning the number of errors, with exception of serve error (having a positive influence in the victory OR serve error: 1.8; 95%CI: 1.2-2.3) and set continuity, all the other variables showed a negative influence in the victory of the set. The increase in numbers of errors means that they were more likely to lose the set (ORspike_error: 0.4; 95%CI: 0.2-0.7; ORblock_error: 0.4; 95%CI: 0.3-0.5; ORdig_error: 0.5; 95%CI: 0.4-0.6; ORreception_error: 0.1; 95%CI: 0.0-0.2).

Table 1. Means of game action

Variable	x (sd)
Spike	
Point	12.3 (3.2)
Error	4.3 (2.2)
Continuity	9.1 (3.4)
Block	
Point	2.4 (1.6)
Error	5.4 (2.7)
Continuity	5.3 (2.7)
Serve	
Point	1.1 (1.1)
Error	4.1 (1.7)
Continuity	17.4 (3.8)
Dig	
Excellent	4.7 (4.0)
Error	5.7 (3.4)
Continuity	5.2 (4.5)
Set	
Excellent	5.9 (4.5)
Error	0.3 (0.5)
Continuity	18.5 (7.0)
Reception	
Excellent	9.8 (4.4)
Error	1.1 (1.2)
Continuity	7.5 (4.0)

Table 2. Factors associated with set result (reference category: victory)

	Odds Ratio (95%Confidence Interval)		
Explanatory variable	**Crude**	**Adjusted[a]**	**p-value[b]**
Spike			
Point	1.2 (1.1-1.3)	4.1 (2.2-7.6)	<0.001
Error	0.6 (0.5-0.7)	0.4 (0.2-0.7)	0.002
Continuity	0.9 (0.8-0.9)	1.7 (1.1-2.6)	0.018
Block			
Point	1.7 (1.5-2.0)	3.2 (1.9-5.2)	<0.001
Error	0.9 (0.9-1.0)	0.4 (0.3-0.5)	<0.001
Serve			
Point	1.6 (1.4-1.9)	16.1 (5.7-45.9)	<0.001
Error	1.0 (0.9-1.1)	1.8 (1.2-2.3)	0.002
Continuity	1.3 (1.2-1.4)	4.6 (2.8-7.5)	<0.001
Dig			
Excellent	1.0 (1.0-1.1)	0.8 (0.6-1.0)	0.046
Error	0.9 (0.9-1.0)	0.5 (0.4-0.6)	<0.001
Set			<0.001
Continuity	0.9 (0.9-1.0)	0.7 (0.5-0.9)	0.021
Reception			
Excellent	1.0 (0.9-1.0)	0.2 (0.1-0.3)	<0.001
Error	0.6 (0.5-0.7)	0.1 (0.0-0.2)	<0.001
Continuity	0.9 (0.8-0.9)	0.2 (0.1-0.3)	<0.001

[a] Odds ratio adjusted for all the variables in the (main effects) model.
[b] Hosmer and Lemeshow test ($\chi^2_{(8)}$= 1.91, p=0.98).

Discussion and conclusion

This study attempted to determine the associations between performance in volleyball game actions and team success (victory in the set). The results confirmed the earlier researches concerning capacity to spike's performances to differentiate the success in volleyball (Cox, 1974; Eom & Schutz, 1992; N. Marelic et al., 2004; N; Marelic et al., 1998; Palao et al., 2004). However the variables in this study, those more likely to improve the probability to win the set (serve points) do not find agreement in the literature. Our study shows that, considering the other variables constant, the improvement in one serve point increases 16 times the possibility to win the set. Only one study showed a relationship between serve and set result, and found a lower projection (N. Marelic et al., 2004).

The negative influence between all continuity actions with victory in the set is justified by the logic of game itself. When a team wins a point, the players of this team always serve in the next rally. This implied that the worst teams (those losing more points) receive, more times than the best teams (those winning more points). The same logic occurs in dig actions, through a relationship between this action with spike.

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DIFFERENCES IN THE CONDITIONING AND MORPHOLOGICAL CHARACTERISTICS BETWEEN JUNIOR AND SENIOR VOLLEYBALL PLAYERS

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Abstract

The intention of this research is to determine if there are statistically significant differences in the indicators of motor and functional abilities and morphological characteristics between two groups of volleyball players of different age categories, that is, between juniors and seniors. The sample of subjects is composed of 12 junior (17,8 ± 0,72 years) and 9 senior volleyball players (22,2±2,1 years). For the purpose of this research a battery of tests including 14 variables is made, eleven of which serve for the evaluation of motor and functional abilities and three for the evaluation of morphological characteristics. For all 14 variables, including the AGE variable, descriptive parameters (mean and standard deviation) are calculated, and statistically significant differences between juniors and seniors are estimated using Student's t-test for independent samples on the level of significance $p<0.05$. Significant differences are found in the following variables: Height of jump in block and spike (BLJH and SPJH), Spike reach (SPREACH), Volleyball polygon (VOLPOL), and finally, Running 12-minutes (RUN12MIN). From the obtained results one can conclude that seniors achieved significantly better results than juniors in the variables that estimate the explosive jumping performance and specific quickness, and significantly worse results in the variable that estimates aerobic endurance.

Key words: *volleyball players, Student's t-test, conditioning abilities, morphologic characteristics, juniors, seniors*

Introduction

Volleyball is a sport discipline that requires certain conditioning abilities, morphological characteristics, technical and tactical knowledge, and psychological and sociological qualities. In volleyball, like in all other sports, the anthropological requirements mentioned above are usually defined using a hypothetical specification equation. In this research we only discuss the conditioning and morphological dimensions that are important for the success in volleyball, so in this case we can talk about a partial specification equation in volleyball.

In Croatia the volleyball competition system is divided according to age categories. When transferring from one into another age-category, motor and functional abilities, and morphological characteristics of volleyball players are precisely estimated using a number of measuring instruments. On the basis of the results obtained from the measuring, the selection of the individuals that have the preconditions to achieve top results in volleyball on national and later on international level is made.

The goal of this research is to determine the differences between junior and senior volleyball players in the conditioning abilities and morphological characteristics. Those results would contribute to better quality of selection process in volleyball in the future.

Methods

This research is conducted on top-level and perspective junior volleyball players aged 17,8±0,72 (M±SD) and senior volleyball players aged 22,2±2,1 (M±SD) for the purpose of initial testing and gathering of information on the coaches of Croatian male junior and senior national teams for the upcoming European Championship. For the purpose of analysis, the results of 21 subjects are used (n=21). All subjects are healthy and motivated to perform given tasks, and they entered the research after being invited by the selector of Croatian male volleyball national teams. Testing is conducted at the Faculty of Kinesiology of the University of Zagreb at the end of club competition season, that is, during the second transition period of the macro-cycle of competition.

For the purpose of differentiating between two groups of volleyball players, the results of morphological characteristics and motor and functional tests, that are considered interesting for differentiating between juniors and seniors, are taken. Three anthropometrical measures for the estimation of body height (BH), body mass (BM), body fat percentage (BF) are taken for the purpose of differentiating between two groups of volleyball players, and for the purpose of estimating motor and functional abilities, tests for the estimation of explosive jumping performance of block and spike (BLEREACH, SPREACH, BLJH, and SPJH), strength endurance of arms and shoulder muscles (PSHUP60), strength endurance of trunk

(STUP60), specific quickness in volleyball polygon (ODBPOL), agility (9-3-6-3-9), trunk flexibility (TFLEX), specific speed endurance (PINE) and aerobic endurance (RUN12MIN) are taken.

Table 1. Morphological measures and tests for the estimation of motor and functional abilities

MORPHOLOGICAL CHARACTERISTICS		
BM (kg)	Body mass	
BH (cm)	Body height	Mišigoj-Duraković, 1995.
BF (%)	Body fat	
MOTOR AND FUNCTIONAL ABILITIES		
BLREACH (cm)	Block reach	
BLJH (cm)	Jump height of block	Modified according Metikoš et al. 1989.
SPREACH (cm)	Spike reach	
SPJH (cm)	Jump height of spike	
9-3-6-3-9 (sec.)	Nine, three, six, three, nine	Merli, 1987. Marelić, Janković 1997.
VOLPOL (sec.)	Volleyball polygon	Marelić, Janković 1997.
STUP60 (rep.nm)	Sit-ups in 60 seconds	
PSHUP60 (rep.nm)	Push-ups in 60 seconds	Metikoš et al. 1989.
TFLEX (cm)	Trunk flexibility	
PINE (sec.)	Pine	Modified according Sawula, 1991.
RUN12MIN (m)	Running 12 minutes	Metikoš et al. 1989.

The mean value of motor tasks performed in three items is used in the further data processing. The functional measures of aerobic and speed endurances are taken once and only after all tasks have been performed. In the series of tests, a special attention is paid to the order of performances for every subject equally. It has to be mentioned that all measuring and testing have to be conducted within one morning training. That is also the main reason for the chosen battery of motor and functional tests. All measuring is conducted in the complex of the Diagnostic Centre at the Faculty of Kinesiology. Surveyors are skilled for all conducted measuring.

General descriptive statistics is calculated using Statistica 7.0 program system. Beside the results of descriptive statistics, the statistically significant difference of arithmetic means between two groups (seniors and juniors) is estimated using t-test for independent samples.

The following hypothesis is made: $\mathbf{H_0 : X_1 = X_2}$ There is no statistically important difference between seniors and juniors on the level of error $p<0.05$.

Results

In Table 2 are presented values of arithmetic mean (M) and standard deviation (SD) of two groups of subjects, the values of statistical importance (p) and the values of Kolmogorov-Smirnov test for estimating the normality of distribution.

Table 2. The results of motor, functional and anthropometrical measuring and the differences between two groups of volleyball players - seniors and juniors

VARIABLES	SENIORS		JUNIORS		p	K-S test
	n	M±SD	n	M±SD		
AGE	9	22,22±2,11	12	17,83±0,71	0,00*	0,22
BM	9	192,47±5,54	12	194,48±4,56	0,38	0,17
BH	9	85,72±7,69	12	83,21±9,45	0,51	0,12
BF	9	11,12±2,82	12	11,13±5,18	0,99	0,65
BLREACH	9	316,50±6,90	12	310,10±7,37	0,06	0,12
BLJH	9	66,6±5,78	12	58,00±4,35	0,00*	0,1
SPREACH	9	332,55±7,16	12	324,90±6,95	0,02*	0,12
SPJH	9	79,36±5,46	12	69,70±4,95	0,00*	0,08
VOLBPOL	9	17,74±1,19	12	19,63±1,46	0,00*	0,14
9-3-6-3-9	9	7,25±0,34	12	7,63±0,56	0,07	0,14
STUP60	9	51,36±3,20	12	49,10±3,45	0,14	0,15
PSHUP60	9	41,64±8,30	12	35,30±11,62	0,16	0,12
TFLEX	9	15,23±3,20	12	12,70±5,44	0,20	0,16
PINE	9	38,44±1,83	12	38,68±1,59	0,75	0,78
RUN12MIN	9	2400,91±139,60	12	2619,00±205,40	0,01*	0,27

Discussion and conclusion

The critical value obtained using K-S test for the number of subjects n=21 and the statistical importance of 0,05 is 0,287, which means that the tested variables are to have the values calculated using K-S test lower than the critical value (0,287). All variables are distributed normally, except Body fat (BF) and Pine (PINE).

From the results showed in the Table 2 one can notice that the average body height of seniors (192,47) is somewhat lower than the average height of juniors (194, 48) which tells us about good selection of juniors when this anthropometric characteristic is taken into consideration. The average height of the first ten teams on the World Championship 2006 (www.fivb.org, 2007) is 197,38 cm – it is the fact that is also indicative of worse results of Croatian juniors and seniors.

The average values of the BF variable are similar for juniors and seniors. The average value of 11% to the body fat percentage that falls within a normal range of values established for top-level volleyball players according to Viitasalo 1982.

The values in Table 1 show that five variables are statistically significant on the level of 0,05. The VOLPOL variable is a measure of specific quickness in the volleyball court where players have to show their speed, coordination and agility. Structure of this test is tightly connected to the phase of game of defense. Better results of this test are due to good selection of seniors, and also thanks to longer training experience that influenced the development of this specific condition ability.

Statistically important difference between two groups can be seen in the BLJH variable in favor of the senior group. Considering the fact that the explosive strength of jump is very important in top volleyball, one can conclude that a part of subjects of the junior group will not be able to adequately take places of their senior team members. Except for the worse results in the BLJH variable, statistically looking, the group of juniors is also significantly different from the senior group in the SPJH and SPREACH variables.

The importance of these variables is also evident in the fact that the International Volleyball Federation (FIVB) has included the values of spike and block reach in all official bulletins during its competitions. So, beside general information about players, one can also find the information considering the variables of SPREACH and BLREACH. According to Marelić et al. (2007), the results of junior teams on the European Championship in the test of SPREACH are significantly different from the obtained results. The authors point out that twelve best results of junior teams go beyond the value of 350 cm of spike reach.

In all mentioned variables that are statistically important on the level of $p<0,05$, one can notice the domination of the senior team. The reasons for this one need to look for in the selection of players which puts the worse results of juniors into larger context, because the best junior players are invited to play for the representation. The coaches of the both teams should be more careful when analyzing individual accomplishments of junior players and pay special attention to those players that show satisfactory results, motivation, and the level of technical and tactical knowledge, so that they can become senior representatives in future. The proof of this is later worse results of junior representation on the qualifications for the European Championship. Finally, it has to be mentioned that only the RUN12MIN variable shows statistically significant difference between arithmetic means on the level of significance $p<0,05$ in favor of the group of junior volleyball players. However, this indicates that one has to be careful when interpreting the results. In other words, the senior group was motivated when performing the tasks only when the selector of national team was present. Seniors did not give their maximum on the 12-minute aerobic ability test. Due to this, the results do not show the real differences in this variable between the tested groups, and we also wanted to point out the need to be careful in some later researches. We believe that in order to have better controlled measuring and more precise interpretation, coaches have to be present during the whole time of the performance of tasks.

The analysis of the differences in conditioning abilities and morphological characteristics between senior and junior volleyball players shows statistically significant differences in five variables that estimate motor and functional abilities. Seniors achieved significantly better results in the variables that estimate the explosive strength of jumping performance (BLJH, SPREACH and SPJH), and the specific quickness in the volleyball court (VOLPOL), while they showed worse results in the test of aerobic endurance (RUN12MIN). In this research, the explosive strength of jumping performance proved to be a dominant conditioning ability that differentiates juniors from seniors. In that way it gives volleyball coaches broad guidelines when making a selection, that is, when transferring a junior player into senior, higher-quality category, but it also points to priorities in conditioning of younger-aged players. Better results of seniors in the jump performance and specific quickness, which are to a large extent hereditary, are partly due to longer playing and training experience. We believe that the reasons for the worse results in the aerobic endurance of seniors are not due to their bad physical fitness, but it is solely the result of their low motivation during the performance of test.

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DIFFERENCES IN THE SITUATION EFFICIENCY BETWEEN TWO GROUPS OF WOMEN VOLLEYBALL TEAMS IN SIX ROTATIONS OF THE GAME

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Abstract

The intention of this research is to determine if there are statistically important differences between the indicators of situation efficiency of different phases of volleyball game between better and worse placed teams separately for every of six rotations of a game. The research is conducted on the sample of 20 matches played by eight national representations on girl's youth European championship held in Zagreb in 2003. The indicators of situation efficiency are estimated for the following phases of game: serve (SERVE), serve reception (RECEP), spike in the complex of attack (SPATT), block (BLOCK), defence (DEFEN), and spike in the complex of counter-attack (SPCATT). Teams that were placed from the 1st to the 4th place on the championship are in the group of better placed teams, and the teams placed from the 5th to the 8th place belong to the group of worse placed teams. Statistically important differences between the two groups of women volleyball players determined according to the level of significance $p<0.05$ are obtained in Rotation 3 in the phase of the game in block (BLOCK), in Rotation 4 in the phase of spike after the defence (SPCATT), and in Rotation 5 in the phase of serve reception (RECEP).

Key words: *women volleyball players, situation efficiency, t-test game, rotation*

Introduction

Usually, the phases of game that differentiate the successful from the unsuccessful teams are determined according to the analysis of the situation parameters of matches in team sports (Eom et al., 1992, Hughes et al., 2003). For that purpose, matches or sets are used as entities inside which the quality of performances of recorded phases or volleyball elements is analysed.

In volleyball there are six players in one field that, depending on their playing role, are placed in six zones, and they are rotating clockwise during a game always for one zone, that is, for one rotation forward. Every rotation is marked with the number of zone where a setter is, who is a leading organizer of the game in volleyball. For every single rotation there is a characteristic formation of the players according to their playing role, and according to the complex or the phase of game they are in. In order for a team to be successful in the end, it is necessary to achieve the balance of performance in every of the six rotations during a game. The data obtained with the analysis of the situation efficiency of every phase of a game are used as main guidelines in the planning and programming of volleyball training. The analysis of situation efficiency in a single rotation even further explains the reasons of success of certain volleyball teams (Đurković, 2007).

Methods

The main goal of the research is to determine if there are significant differences between two groups of women volleyball players (between the teams of semi-finalists placed from the 1st to the 4th place and the other teams placed from the 5th to the 8th place) in six phases of volleyball game for every of six rotations of a game. The data were gathered on the 2003 woman cadet's European championship in Zagreb. Eight national representations played on the championship (Byelorussia, Croatia, Germany, Hungary, Italy, Poland, Russia, and Serbia and Montenegro). Every team represents a separate entity - 20 matches were played according to the tournament system, so accordingly, 40 entities were taken for the purpose of this research. The data used in this work were gathered using Datavolley Rel. 2.0. Software by DATAPROJECT.

Variables used for the differentiation between the two groups of women volleyball players constitute six phases of volleyball game: SERVE (SERVE), SERVE RECEPTION (RECEP), SPIKE IN THE COMPLEX OF ATTACK (SPATT), BLOCK (BLOCK), DEFENCE (DEFEN), AND SPIKE IN THE COMPLEX OF COUNTER-ATTACK (SPCATT). The only phase left out in this research is setting because the efficiency of setting is determined by the successfulness of spike. In other words, sometimes technically and tactically badly setting does not necessarily mean that there is a mistake in spike and vice versa. The performances of certain actions inside six analysed phases of game are marked using the scale of five degrees. For example, the lowest degree of performance (f. n. 1) on the scale defines a mistake, and the highest degree of performance (f. n. 5) defines winning of a point or an *ideal* performance.

The frequencies defined and ranked in this way are inserted in the following formula to get the coefficient of performance for a certain phase.

$$\frac{\text{(Performance frequency. n. 1) x1 + (perform. f. n. 2) x2 + (perfom. f. n.3) x3+ (perform .f.n. 4 x 4) + (perform. f. n.5)x5}}{\text{Total number of frequencies (performances 1 + perform.2 + perform.3 + perform. 4 + perform. 5)}}$$

The results obtained in this way are then fed into a computer and analysed with statistical program Statistica for Windows ver. 5.0. Minimal and maximal values, arithmetic mean, and standard deviation are calculated using standard descriptive analysis. Further, the normality of distribution is calculated with K-S test. The differences between the two groups of volleyball teams for every phase of game in every of six rotations are calculated using Student's t-test for independent samples.

Results

Descriptive statistic (Table 1) is calculated for every of the six volleyball rotations separately. Arithmetic mean, minimal and maximal results, and standard deviation for six phases of game are calculated. The normality of distribution is checked using K-S test.

Table 1. Results of the descriptive statistic of six rotations of volleyball game

ROT4	M	SD	K-S	ROT3	M	SD	K-S	ROT2	M	SD	K-S
RECEP	3,78	0,51	0,084	RECEP	3,86	0,46	0,092	RECEP	3,92	0,51	0,104
SERVE	2,61	0,39	0,073	SERVE	2,74	0,35	0,136	SERVE	2,71	0,35	0,081
DEFEN	3,21	0,59	0,08	DEFEN	3,14	0,87	0,112	DEFEN	3,36	0,68	0,111
BLOCK	2,77	0,69	0,125	BLOCK	2,76	0,82	0,097	BLOCK	2,51	0,88	0,093
SPATT	3,69	0,45	0,104	SPATT	3,67	0,54	0,101	SPATT	3,78	0,46	0,094
SPCATT	3,45	0,7	0,133	SPCATT	3,78	0,59	0,09	SPCATT	3,7	0,72	0,114
ROT5	**M**	**SD**	**K-S**	**ROT6**	**M**	**SD**	**K-S**	**ROT1**	**M**	**SD**	**K-S**
RECEP	3,87	0,6	0,078	RECEP	4,06	0,41	0,108	RECEP	3,9	0,43	0,069
SERVE	2,62	0,29	0,137	SERVE	2,64	0,39	0,058	SERVE	2,72	0,28	0,07
DEFEN	3	0,82	0,13	DEFEN	2,95	0,82	0,112	DEFEN	3,11	0,68	0,139
BLOCK	2,49	1,07	0,097	BLOCK	2,82	0,71	0,148	BLOCK	2,78	0,7	0,092
SPATT	3,86	0,52	0,082	SPATT	3,85	0,52	0,121	SPATT	3,79	0,6	0,082
SPCATT	3,49	0,72	0,102	SPCATT	3,7	0,81	0,177	SPCATT	3,65	0,58	0,143

M - arithmetic mean: SD - standard deviation: K-S – results of Kolmogrov – Smirnov test

Table 2 shows the results of differences between arithmetic means for every volleyball rotation.

Table 2. Results of t-tests of the rotations of game

	5. - 8. M±SD	1. - 4. M±SD	p			5. - 8. M±SD	1. - 4. M±SD	p	
ROT 1				SETTER IN ZONE 1	**ROT 4**				SETTER IN ZONE 4
RECEP	3,77±0,46	4,03±0,38	0,06		RECEP	3,74±0,36	3,81±0,63	0,66	
SERVE	2,67±0,33	2,77±0,24	0,26	NET	SERVE	2,53±0,36	2,69±0,42	0,21	NET
DEFEN	3,02±0,64	3,20±0,73	0,41	DS CS2 S1	DEFEN	3,06±0,60	3,35±0,56	0,13	**S** CS1 S2
BLOCK	2,70±0,79	2,87±0,62	0,45		BLOCK	2,85±0,80	2,69±0,58	0,48	
SPATT	3,79±0,68	3,80±0,54	0,94	S2 CS1 **S**	SPATT	3,66±0,46	3,72±0,45	0,69	S1 CS2 DS
SPCATT	3,50±0,67	3,80±0,44	0,09		SPCATT	3,23±0,77	3,67±0,55	0,05	
ROT 2				SETTER IN ZONE 2	**ROT 5**				SETTER IN ZONE 5
RECEP	3,77±0,51	4,06±0,47	0,07		RECEP	3,57±0,52	4,17±0,53	0,00	
SERVE	2,67±0,35	2,74±0,35	0,58	NET	SERVE	2,64±0,33	2,60±0,25	0,64	NET
DEFEN	3,30±0,72	3,43±0,66	0,56	CS2 S1 **S**	DEFEN	2,97±0,99	3,04±0,63	0,77	CS1 S2 DS
BLOCK	2,34±0,78	2,69±0,95	0,21		BLOCK	2,56±1,22	2,42±0,92	0,68	
SPATT	3,84±0,50	3,72±0,42	0,42	DS S2 CS1	SPATT	3,75±0,58	3,97±0,45	0,19	**S** S1 CS2
SPCATT	3,86±0,78	3,55±0,65	0,18		SPCATT	3,5±0,75	3,48±0,71	0,93	
ROT 3				SETTER IN ZONE 3	**ROT 6**				SETTER IN ZONE 6
RECEP	3,73±0,41	4,00±0,48	0,07		RECEP	3,99±0,44	4,12±0,37	0,30	
SERVE	2,73±0,32	2,76±0,39	0,74	NET	SERVE	2,73±0,38	2,55±0,39	0,17	NET
DEFEN	3,01±0,62	3,27±1,07	0,35	S1 **S** CS1	DEFEN	2,86±0,82	3,03±0,83	0,52	S2 DS CS2
BLOCK	2,50±0,72	3,02±0,84	**0,04**		BLOCK	2,71±0,78	2,94±0,62	0,30	
SPATT	3,63±0,56	3,72±0,52	0,61	CS2 DS S2	SPATT	3,85±0,55	3,85±0,49	0,97	CS1 **S** S1
SPCATT	3,69±0,73	3,88±0,39	0,32		SPCATT	3,59±1,04	3,81±0,48	0,40	

Legend: S-SETTER, DS-diagonal spiker, CS1, 2-central spiker, S1, 2-spiker

Discussion and conclusion

Looking Table 1 one can also notice that through all six rotations the variable serve reception (RECEP) and the variable spike (SPATT) have the highest average results. Serve reception is a precondition for winning a point in Complex 1. In other words, the higher quality of serve reception is, the easier is for a setter to organize setting, and for a spiker to win a point. Due to the high values of these variables, it is logical that the other variables, that are dependent, have lower average values (serve, block, defence). Further on , the phases of game in a certain rotation that are statistically important for the differentiation between the group of teams that was placed better from the one that was placed worse on the level of importance $p<0.05$ are singled out using t-tests.

Table 2 shows that in three rotations some variables proved to be statistically significant on the level $p<0.05$. Those are the variables that are recognised as the phase of game in block (BLOCK), the phase of attack after defence (SPCATT), and the phase of serve reception (RECEP).

However, one can also notice that the variable RECEP, except in rotation 5, has the high values of statistical importance ($p<0,06$ and $p<0,07$) in the first two rotations. This variable is recognized in game as reception of opponent serve. In professional volleyball, usually the team that receives serve (performs Complex 1) is in advantage over the team that starts the game with serve (Complex 2). According to Marelić et al. (1999), the positive serve reception in good-quality teams is about 60-70% of the total frequencies of serve, which means that Setter can organise the setting of fast balls from an ideal position on the net, which results in just one opponent's player in block, and in the end, with the advantage for spiker. Further, in Rotation 3 when a setter starts the game from the middle of the net (see positions in Table 2), statistically looking the variable BLOCK differentiates significantly the two groups of women cadets ($p<0.04$). That is interesting because in this rotation, beside Spiker 1 (S1), Central Spiker (CS1), there is also a Setter (S) in the block. Setter is the one who is under the biggest pressure in the block, because she has to stop the opponent's Spiker (S1) in the right end of the net. It is obvious that with a good serve of Spiker 2 (S2) the players in these playing positions were considerably better in performing a point-winning block and also the block after which counter-attack could be organized.

In Rotation 4 statistically significant differences ($p<0.05$) can also be noticed in the variable SPCATT, that is, in the phase of spike after defence. Similarly as in Rotation 3, Setter is in the block on the net together with Central Spiker 1 and Spiker 2. It is possible that together with the reasons mentioned before considering the previous rotation, the quality

of Diagonal Spiker's (DS) serve (in the majority of representations Diagonal Spikers were serving a strong jump serve) and their spikes from the back zone has brought a considerable advantage in the qualifications for semi-finals.

Analysing the differences between the positional parameters of six volleyball rotations on European cadet's championship, we tried to determine if there are statistically important differences between two groups of teams. The data were collected using a digital camera and processed with a specialized volleyball statistical program.

For that purpose, the descriptive parameters are calculated, and the analysis of differences is made using Student's t-test. All variables are normally distributed, which is checked with K-S test. The results of the series of t-tests conducted for every of six rotations show statistically important differences on the level $p<0.05$ in the following variables: in Rotation 3 when. *Setter* is in the starting position in the middle of the net, statistically looking the variable block - BLOCK differentiates considerably the two groups of teams, just as in Rotation 4 where the variable of the phase of spike after defence - SPCATT, differentiates considerably semi-finalists from the other teams. In the both rotations Setter is in starting position on the net. Then there are two spikers on the net, but also two spikers from the back zone - *Diagonal Spiker* that attacks from the zone 1 and *Spiker* that attacks from the zone 6. It is possible that the quality of serve and attacks from the back zone of the mentioned spikers contributes directly to the difference of the variables SPCATT - spike in counter-attack. In Rotation 5 the variable reception - RECEP differentiates considerably the two groups of teams on the level $p<0.05$. Although the points are not won with reception, this variable is in fact a precondition for a successful realization of the phase of setting and spike in attack with which the biggest number of points is won.

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EFFECT OF TEAM LEVEL ON VOLLEYBALL GAME ACTIONS PERFORMANCE

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Abstract

The present study aimed to analyze the effect of team level on the performance of the volleyball game actions. 65.949 actions from to 550 sets of Men's Senior World League (2005) were analyzed. The team's level was established in relation to the final classification of the team in the competition (level 1: 1st – 8th; level 2: 9th – 16th). The results show a distinctive performance according to team levels for the spike (t=2,918; p=0,004), block (t=2,009; p=0,045) and dig (t=-1,991; p=0,047). The present study shows that the spike is the action which is most correlated to the result of the competition. The best teams also had high performances in the attack and block, getting a balance in these two actions.

Key words: *volleyball, notational analysis, terminal actions, continuity actions*

Introduction

The top level male volleyball has changed essentially during the last years. In order to have changes in the rules (new scoring system and the creation of a new player, called Libero) the duration of matches has decreased and there is more balance between defense and attack (Yiannis, Panagiotis, Ioannis, & Alkinoi, 2004). The changes promoted by International Volleyball Federation (FIVB) are making the game more exciting, from a spectator's point of view, and bridging the gap between teams from different levels (Kountouris, 2005). Regardless of the rule changes, the game is constructed by a series of actions that are directly related to the team's performance and proficiency. In accordance to the studies done in this ambit, the spike has been showing a high correlation with the game victory (Eom & Schutz, 1992; Grgantov, Dizdar, & Jankovic, 1998; Marelic, Zufar, & Omrcen, 1998). However, only the study conducted by Palao (Palao, Santos, & Ureña, 2004) studied the game actions performance according to team's levels. Analyzing 33 male matches from 2000 Olympics Games in Sydney, the study shows that the performance of serve, reception, spike and block differentiated the team's levels (higher vs. lower). The present study aimed to analyze the effect of team level on the performance of the volleyball game actions (serve, reception, spike, block, set and dig), as measured by game-related statistics.

Methods

The sample was composed of 65.949 actions from 550 sets of Men's Senior World League (2005). The variables registered were serve performance, reception performance, spike performance, block performance, set performance, dig performance and team level. The team's level was established in relation to the final classification of the team in the competition (level 1: 1st – 8th; level 2: 9th – 16th). Game actions performance was evaluated in relation to the success and options that the actions gave to own team and the opponent's team. Data were obtained through official FIVB software "Volleyball Information System" (VIS). We differentiated two types of actions to categorize the performance: a) *Terminal Actions (TA)* (serve, spike and block), which distinguished three levels to categorize the performance: *Point* – action was a success and gave point for the team; *Continuity* – the ball was defended by opponent's team and still in game; *Error* – failed action or action that did not allow the option to continue (point for the opponent). b) *Continuity Actions (CA)* (reception, set and dig). We distinguished three levels to categorize the performance: *Excellent* – the actions gave all attack options; *Continuity* - the actions did't give all attack options; *Error* – failed action or action that did not allow the option to continue (point for the opponent).

With the categories of action performance, a performance coefficient is computed to the Terminal Actions (Figure 1) and to Continuity Actions (Figure 2).

$$\text{Coef\_TA} = \frac{4 \times \text{Points} + 2 \times \text{Continuity} + 0 \times \text{Error}}{\text{Total attemps (Points+Continuity+Error)}}$$

Figure 1. Performance coefficient for Terminal Actions (Spike, Serve and Block)

$$\text{Coef\_CA} = \frac{3 \times \text{Excellent} + 1{,}5 \times \text{Continuity} + 0 \times \text{Error}}{\text{Total attemps (Excellent+Continuity+Error)}}$$

Figure 2. Performance coefficient for Continuity Actions (Reception, Set and Dig)

To test the reliability, an independent observer of the VIS, observed 34 sets, corresponding to 12.36% of the total sets analyzed. Kappa of Cohen analysis and percentage of agreement demonstrated good inter-observer reliability which confirmed the accuracy of observations.

A descriptive and inferential analysis of the data was done using the software SPSS 14.0 (Independent-samples t-test) with a level of statistic significance of $p<.05$.

Results

The results show a distinctive performance according to team levels (Table 1) for the spike (t=2,918; p=0,004), block (t=2,009; p=0,045) and dig (t=-1,991; p=0,047). The teams belonging to level 1 showed higher performance in spike and block and lower performance in dig. The higher performance in spike due to the greater number of points (t=1,979; p=0,048) and the lowest number of errors (t=-2,226; p=0,026).

Table 1. Differences of Terminal Actions performances between team's levels

	Team Level[1]	Mean	Std. Deviation	t	Sig. (2-tailed)
Spike point	Level 1	12,68	3,23	1,979	,048
	Level 2	12,10	3,20		
Spike error	Level 1	4,02	2,10	-2,226	,026
	Level 2	4,45	2,17		
Spike continuity	Level 1	8,62	3,31	-2,174	,030
	Level 2	9,28	3,36		
Coefficient of spike	Level 1	2,70	,32	2,918	,004
	Level 2	2,61	,33		
Block point	Level 1	2,54	1,77	1,746	,082
	Level 2	2,27	1,56		
Block error	Level 1	5,66	2,70	1,468	,143
	Level 2	5,31	2,66		
Block continuity	Level 1	5,13	2,80	-1,049	,295
	Level 2	5,39	2,68		
Coefficient of block	Level 1	1,62	,50	2,009	,045
	Level 2	1,54	,45		
Serve point	Level 1	1,16	1,15	1,647	,100
	Level 2	1,00	1,06		
Serve error	Level 1	4,22	1,76	1,075	,283
	Level 2	4,05	1,69		
Serve continuity	Level 1	17,76	3,69	1,410	,159
	Level 2	17,28	3,83		
Coefficient of serve	Level 1	1,74	,17	1,045	,296
	Level 2	1,72	,18		

Legend: [1] n= 188 Level 1; 362 Level 2

In block, the higher performance was due to the lower percentage of actions that allow continuity (t=-2,114; p=0,035). The level 1 teams (Table 2) had lower dig performance because they make a higher percentage of actions with continuity (t=3,208; p=0,001) and a lower percentage of excellent actions (t=-3,030; p=0,003). There are no differences in serve (t=1,045; p=0,296), reception (t=1,209; p=0,227) and set (t=-1,259; p=0,209) performance according to team levels.

Table 2. Differences of Continuity Actions performances between team's levels

	Team Level[1]	Mean	Std. Deviation	t	Sig. (2-tailed)
Reception excellent	Level 1	10,06	4,22	1,177	,240
	Level 2	9,59	4,52		
Reception error	Level 1	1,05	1,18	-1,049	,294
	Level 2	1,16	1,20		
Reception continuity	Level 1	7,15	3,77	-1,662	,097
	Level 2	7,75	4,14		
Coefficient of reception	Level 1	2,53	,56	1,209	,227
	Level 2	2,46	,57		
Set excellent	Level 1	5,21	4,86	-2,351	,019
	Level 2	6,20	4,31		
Set error	Level 1	,27	,51	,497	,619
	Level 2	,25	,50		
Set continuity	Level 1	18,48	7,36	,057	,955
	Level 2	18,44	6,82		
Coefficient of set	Level 1	2,28	,48	-1,259	,209
	Level 2	2,34	,44		
Dig excellent	Level 1	3,81	3,80	-3,688	,000
	Level 2	5,12	4,03		
Dig error	Level 1	5,23	2,62	-2,670	,008
	Level 2	5,96	3,77		
Dig continuity	Level 1	5,64	4,19	1,732	,084
	Level 2	4,94	4,64		
Coefficient of dig	Level 1	1,71	,65	-1,991	,047
	Level 2	1,83	,69		

Legend: [1] n= 188 Level 1; 362 Level 2

Discussion and conclusion

The present study confirmed the earlier works (Eom & Schutz, 1992; Grgantov et al., 1998; Marelic et al., 1998) which indicated that the spike is the action which is most correlated to the result of the competition. The results of our study didn't confirm the results of Palao (Palao et al., 2004) because game action's serve and receptions, differenced the teams at the competitive level. These differences may be explained by two main factors: the fact that the samples are different (in the Olympic Games the teams levels are more homogeneous than in World League), and that Palao's study supposes three team levels: level 1: 1st - 4th; level 2: 5th - 8th; level 3: 9th - 12th, while our study only two.

The major conclusion that stands out is that the best teams had also high performances in the attack and block, getting a balance in these two actions. The low performance of best teams in dig is curious, indicating that teams with a weaker defense will not have such a disadvantage.

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DEVELOPMENT OF SPORT PERFORMANCE IN THE OLYMPIC GAMES WOMEN DISCUS THROW FINALISTS

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Abstract

The goal of this research study was to determine the curve of the development of Olympic results in women discus throw events from the year 1928 to the year 2004.

The sample of examinees on the basis of which this research study was conducted was comprised of athletes, top women discus throwers from various countries. The discus throwers were finalists of the Olympic Games from the year 1928 in Amsterdam to the year 2004 in Athens. This means that the sample for each Olympics was defined by a set of 8 athletes.

The results obtained in this paper say that in the women discus throw finals at the Olympic Games in Beijing 2008 the disc will be put on average 69,45 meters. This prognosis is based on the polynomial regression function, on the basis of the II degree polynomial.

Key words: *sport performance, women discus throw*

Introduction

The constant follow-up and the recording of the best results represent the basis for the analysis of these results and the rational prognostication of sport performance. The analysis of the progression of results is also important because it helps to identify the relationship between sport performance and the social, economic, technological and other factors that influence the development of sports (Wazni, 1978). The termination of the aforementioned progression of sport performance is not difficult in accurately measurable sport events (swimming, weight-lifting, athletics, etc.), where the results are achieved in standard conditions prescribed in the Regulations Book of the given event and are measured by accurate distance-measuring means and electronic devices. The progression of results in any sport may be observed from various aspects: the development of the best result in each year, the development of a world record and the development of results achieved at the Olympic Games. The competition in throwing events in athletics takes place in standardized conditions (weight of the implements, the diameter of the circle from which an implement is thrown, the length of the run-up, etc.) that are determined by the rules of the International Athletics Federation. The athletes are ranked on the basis of the results meticulously measured by means of accurate devices.

The dynamics of the progression of results in athletics is characterized by certain cyclic oscillations (Wazni, 1978). These oscillations are connected with the Olympic Games and with role that they have in sport. The Olympic Games represent an incident of a special encounter of various training systems and of the theory and practice of sports conditioning applied in certain countries.

Although the results achieved in athletics are suitable for the registration and for the follow-up of the progression of sport performance, as well as the prognosis of results, the survey of professional and scientific literature may help to conclude that not enough attention was paid to this issue (Harasin, 2002). A large number of factors influence the dynamics of a result in sports, so that no suggestion of an appropriate mathematical model that would explain the mechanism of this process can be accepted (Zatsiorsky, 1973). The tempo of the development of results depends primarily on the degree of the technical complexity of an event and on the technology of the conditioning training aimed at developing the capacities that are important for the given event (Wazni, 1978). The analysis of the progression of results in certain periods makes it possible to conclude that there exist four factors that influence the development of results in athletics: The level of the knowledge of the training processes, the changes that occur in athletics-related techniques, developmental characteristics of the population and the changes of sportswear and of sport equipment (Dyer, 1989).

The goal of this research study was to determine the curve of the development of Olympic results in women discus throw events from the year 1928 to the year 2004. The dynamics of the development of sports performance will be evidenced on the basis of collected final results achieved at all Olympic Games above mentioned. This dynamic will be obtained by analyzing the trend of the development of the mean of results achieved by the finalists. It will be attempted to determine the regularities that influenced the dynamics the progression of results in women discus throw. In order to

prepare an athlete that has the capacity to fight for an Olympic medal in the year 2008 one should at least approximately know what level of sport performance the competition will take place. This knowledge will make it possible for a coach to determine the model of preparedness of an athlete who is prognosticated to be able to achieve the anticipated result, to select the discus throwers and consequently to program and apply an adequate technology of the preparation process.

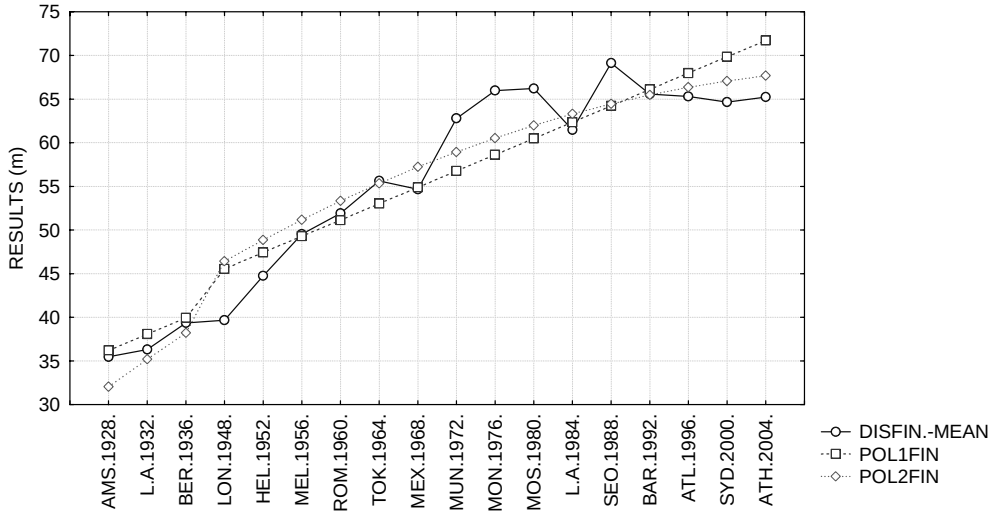
Research methods

The sample of examinees on the basis of which this research study was conducted was comprised of athletes, top women discus throwers from various countries. The discus throwers were finalists of the Olympic Games from the year 1928 in Amsterdam to the year 2004 in Athens. This means that the sample for each Olympics was defined by a set of 8 athletes. The data that will be used in this research study were taken from Complete Book of the Olympics (Wallechinsky, 2000) and from IAAF web sites. The collected data will be processed by the method algorithm and program for the analysis of trends by means of the program package Statistica 7.0. By means of the polynomial analysis the trend of the development of the mean results in the Olympic finals will be processed. On the basis of the polynomials of the I and II degree the one-dimensional changes of the state of a group of objects in which a change of one quantitative variable has been recorded will be analyzed for the period 1928- 2004. Additionally, the prognosis of the results for the Olympic Games in 2008 will be made by means of the II. degree of the polynomial regression function.

Results and discussion

The results at the Olympic Games in Amsterdam were, naturally, when compared to contemporary results, very poor. Continuous improvement of results in women discus throw events may be noticed. Although the progression of analyzed results is linear, the time intervals of a slower, that is, of a faster progress of achievements in sports (Graph 1) may be noticed. After 1968 the development of results progresses faster than before. This leads to the conclusion that a more contemporary system of sports preparation and particularly the participation of scientists from various scientific disciplines in creating the methods responsible for the best accomplishments in women discus throw competitions starts to significantly influence the results achieved in discus throw. At the Olympic Games 1984 in Los Angeles the results were poorer than at several Olympics before. The reason for this lies in the boycott of the Olympic Games by the Eastern countries (USSR, GDR, Poland, Bulgaria, Hungary and Czechoslovakia). Although, Western countries boycotted former Olympic Games in Moscow, that didn't influence the high level of competition and results, because the best discus throwers were from the Eastern countries. After that, at the Olympic Games in Seoul in 1988 a significant increase in the results achieved occurred in a very strong competition. After the Seoul the results showed the tendency of decrease. The reason is probably a stricter doping control introduced at the Olympic Games.

Table 1 displays the results obtained by the polynomial regression analysis of the mean of results of the women discus throw finalists. A higher correlation of 0,96 and the value of determination coefficient which is 91,89 of the explanation of the variance for polynomial analysis of the II degree, than results obtained by the polynomial analysis of the I. degree (R=0,94, R=88,06) leads to conclusion that the polynomial of the II degree better approximate the mean values of the results of women discus throw finalists than polynomial of the I. degree. Table 2 displays the mean values of original results and of the polynomials of the I. and II degree, as well the prognosis of the expected results for next Olympic Games in Beijing 2008.



Graph 1. Graphical presentation of the mean of the finalists' results on the basis of the polynomial regression analysis

Table 1. Results of the polynomial regression analysis

br.	MODEL	R	R	B0	B1	B2
1.	B0+B1*V1	0,93839	88,06	-864,765	0,467306	-
2.	B0+B1*V1+B2*V2**2	0,95860	91,89	-18105,0	18,00670	-0,004460

Table 2. Analysis and prognosis of the results of the finalists on the basis of the polynomial regression analysis

YEAR	ORIGINAL RESULTS	POLYNOMIAL OF THE 1. DEGREE	POLYNOMIAL OF THE 2. DEGREE
AMSTERDAM 1928.	35,48	36,20	32,05
LOS ANGELES 1932.	36,31	38,07	35,21
BERLIN 1936.	39,35	39,94	38,23
LONDON 1948.	39,67	45,55	46,42
HELSINKI 1952.	44,76	47,42	48,87
MELBOURNE 1956.	49,52	49,28	51,17
ROME 1960.	51,91	51,15	53,33
TOKYO 1964.	55,63	53,02	55,35
MEXICO CITY 1968.	54,67	54,89	57,22
MUNICH 1972.	62,77	56,76	58,95
MONTREAL 1976.	65,97	58,63	60,54
MOSCOW 1980.	66,23	60,50	61,99
LOS ANGELES 1984.	61,49	62,37	63,29
SEOUL 1988.	69,13	64,24	64,46
BARCELONA 1992.	65,57	66,11	65,47
ATLANTA 1996.	65,31	67,98	66,35
SYDNEY 2000.	64,66	69,85	67,08
ATHENS 2004.	65,23	71,72	67,67
BEJING 2008.		**73,58**	**69,45**

Coclusion

The development of results achieved by the women discus throwers finalists at the Olympic Games from the year 1928 to the year 2004 was analyzed in this paper. The sample of examinees was comprised of the best ranked discus throwers at each Olympic Games from year 1928 held until today. The basic data were processed by the polynomial regression analysis in such way that the mean of the values of the finalistsÌ results was analyzed. The analysis of the development of results on the basis of the polynomial of the II degree of the regression analyses shows a high statistical significance. The results achieved until 1980 show a tendency of a permanent faster or slower progress. Degradation of results was in 1984, because Eastern countries boycotted Olympic Games in Los Angeles. After, at Olympics in Seoul were at high level results because of strong competition. From 1988 the results start to decrease probably due to the fact that, on the one hand, the whole generation of discus throwers left the athletic arena, and on the other, that the stricter doping control was introduced. The results obtained in this paper say that in the women discus throw finals at the Olympic Games in Beijing 2008 the disc will be put on average 69,45 meters. This prognosis is based on the polynomial regression function, on the basis of the II degree polynomial.

The analysis of the development of results in women discus throw at the Olympic Games from the year 1928 to the year 2004 provided a multitude of useful pieces of information that may be used in practice in such a way that they may help the coaches, according to the prognosis of the results, to select and coach the future participants of the Olympic Games i women discus throw events.

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DIFFERENCES IN BASIC MOTOR ABILITIES AMONG YOUNG FEMALE TEAM HANDBALL PLAYERS

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Abstract

The success in the game of team handball is conditioned by the optimal development and relationship of certain abilities. The aim of this study is to determine differences in some basic motor abilities between young female handball players from different handball clubs in Zagreb and near Zagreb. Discrimination analyses determined three discrimination functions, two of which are statistically significant on the level $p<.01$. The first discrimination function explains around 68% variance of discrimination space, and it was mainly defined by the following projections of variables: sidestepping with turning for 180°, touch-toe astride, sidestepping, vertical two-feet take off from a standstill and horizontal jumping ability. The second discrimination function explains about 60% of variance of discrimination space, and it is mostly defined by projections of variables 20-m run from standing position, and throwing the 1 kg medicine ball.

Key words: *basic antroplogical characteristics, diskrtiminant analysis, young female team handball players*

Introduction

The optimal relationship and development of all functional and motor abilities and technical-tactical knowledge of young female team handball players are the basis of efficient performance of female handball players in situational conditions of the game of handball. Young female team handball players aged from 12-14 in respect of their development throughout years, are in the phase of formation of players (Bompa, 2000), which is characterized by systematic training process which aims at multifaceted development of basic motor abilities. Their improvement and later their stabilisation and maintenance, represent the basis in the hierarchy structure of success in handball. The level of basic motor abilities is necessarily seen as values which can guarantee uninhibited development and improving of specific situational motor abilities (according to Vuleta, Gruić and Ohnjec, 2007).

The values of data obtained from applying diagnostic procedures, must be implemented in basic components of planned and programmed sports training process in the following direction: selection of candidates who will participate in certain competitions, defining of conditions of one or more subjects in the direction of desired changes in abilities and knowledge, which make high competition efficiency possible for the sportsman, programming and training process which must ensure safe and economical passing from determined start position to the desired position, as well as comparison of values obtained to model parameters, i.e. with modalities of characteristics of top handball players (according to Vuleta, Milanović and Jukić, 1999). In discussions about obtained information on differences between groups of subjects, selection criterion and effects of long-term sports realization must be taken into consideration (Vuleta, Milanović et al. 2004).

The aim of this study is to determine differences in some basic motor abilities between young female handball players from different handball clubs in Zagreb and near Zagreb, who participating the same range of competition (regional national competitions for girls born at 1994. and younger).

Metods

The sample of this study consist of 58 young handball female players aged 12-14 who are playing in four different women handball team: Sesvete (17) from Sesvete – *Group 1*, Lokomotiva (12) from Zagreb – *Group 2*, Trešnjevka (13) from Zagreb – *Group 3* and Samobor (16) from Samobor – *Group 4*. The subjects were healthy and without any morfological or patological demages of locomotor system.

The set of variables involve 9 tests for evaluation of basic motor abilities presented in Table 1.

Tablica 1. The set of variables for evaluation of basic motor abilities

	Name	Description	Intentional measurement object
1.	MFE2OV	20-m run from standing position	speed power
2.	MFEBML	throwing the 1 kg medicine ball	explosive power of chest throw
3.	MFESDM	horizontal jumping ability	explosive power in the aspect of horizontal take-off
4.	MAGKUS	sidestepping	agility
5.	SARGENT	wertical two-feet take off from a standsill	explosive power in the aspect of vertical take-off
6	20 YARDI	stepping with turning for 180°	Agility- frontal
7.	MFLPRR	touch-toe astride	flexibility
8	ISKRET	overarm flip	flexibility of arms and shoulders
9.	MTRB30	Trunk lifting for 30’	Power of trunk banding

Within the descriptive analyses context central tendency and dispersive parameters (arithmetic means and standard deviation) of predictor set variables have been calculated for each group of subject separately. The differences between observed groups in tests of basic motor abilities have been determined by canonical discriminant analyses.

Results

Means and standard deviation of results on predictor set of variables for evaluation of basic motor abilities are presented in Table 2.

Table 2. Arithmetic means (AM) and standard deviations (Std.Dev.) of results on predictor set of variables for evaluation of basic motor abilities for each group of subjects

	Group 1		Group 2		Group 3		Group 4	
Variable	**AS**	**Std.Dev.**	**AS**	**Std.Dev.**	**AS**	**Std.Dev.**	**AS**	**Std.Dev.**
MFE2OV	3,51	0,19	4,02	0,15	3,84	0,25	3,59	0,31
MFEBML	7,64	1,17	6,21	1,05	6,73	1,15	7,46	1,00
MFESDM	174,96	10,37	178,08	19,30	150,41	25,80	172,27	27,15
MAGKUS	8,43	0,32	9,01	0,57	9,62	0,72	9,12	0,77
SARGENT 1	32,41	4,50	33,83	5,39	23,82	8,65	32,35	6,43
20 YARDI	5,32	0,18	5,41	0,33	5,92	0,29	5,56	0,32
MFLPRR	78,96	10,41	73,22	8,71	60,90	11,22	70,42	7,70
MFLIP	74,10	9,70	70,08	10,92	69,21	8,26	77,25	20,93
MTRB30	24,53	3,34	27,00	4,45	24,54	3,23	26,75	3,61

The results of canonical discriminant analyses with correspodending coefficient values are presented in Table 3.

Tablica 3. The results of discriminant analysis: eigenvalues (E), cannonical corelation (R), Wiks’ Lambda, chi-squared value (Chi-Sqr), degrees of freedom (df) and level of signifikance(p)

	E	R	Wilks’ Lambda	Chi-Sqr.	df	p-level
0	2,28	0,83	0,09	120,63	27	0,00
1	1,55	0,78	0,30	60,66	16	0,00
2	0,30	0,48	0,77	13,37	7	0,06

The discriminant factor structure of statstically significant discriminant functions are presented in Table 4.

Tablica 4. Discriminant factor structure (F) of variables

	F1	F2
MFE2OV	-0,13	0,66
MFEBML	-0,07	0,40
MFESDM	-0,31	-0,04
MAGKUS	-0,44	0,24
SARGENT 1	-0,36	-0,05
20 YARDI	-0,53	0,06
MFLPRR	-0,45	0,15
MFLIP	-0,04	0,11
MTRB30	-0,04	-0,16

Tablica 5. Groups centroids(D) on discriminant functions

	D1	D2
Grupa 1	-1,38	1,23
Grupa 2	-1,14	-2,15
Grupa 3	2,36	-0,10
Grupa 4	0,40	0,39

Table 5 and Figure 1 show the position of four groups centroids (arithmetic means of analysed groups) on the first and second discriminant function.

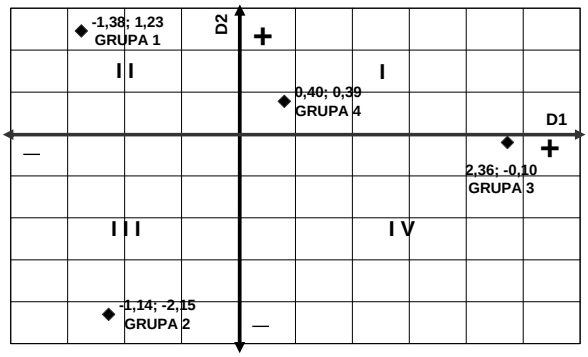

Figure 1. Groups centroid on the first and second discriminant function (D)

Table 6. Classification Matrix

	Correct	Grupa 1	Grupa 2	Grupa 3	Grupa 4
Grupa 1	82,35	14	1	0	2
Grupa 2	100,00	0	12	0	0
Grupa 3	76,92	0	0	10	3
Grupa 4	68,75	3	1	1	11
Total	81,03	17	14	11	16

Discussion and conclusios

Within the discriminant analyses three discriminant functions are calculated, out of which two are statistically significant at the level p<.01 (Table 3). About 68% variance of discrimination space are explained with first discrimination function and it is mainly defined by projections of the following variables: sidestepping with turning for 180° (20 YARDI), touch-toe astride (MFLPRR), sidestepping (MAGKUS), vertical two-feet take off from a standstill (SARGENT 1) and horizontal jumping ability (MFESDM) (Table 4). Features of groups on negative side of the first discriminant function are: better agility i.e. side and frontal ability to change the moving directions quickly and precisely, better flexibility of muscular and joint complexes of lower spine-pelvis-uper leg system, and explosive power of vertical and horizontal type. Groups on the positive side of first discriminant function are characterised by weaker frontal and side agility, flexibility and explosive power of vertical and horizontal type.

The second discrimination function explains about 60% of variance of discrimination space, and it is mostly defined by projections of variables 20-m run from standing position (MFE2OV), and throwing the 1 kg medicine ball (MFEBML). Features of groups on positive side of the second discriminant function are: better speed power and explosive power of chest throw, till the groups on negative side are in the same abilities weaker.

Separately analyses of groups (Table 5, Figure 1) regarding the position of groups' centroids on the first and second discriminant function, imply slighter differences between group 1 and 2 in respect of position on the first discriminant function, and greater differences towards group 4, and particularly towards group 3. Better agility, flexibility and explosive power of vertical and horizontal type are features of group 1 and 2, and vice versa, i.e. poorer results in variables, stated abilities, are features of group 4, and especially group 3. Second discrimination function differs groups 1 and 2 to a great extend, whereas it differs group 3 and 4 to lesser extend.

It is possible to predict to which group certain subject belongs, i.e. to classify the subject, on the basis of results in Table 6. Discriminant function classified all subjects from group 2 (100%) correctly. According to their abilites 3 players

from group 4 were classified to group 1, one player from group 1 and 4 in group 2, one player from group 4 was classified in group 3, 2 players from grou 1 were classified in group 4, and also 3 players from group 3 were classified to group 4.

This study confirms differences between young female team handball players of the same age who belong to different teams. Projection of data obtained in practice, should influence future actions of directing and selecting young female team handball players, and it should help in defining their basic motor abilities, as a basis for the follow up f specific and situational improving in the game of handball.

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CHANGES OF ANTHROPOLOGICAL STATUS OF CHILDREN IN WRESTLING SPORTS FOLLOWING A THREE-YEAR TRAINING-PROCESS

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Abstract

The presented work is the final work of a project named "Monitor of changes of children's anthropological status in wrestling sports", and its aim is to analyse changes of anthropological characteristics which are the result of active participation in the subjects' three-year training programme. The group of subjects was consisted of 30 athletes (11years old±6 months at initial testing, and 14years old±6months at final testing) who were engaged in wrestling sports (judo and wrestling) and who were tested at the beginning and at the end of the three-year training process. The reaserch consisted of a battery of 16 tests to evaluate anthropometrical characteristics, motor and functional abilities. The analysis of differences between initial and final status of the group of judokas and wrestlers points to statistically significant positive changes in all tests and it can be concluded with complete certainty that wrestling sports training positively influences on the development of the all analysed motor and functional abilities and to a great extent positively directs the morphological development.

Key words: *judo, Greco-Roman wrestling, training, motor abilities, functional abilities*

Introduction

Although the popularity of a sport probably does not depend on its dominantly positive influences on anthropological status but on the series of other factors, it is still necessary to prove all the positive aspects of training of judo and wrestling.

Already published research can point to the positive influence of wrestling sports training on the anthropological status. Sekulić et al. 2006 establish positive shifts at the 7-year old boys after nine months of training judo. In the research which includes judo wrestlers 11-17 years old, Jagiello, Kalina and Tkaczuk 2004, point to the progress in strenght after training in a preparatory period, and Clark et al. 1984, proves that wrestling training influences on the growth of strength at 7 – 9 year-old chldren.

This work is also going towards that direction, and as the final work of the project named "Monitor of changes of children's anthropological status in wrestling sports" has its aim to analyse the changes of anthropological characteristics at the subjects who finished a three-year training programme. The secondary goal was to define which part of the anthropological status was mostly enclosed during the three-year training process and which and how extensive changes happened in that segment.

Methods

The experimental group (30 subjects) was consisted of those athletes (17 judo wrestlers and 13 wrestlers) who started and finished the three year training process (in the period between their 11±6 months to 14 years±6 months) in wrestling sports. The analysed group of subjects was only one part of the tested subjects who were included in the project "Monitor of changes of children's antropological status in wrestling sports" because unfortunately the speciment of the experimental group disintegrated, i.e. the children gave up on judo and wrestling training. The control group of the subjects in this research consisted of 28 (in the period between their 11±6 months to 14 years±6 months) boys who were not doing any organized sports activity during three years except in PE classes.

A battery of sixteen tests (16) was applied in this research to evaluate:

anthropometrical characteristics (ATV – body mass, ATT – body weight, AOP – forearm circumference, ANN – upper arm skinfold), motor abilities, coordination, (ONT – agility on the ground, KUS – side-steps, MPN – obstacle course backwards), flexibility (MPR – sit-and-reach), speed of movement (hand tapping), power muscular endurance (MSD – standing broad jump), repetitive strenght (MPT60 – sit-ups, SKL60 – push ups, CUC- squats), specific endurance(BAC90 – throw+two push ups in 90 seconds), static muscular endurance (MIV – bent-arm hang), and functional abilities (F6-six-minute run). The judo wrestlers and wrestlers boys were tested by the battery of 16 tests and the control groups

were tested by 11 tests used in PE classes in Croatian elementary schools. The description of the standard tests for the evaluation of anthropological characteristics in education in the Republic of Croatia was provided by Findak et al. 1996, and the specific tests for judo and wrestling has already been described together with the mentioned project ("Monitor of changes of children's antropological status in wrestling sports", project number No. 0034214, main researcher prof.dr.sc. Sertić, H.).

The tests were conducted by educated measurers of the Faculty of Kinesiology.

The data were processed in the statistical package Statistica for Windows, version 5.0, using discriminative analysis, multivariate analysis of variance (MANOVA) and t-test for dependent and independent samples.

Results

Table 1. Discriminant function analysis results of experimental group

	d2	F	p
DF	32,62	29,53	**0,00**

Legend: d2 squared distance between the centroids of groups, F-validity of f-tests, p-error

Using discriminatory analysis the existance of statistically significant difference of the experimental group of subjects between the initial and final testing was established (table 1).

Table 2. Multivariate analysis of variance between initial and final testing of experimental group

VAR	INITIAL MEAN±SD	FINAL MEAN±SD	F-TEST RESULTS	P
ATV	153,277±7,6631	168,707±7,6136	257,31	**0,00**
ATT	44,603±9,8334	58,047±11,8848	145,18	**0,00**
AOP	21,517±2,1884	24,382±2,4085	142,79	**0,00**
ANN	12,087±5,0506	10,233±3,9819	6,05	**0,02**
MPN	13,846±3,3844	10,769±2,8665	51,59	**0,00**
MPR	55,333±8,0374	61,342±6,9424	15,28	**0,00**
MSD	173,133±18,8821	203,000±25,8950	106,93	**0,00**
MTR	26,867±2,6618	31,767±3,2022	68,55	**0,00**
MIV	32,271±19,3496	50,793±21,6507	40,09	**0,00**
MPT60	40,200±7,5265	48,567±7,7712	29,61	**0,00**
ONT	20,980±3,9892	16,242±4,9392	42,30	**0,00**
KUS	11,243±0,9630	10,202±1,0026	33,22	**0,00**
BAC90	12,033±2,7852	14,167±2,5200	16,82	**0,00**
SKL60	20,267±10,3722	32,833±13,1072	30,58	**0,00**
CUC60	44,833±6,6129	52,700±4,7135	43,44	**0,00**
F6	1063,000± 123,1251	1293,500±121,5857	65,60	**0,00**

Legend: VAR-variables, INITIAL /FINAL MEAN±SD-arithmetic mean at initial and final testing±standard deviation, F-Test results, p – error

Table 2. represent influence of each test on differentiating experimental group after three years of training period. All tests achieved a significant positive shift after between this two time lines.

Table 3. Difference between experimental and control group at initial testing

	Mean E	Mean C	t	df	p
ATV	153,277	150,368	1,38128	56	0,172678
ATT	44,603	41,479	1,21940	56	0,227803
AOP	21,517	20,904	1,10236	56	0,275022
ANN	12,087	12,833	-0,39693	56	0,692926
MPN	13,846	16,392	-2,63679	56	0,010811
MPR	55,333	48,738	2,93468	56	0,004834
MSD	173,133	160,500	2,40863	56	0,019328
MTR	26,867	24,976	2,67890	56	0,009679
MIV	32,271	25,354	1,42669	56	0,159222
MPT60	40,200	28,750	5,80987	56	0,000000
F6	1063,000	1009,893	1,47742	56	0,145164

Legend: Mean E – arithmetic mean of experimental group; Mean C – arithmetic mean of control group; t – t value; df – degrees of freedom; p – error.

Table 4. Difference between experimental and control group at final testing

	Mean CS	Mean A	t-value	df	p
ATV	168,707	159,089	4,18209	56	0,000103
ATT	58,047	47,789	3,26740	56	0,001857
AOP	24,382	21,782	4,13648	56	0,000119
ANN	10,233	13,571	-2,04799	56	0,045261
MPN	10,769	14,773	-5,12630	56	0,000004
MPR	61,342	46,583	7,32800	56	0,000000
MSD	203,000	178,548	4,11678	56	0,000128
MTR	31,767	28,048	4,29272	56	0,000071
MIV	50,793	34,447	2,77532	56	0,007483
MPT60	48,567	34,929	7,60066	56	0,000000
F6	1293,500	1067,000	6,66634	56	0,000000

Legend: Mean E – arithmetic mean of experimental group; Mean C – arithmetic mean of control group; t – t value; df – degrees of freedom; p – error.

Discussion and conclusions

Variance analyses between the initial and final status in the experimental group judokas and wrestlers point to a statistically significant positive shift in all tested characterstics and abilities of anthropological status. It can be concluded with certainty that wrestling and judo training of 11 and 14-year-old boys, three times a week, 75-90 minutes, brings greater positive changes than doing sports activities only in PE classes in primary schools. The evidence that doing sports activities only twice a week is not enough to bring significant changes in anthropological status shows the research where it is demonstrated that changes are greater as the training period of judo wrestlers and wrestlers is longer. (Vračan, Sertć, Baić 2004; Cvetković, Sertić, Marić, Pekas, Baić 2004; Baić, Sertić, Segedi 2005). Testing the difference between the experimental and control group (table 3 and 4) show that at the end of the three-year training period, the significant difference is present in all tested variables which confirms above mentioned conclusion. Differences in anthropometrical characteristics between the experimental and control group, regardless genetic conditionality of changes, indicates that judo wrestling and wrestling training direct more regularly the body growth and development by the reduction of subcutaneously fatty tissue (variable upper arm skinfold ANN at the beginning of the measurement does not indicate differences between the experimental and control group, and at the end of the three-year training process these differences are statistically sigificantly better in favour of the experimental group) and by the increase of muscular mass for which is forearm circumference a good indicator in case of upper arm skinfold reduction. There are differences between the two subject groups already at the initial testing of some motor abilities (coordination, flexibility, power muscular endurance of legs, and speed of hand movements). The differences are even bigger at the end of the three-year training period. The most interesting to follow is the dynamic of motor abilities development during the three-year training of wrestling sports. Development dynamic of certain abilities and characteristics of children in wrestling sports can be followed analysing the already published project data.

Only after one year of training period, boys in wrestling sports reach the significant growth of abilities, but one part of the motor space has not been yet included in these changes. There are no statistically significant changes in variants to evaluate flexibility, specific endurance, relatively dynamic muscular endurance of legs and upper arm skinfold. (Sertić, Segedi, Baić 2005).

Properly aimed training at the age of 11 does not imply great emphasis on specific endurance and strength, threfore there are less changes of these abilities.

After two years of the training process statistical significant changes are seen in all variables except in the area of the specific endurance estimated by a variable plus two push-ups in 90 seconds (BAC+2SKL). (Vračan, 2007)

Three-year effects of training (table 4) finally include this part of motor space so it can be concluded with great certainty that wrestling sports training positively influences on the development of all tested motor and functional abilities, and to a great extent positively directs the body growth and development.

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CONSTRUCTION AND VALIDATION OF A MEASUREMENT INSTRUMENT FOR EVALUATION OF SPECIFIC AGILITY IN KARATE

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Abstract

Agility has proven to be a very important component of sports success, therefore it is certain that in specification equations of different sports, complex and conventional, as well as monostructural and polystructural, takes a high position. Some authors think that tests taken over from other sports will not be an indicator good enough for karatekas, therefore there has been developed an idea to construct a new test to evaluate specific agility in karate. The main goal of this work is a construction and validity of a measure instrument for evaluation of specific karate agility. After the validation of the new measure instrument it has been shown that the measure instrument *MAGKDJ* is realible and stable enough, homogeneous, sensitive (it discriminates well enough subjects according to a treated ability), it is factually valid (test for the evaluation of agility is factually clear).

Key words: *diagnostics, trainability, motor abilities, evaluation*

Introduction

Agility is defined as an ability of a quick shift of movement direction (Greek – agilis – agile, diligent, fast, quick). For the benefits of a sport, and especially training conditioning, agility can be defined as an ability of a fast and efficient shift of the body in space under conditions of sudden stopping and shifting of the movement direction (Metikoš et al., 2003).

Without using a large number of instruments for evaluation of coordination, it is not possible to obtain a valid structure of coordination factor.

Trying to establish the latent structure of a greater number of motor tests of agility evaluation, Metikoš and his associates have isolated five latent dimensions which were named as following:

Agility in performance of different movement directions shifts in small space

Agility in conditions of simple frontal and lateral movements

Agility in rotation

Agility in frontal and lateral movements with direction shifts up to 90^0

Agility in frontal movements with direction shifts of more than 90^0

Agility has proven to be a very important component of sports success, therefore it is certain that in specification equations of different sports, complex and conventional, as well as monostructural and polystructural, takes a high position. Only by looking at the division of the latent structure of agility indicates that it is extremely demanding, as well as specific, to measure agility for any sport. Therefore, there is a need for tests which by their structure can reach specific requirements of a certain sport (in this case karate). Some authors think that the tests taken over from other sports will not be an indicator good enough for karatekas, therefore there has been developed an idea to construct a new test to evaluate specific agility in karate. The main goal of this work is the construction and validity of a measure instrument for evaluation of the specific karate agility.

Research methods

The subject samples were consisted of 36 male karatekas and 11 female karatekas members of the Karate club "Princ". The subjects were aged 12±2,5 and had been training karate for at least a year.

The test serves to evaluate agility of karatekas who have at least one year experience in training and have already acquired specific karate movements (moving in karate position and hand punch gjaku tsuki).

The variable sample is consisted of three standardized measure instruments for agility evaluation:

MAGOSS – figure of eight with a bend test (Momirović et al., 1971, in Metikoš et al., 1989)

MAGKUS – side steps test (Momirović et al., 1971, in Metikoš et al., 1989)

MKRCET – square movement test

Newly-designed measure instrument for agility evaluation:

MKSDJ – movement in karate position with a gjaku tsuki punch

Description of the newly-designed test: Movement in karate position with a punch (MAGKDJ)

1. Duration: evaluation of the complete duration of a test for one examinee is one and a half minutes
2. Number of measurers: 1 measurer
3. Equipment: one stop-watch, adhesive tape for the floor mark
4. Position of performance: a task is performed in a room or outdoors (with straight or hard ground) minimum dimensions 5x2 meters. There are two parallel lines to the ground 1 meter long and 2 meters distant from each other. The examinee stands in a combat karate position fudo dachi in guard within the lines vertically to the first line.
5. Performance: the exercise is performed in the standing position, and it is required that the examinee on the "go" sign turns as fast as possible through 180 degrees and in a hop-step movement sori ashi, without crossing the legs, moves towards the second line. When he or she steps on the second line or crosses it, he or she stops and performs gjaku tsuki punch and returns to the first line in the same way which he also has to touch with his/her foot or cross it and again do the gjaku tsuki punch. The movement is repeated six times.
6. Position of the examiner: the examiner sits next to the examinee, controls the validity of the performed assignment.
7. Evaluation: time is measured in one-tenth of a second from the "go" sign until the end of the sixth crossing of the two-meter track. The assignment is performed three times with an adequate break and all three performances are scored.
8. Guidlines to examinees: "Stand in the left fudo dachi karate position with your front leg on the marked line. On my sign "hop" you will turn through 180 degrees and in side-steps, without crossing your legs, you will move towards the second line. When you step on the second line or cross it over, you will stop, make a gjaku tsuki punch and go back the same way to the first line, which you also have to touch with your foot or cross it and again perform a gjaku tsuki punch. You move repeatedly so that you have to touch the line six times in a short period of time, after that, the assignment is finished."
9. Practice: the examinee is entitled to one try.
10. Comment: the punch is valid if the body is vertical to the ground and during a gjaku tsuki punch the hip rotates.

In data processing the statistical package STATISTICA/W 5.0 will be used.

Central parameters, disperision parameters, and indicators of distorted parameters will be analysed from descriptive statistics. The normality of the distribution was tested by the Kolmogorov-Smirnov test.

Validity, i.e. evaluation of metric characteristics of the newly-designed measure instrument will be conducted in order to establish sensitivity, reliability, homogeneity and factor validity.

Results and discussion

Table 1. Descriptive parameters of the first measurement particles

VAR	Valid N	Mean	Min	Max	Std.Dev.	Skewness	Kurtosis
MAGKDJ1	47	6,863830	4,200000	10,66000	1,585857	0,282120	-0,262837
MAGKDJ 2	47	6,690638	4,000000	10,31000	1,523789	0,216217	-0,440710
MAGKDJ 3	47	6,512128	3,960000	10,37000	1,483493	0,374176	-0,264912

Legend: VAR- variables, Valid N- nuber of participants, Mean-average score, Min-minimum score, Max-maximum score, Std.Dev.-standard deviation

Distribution and its form indicate a degree of sensitivity of the measure instrument. The value of skewness in MAGKDJ particles are around 0.29 which indicates a positive asymmetry of the frequence distribution and basically shows that the assignment is slightly more difficult than it is optimal. The value of kurtosis indicates deviation of the noted distribution from the normal but only in the sense of elongation.

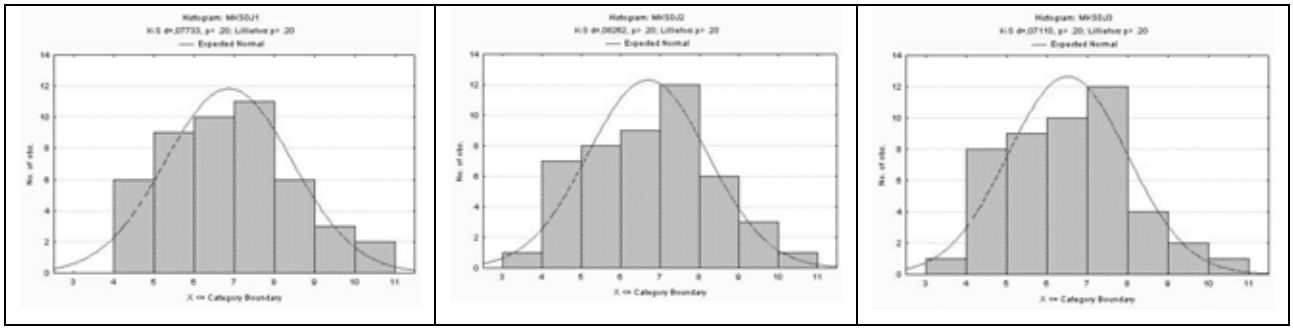

Figure 1. Graphic image of the subject results according to particles in the MAGKDJ test

Since the Kolmogorov-Smirnov normality distribution test indicated that the noticed divisions do not differ from the normal ones, it can be concluded that the measure instrument MAGKDJ meets the standards of sensitivity, that is, ability of distincting entities according to the tested capability.

Table 2. The results the Kolmogorov-Smirnov test for the evaluation of normality distribution

VAR	N	max D	K-S
MAGKDJ 1	47	0,077	p > .22
MAGKDJ 2	47	0,083	p > .22
MAGKDJ 3	47	0,071	p > .22

Legend: K-S -*Critical (table) KS-test value based on the entity number with the degree of error of 0,01, max D-Maximal distance

Table 3. Correlation matrix between particles of the MAGKDJ test in the first measurement

	MAGKDJ 1	MAGKDJ 2	MAGKDJ 3
MAGKDJ 1	1,00	**0,94**	**0,95**
MAGKDJ 2	**0,94**	1,00	**0,95**
MAGKDJ 3	**0,95**	**0,95**	1,00

Table 4. Coefficient of reliability, representativeness and homogeneity of the MAGKDJ test

RTT	0,982275
ALPHA	0,982276
ALPHA1	0,42883
ALPHA2	0,880872
LAMBDA6	0,973929
RHO1	0,948538
RHO2	0,99932
TAU	0,948472
MSA	0,998496
AVR	0,948647
HOM1	0,991278

RTT – reliability calculated under the circumstance of an equal share of all particles in the proper subject of measurement, ALPHA – reliability calculated on the basis of the first inherent matrix correlation value, ALPHA 1 – bottom reliability limit, ALPHA 2 – top reliability limit , LAMBDA6 – Guttman-Nicewander's reliability measure, RHO1 – bottom reliability limit - , RHO2 – top reliability limit, TAU - bottom reliability limit, MSA Kaiser-Rice's representative coefficient, AVR average correlation between the particles that can be used as a homogeneity standard, HOM1 – Momirović and Gredelj's homogeneity coefficient.

The *MAGKDJ* test has been used three times and to establish the reliability the internal consistence method will be used.

A module for reliability evaluation (Statistica W/5.0) was used to calculate Cronbach α, and it is 0,9817. In the analysis of the reliability test *MKUKS* the coefficients of reliability are as following: Cronbach α: 0,917 and standardized α: 0,982. Coefficients as high as these, especially the first one, indicate high reliability of the *MAGKDJ* test.

Based on the matrix correlation between particles, and under a classic measurement model using the RTT.stb programme (Dizdar 1999) following measures have been calculated. (Table 4)

There has been established a statistically significant correlation between *MAGKUS, MKRCET, MAGOSS* and *MAGKDJ* tests by the cross correlation matrix of the subjects results condensed in the first main component of these tests. (Table 5)

Table 5. The cross correlation matrix of the subject results condensed in the first main component of the MAGKUS, MKRCET, MAGOSS and MAGKDJ tests (N=47).

	MAGKUS	MKRCET	MAGOSS	MAGKDJ
MAGKUS	1,00	**0,80**	**0,48**	**0,90**
MKRCET	**0,80**	1,00	**0,49**	**0,78**
MAGOSS	**0,48**	**0,49**	1,00	**0,61**
MAGKDJ	**0,90**	**0,78**	**0,61**	1,00

A common factor with very high correlations of variables with a factor (>0,70) (table 6.) has been produced by factor analysis of the tests *MAGKUS, MKRCET, MAGOSS* and *MAGKDJ* according to the G-K extract criterion. Based on these results it can be concluded that *MAGKUS, MKRCET, MAGOSS* and *MAGKDJ* tests measure the same dimension, and that the *MAGKDJ* test is a factually valid test.

Table 6. The correlation matrix of the subject results condensed in the first main component of the MAGKUS, MKRCET, MAGOSS and MAGKDJ tests with factor (N=47).

VAR	Factor
MAGKUS	-0,927745
MKRCET	-0,888243
MAGOSS	-0,710615
MAGKDJ	-0,952277

Table 7. The correlation matrix of the subject results in the MAGKDJ test with factor (N=47)

VAR	Factor
MAGKDJ 1	-0,980962
MAGKDJ 2	-0,982852
MAGKDJ 3	-0,984198

By the factor analysis of particles of the newly-designed measure instrument it can be noted that all three particles have high projections on the same factor (Table 7), i.e. they measure the same abilities. The results on the factor of all three particles are very high so we can talk about very high validity of all three particles. A negative sign in correlation with the factor is the result of a reversed scaling of all measure instruments (less value on the test represents a better result).

Conclusion

The reaserch conducted on the sample of 47 male and female karatekas and with a purpose to construct and evaluate a new measure instrument of agility evaluation has produced satisfactory results. The measure instrument MAGKDJ is reliable, stable enough, homogeneous, sensitive (it discriminates well enough subjects according to a treated ability), it is factually valid (factually clear test for the evaluation of agility). The conclusions of the measure characteristics of the MAGKDJ test have been drawn based on the results analysis with the help of Kolmogorov-Smirnov test for the evaluation of the normality of distribution, RTB.std test by which it has been established a high reliability, homogeneity as well as representativeness and factor analysis by which the factor validity of the new test has been evaluated. The results of the analyses have pointed to high coefficients of reliability, homogeneity, validity and representativeness, therefore it can be concluded with great certainty that MAGKDJ is a test with very good measure characteristics and as such can be used in practice, i.e. training process with aim to evaluate specific agility of karatakas.

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EQUIVALENCY LEVEL OF SCORING EVALUATION OF THE EVENTS IN ATHLETIC HEPTATHLON

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Abstract

Suitability of the actual combined event scoring tables was analyzed. The level of equivalency was determined between the valorization of the results across the events and among the heptathlon groups of events. The scale is also made of proportional relationships of the heptathlon events' evaluations in relations to the 1 cm increase in high jump and the progressive point increase scale of the heptathlon events' evaluations across the achievement point levels in relation to the achievement equivalents. The achievement valorization point increase scale in the run events appertains to the type of parabolic dependence with expressed point progression; the same scale in the jump events is of the type of parabolic dependence with less expressed progression, whereas in the throw events the scale is parabolic with insignificant progression. The level of valorization progression of results across events and among the events' groups is variably expressed across the segments of the scoring scale.

Key words: *combined event, athletics, scoring tables*

Introduction

Complex, combined event competitions (all-round competitions) in various events of the same sport, or in the events of various sports, give oportunities for more comprehensive manifestation of humanity in sport. Within the theory, or, better, within the philosophy of sport, a lot of questions are put and many answers are seeked for regarding comprehensive development of a human being and his/her universal manifestation. The concept of athletics implicitly understands athletic and psychomotor versatility and body composition suitability. Individual specialist events include a whole spectrum of natural movement forms (walking, running, jumping, and throwing). Opposite to them are the combined event, as their counterbalance and a symbol of versitality.

From the Greek pentathlon to the modern decathlon and heptathlon, in athletics is constantly accentuated a tendency to widen the space of versatility to all typical athletic events which presents natural forms of movement in order to widely manifest psychomotor potential within the prescribed sports techniques. Athletes in combined, composite events manifest their maximal versatile psychomotor potential.. We must determine typical efficacious structures of interrelations amongst events by which athletes realize their actual versatile potential. Besides high efforts to establish and manifest the balanced strucrture of psychomotor qualities, sports practice evidences that high ranked heptathlon athletes have specific typological characteristicics and are highly specialised just in one event group of the combined event, or in the combination of particular events.

It is a matter of complex manifestations and mutualrelationships of psychomotor qualities which are manifested within one event, as well as in a set heptathlon sequence of events. It is presumed that there is a complex non-linear functional dependence among the heptathlon events and that it should be respected within the personal typical taxonomic structure, which a particular heptathlon athlete enables her highest competition achievements. The specialty of the composite combined athletic event is that the final result is expressed in points, therefore, sports theory and practice should find the answers to the following questions: 1) does the actual heptathlon scoring system and to which extent pins up manifestation of universal and athletic versatility; 2) is equivalent progressive evaluation of events in heptathlon realized and to which extent, 3) how much does scoring system predetermine interrelationships among the heptathlon events and to which level is it in accord with the natural interrelationships of psychomotor qualities in women. Last, but not the least important - the crucial question should be asked: is modern heptathlon really an athletic event in which female athletes can maximally manifest their versatile psychomotor and functional abilities? We must reconsider the role and influence of the actual scoring system on either encouraging, or limiting natural manifestation of female heptathlon athletes.

Scoring tables are extremely important for achievement evaluation and training programming. Their construction directly and indirectly influnces the development these composite events, and their frequent changes change attitudes towards combined events. Revisions of the combined events achievements evaluation systems, from the first "All-round Championships of America" scoring tables with linear progression to the establishment of actual IAAF scoring tables for decathlon/heptathlon in 1985, which are based on the principle of "progressivity", were results of numerous

scientific research studies aim of which was to find as efficacious solutions as possible and to remove inconsistencies which hindered manifestation of versatility in combined events (Bowerman, 1995; Tidov, 1989; Jiyingo & Xinmin, 1995; Milanović, 1983; Smajlović, 2005). One of the quintessential questions is a system of progressive equivalent evaluation of achievements both across individual events and branches to which they appertain. The purpose is to guarantee a true versatile development.

The basic subject here is to determine the level of the equivalency of the evaluation of the achievements across events and among the groups of heptathlon events by using the actual combined event scoring tables in order to establish proportional relationship among validations of achievements in heptathlon events and in that way to motivate improvement of general and heptathlon versatility.

The assessment of the pro and contra influence of the actual scoring system on maximal development and manifestation of natural potential of either heptathlon or decathlon athlete demands the identification of the natural and prescribed structure according to the relationships and absolute values of heptathlon achievements and the determination of their correlation to the level and the structure of most successful worl athletes. Various authors who discussed numerous issues related to the actual IAAF scoring table (*Xinmi & Jiyingo*, 1995) agreed on the need of their re-compilation.

Methods

The proportionality of point valorization of the heptathlon events was determined in relation to the magnitude of the increase of the result in each event in relation to the 1 cm increase in the high jump event. Equivalents of point evaluations of the heptathlon events are derived in such a way that for each event a range of points was determined for point values – from one point to 1,400 in centimetres or seconds. On the basis of correlations of the magnitude of the range of each heptathlon event, according to the range magnitude in the high jump event the increase equivalents were obtained. Increase coefficient constant values were analysed in the coordinate Log-Lin system.

Results

Training programme and career planning depends a lot on achievement evaluation using IAAF scoring tables; therefore we made the scale of proportional evaluation relations of events by means of IAAF heptathlon scoring tables system (Table 1). The proportionality of heptathlon events' point valorization was determined with regard to the achievement increase magnitude in each event as compared to the 1 cm increase in high jump event.

The equivalents of point valorization of the heptathlon events are derived so that for each event the range of results was determined for point values – from one point to 1,400 points in centimetres or seconds. On the basis of the mutual relationships of the range magnitude in each event in relation to the range magnitude in the event high jump the imcrease equivalents were obtained.

Table 1. Scale of proportional relations of heptathlon events evaluation

Events	Point min-max	Results	Difference min-max	Equivalent
High jump	1	76 cm	136 cm	1 cm
	1.400	212 cm		
100 m hurdles	1	26.4 s	15.15 s	0.111 s
	1.400	11.25 s		
200 m	1	42.08 s	22.11 s	0.162 s
	1.400	19.97 s		
800 m	1	250.79 s	148.39 s	1.09 s
	1.400	102.4 s		
Long jump	1	214 cm	552 cm	4.06 cm
	1.400	766 cm		
Shot put	1	153 cm	2141 cm	15.74 cm
	1.400	2294 cm		
Javelin throw	1	387 cm	7370 cm	54.19 cm
	1.400	7757 cm		

Equivalent values practically means that the progress of 1 centimetre in high jump is equal to the progresss of =.111 s in 100 m hurdles, or 54.19 cm in javelin throw, etc. These data may become leading in orientation of training programmes.

Further analysis of IAAF combined event tables reveales the fact that t achievements at the starting level of 100 points are evaluated differently from their result equivalents (Table 2). At the level of 100 points achievement equivalents got the highest evaluations in the throwing events (9.53 - 9.68), then in the jump events (6.75 - 7.02), and the lowest evaluations are for the run events (5.58 - 5.68). Achievements at the level of 1400 points are evaluated in the following relations.

Table 2. Heptathlon events scoring equivalents progressive increase across the levels ranging

Events	800m	200m	100 m hurdles	Long jump	High jump	Javelin throw	Shot put	Points level
Equivalent	1.09s	0.16s	0.11s	4.06cm	1.00cm	54.19cm	5.74cm	
	5.58	5.68	5.64	6.75	7.02	9.68	9.53	100
	7.70	7.73	7.71	8.24	8.38	9.93	9.85	200
	9.30	9.25	9.26	9.26	9.30	10.09	10.04	300
	10.63	10.51	10.54	10.06	10.01	10.20	10.18	400
	11.79	11.61	11.66	10.73	10.60	10.29	10.28	500
	12.84	12.59	12.66	11.31	11.10	10.36	10.37	600
	13.79	13.48	13.58	11.82	11.55	10.42	10.45	700
	14.67	14.30	14.42	12.29	11.95	10.47	10.51	800
	15.50	15.07	15.21	12.71	12.32	10.52	10.57	900
	16.27	15.80	15.95	13.10	12.65	10.56	10.62	1000
	17.01	16.48	16.65	13.47	12.97	10.60	10.67	1100
	17.71	17.13	17.32	13.81	13.26	10.63	10.72	1200
	18.38	17.75	17.96	14.13	13.53	10.67	10.76	1300
	19.03	18.34	18.57	14.44	13.79	10.70	10.79	1400

100- 1400 points

The highest evaluations are given to the achievement equivalents in running events (18.34 - 19.03), then those in jumping events (13.79 - 14.44), and the lowest evaluations are given to the equivalents in throwing events (10.70 - 10.79).

Progresion of achievement point evaluation, ranging from 100 to 1400 points, are represented with logarithmic curves as well. Two levels of parabolic functional dependences and one type close to the linear regression is obvious. The point increase in running events appertains to the parabolic type dependence of the expressed progression; the point increase in the jumping events is of a parabolic dependence of a less expressed progression, whereas in the throwing events the point increase is also parabolic of an insignifican progression. Increase coefficient values (d) depict the level of progress of point evaluation across heptathlon events, which ranges from 0.894 for javeline throw to 12.134 for 800 m race. The lowest constant in the coordinate Log-Lin system has the events of running 4.103 - 4.344), jumping (6.206 - 6.594), and throwing 9.517 - 9.667).

Discussion and conclusion

The scale of point increase of achievement valorization of the run events appertains to the type of parabolic dependence with expressed progression, point valorization in the jump events is the type of the parabolic dependence with less expressed progression, and the point valorization in the throw events is also parabolic with a trifle progression. The grade of results' valorization progression across ther events and among the groups of events is variably expressed across the segments of the scoring scale which is especially important for the sports practice due it is a basis for strategy and dynamics of sports preparation planning.

Actual heptathlon score tables are based on non-equivalent minimal (starting) intrrelationships of results of the event evaluation scale and they do not reflect natural mutual relations which are crucial for the manifestation of maximal combined event potential. The obtained results confirmed the hypothesis that the application of the actual IAAF scoring tables predetermined the structure of the interrelations of the heptathlon events.

By accepting a better evaluation of certain events or group of events, coaches and athletes, to who sports achievement is the primary goal, denie, betray the declared primordial concept and the inherited purpose of the combined events.

The consequence is that nowadays we are witnessing thath top level ranking heptathlon athletes have specific typological characteristics with high level of specialization in in only one group of events, or in combination of events, instead of having women athletes with high quality in every event. Therefore, a serious reconsideration should be focused on scoring system in decathlon and heptathlon.

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THE HIERARCHY OF MOTOR FACTORS OF THE SPORT'S PERFORMANCE STRUCTURE IN YOUTH JUDO

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Abstract

The aim of this work was to extend the knowledge of the sport performance structure in judo in term of the hierarchical structure of motoric factors through the quantified mathematic model.

The knowledge of hierarchical motoric factors forms the theoretical basis for department of motoric capabilities and abilities in preparation of young judoists. The base method of our research, besides studying literature, was ex post facto managed research.

The research group was composed by 24 Slovak judoists in the average age of 14,3. They were also the members of The Centre of talented youth in The West Slovak Region.

In the structural analysis of motoric factors we started from eighteen independent variables and from the performance criteria, which were determined by two ways. For the retrieved data processing we used the multiple correlation analysis and the regression analysis for linear models dependency. Except the correlation analysis we used the descriptive statistics and comparison of the matched values significance.

We came to the conclusion that the first level factors that limit sport performance in judo are: special coordination endurance, the quality of technique execution, the contest offensive effectivity, static balance, the dynamic endurance, upper limbs strength.

The second level factors which underlie sport performance in judo are: sport and decimal age, disjunctive speed-reactive capabilities, the dorsal muscle strength and upper limbs dynamic strength.

Key words: *hierarchical structure, mathematic model, structural analysis*

DIFFERENCES BETWEEN WINNERS AND LOSERS IN CONSISTENCY OF BASIC STROKES IN TENNIS MATCHES ON CLAY COURT

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Abstract

The purpose of the research was to establish differences in tennis matches between winners and losers regarding the consistency of selected technical elements, and how the accuracy of those elements influences the result of the clay court match. The analysis emphasized the beginning of the point, so maximum of ten strokes per point were recorded. The sample consisted of 15 matches (best of five sets) with a total of 3668 points played in Roland Garros in 2004. The variable sample has been selected from 47 technical elements of tennis game, and it was made out of the nine following elements: forehand cross court, forehand down the line, forehand inside out, forehand inside in, backhand cross court, backhand down the line, elements of the net game, return and serve. Both player's elements were registered in one of the three chosen target fields inside the tennis court. In order to establish if the winners in matches are more consistent than the losers, multivariable test Hotelling was used. Results show that winners are more accurate than losers in all three target fields in six out of nine elements. It was concluded that the more consistent player wins the tennis match on clay court.

Key words: *technical elements, multivariable test, target system*

Introduction

In competitive tennis, player is trying to place the ball in opponent's part of the court by making the pressure on the opponent, and at the same time trying to be consistent and not make mistakes (Filipčič 2000). Tennis matches of top professionals distinguish winners and losers in technical and tactical way. Even though, there is a small difference between winners and losers, the difference is still very important and is crucial to the end result of the match.

In present research, the accuracy of winners and losers was measured, and only the first ten strokes in each point was recorded. Points were played in top men's professionals matches on clay courts.

Till now there was not many published paper on the subject. Schonborn (1999) conducted statistical analysis on the average number of strokes on clay courts (6.8 strokes per point). He found out that 62% of the strokes in matches on clay courts is finished before the sixth stroke. Regarding the tactical analysis of the tennis game, Filipčič (2000) suggested the use of the Schonborn's "Target System", which divides tennis court in five different rectangles which the players should use in the match for their tactical decisions.

Methods

The sample consisted of 15 men's tennis matches (best of five sets) played in the 2004. Roland Garros. The total of 3668 points were analyzed. In order to achieve high level matches for analysis between winners and losers, only completed matches from the third round to the final round were selected.

The data was collected by using tennis specific target areas in the tennis court (Figure 1). To analyze the data, only the variables with more then 10 frequencies per match were selected for statistical analysis. The selected elements for analysis were forehand (fh) cross, forehand down the line, forehand inside out, forehand inside in, backhand (bh) cross, backhand down the line, elements at the net, return, and serve. Those elements represent the most frequent elements in tennis game. Program STATISTICA 7 was used to test the differences between the matches of winners and the matches of losers. The basic statistical parameters of all the variables were computed in the first phase. In order to analyze the total number of shots and their accuracy in selected fields, multidimensional t-test (Hotelling) was used.

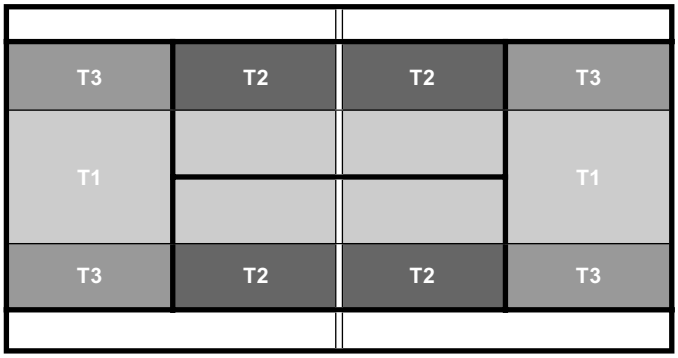

Figure 1. Target areas according to the ITF/ ITN groundstroke accuracy test used for analysis of the game.

Results

Each one of the nine selected elements had six components: winner in target T1; winner in target T2; winner in target T3; loser in target T1, loser in target T2; loser in target T3. Basic statistical parameters for the first selected variable (Forehand cross court) are shown in Table 1. The numbers show the frequencies of Forehand cross-court in the target T1 (over the service line and close to the single line), target T2 (inside the service box and close to the singles line), target T3 (inside and over the service box and close to the center of the court). According to the Mean difference, it is evident that winners have better results in all three selected targets. The Mean results show the average result of strokes hit in certain targets in one match for winners and losers. Minimal and maximal result show the high variability in number of strokes hit inside the targets in all the matches. This variability is explained by the length of the matches played. In Roland Garros the matches are played in best out of five sets, so in a certain match that finishes in three sets there are less strokes hit in targets than if the match is finished in five sets.

Table 1. Basic statistical parameters of element Forehand cross-court in appropriate targets from winners (W) and losers (L)

	Min.	Max.	Mean	SD
Fhcross T1w	39.00	86.00	54.20	12.99
Fhcross T2w	9.00	19.0	13.46	3.13
Fhcross T3w	36.00	86.00	65.33	14.88
Fhcross T1L	36.00	84.00	51.06	13.18
Fhcross T2L	8.00	17.00	11.53	2.77
Fhcross T3L	29.00	78.00	58.60	14.82

Legend: Min. - minimal result, Max.- maximal result, Mean - arithmetic mean, SD – standard deviation

Results of the multidimensional test Hotelling showed that among the selected variables, in six out of nine variables winners showed statistically significant difference then the losers (Table 2). The significant difference was observed in forehand cross (0.01), forehand inside out (0.00), forehand inside in (0.00), backhand cross (0.01), backhand down the line (0.00) and return (0.05).

Table 2. The results of analysis- difference between winners and losers in matches

	Fh cross	Fh down line	**Fh inside out**	**Fh inside in**	**Bh cross**	**Bh down line**	Elem net	**Return**	Serve
Hotelling test	**18,258**	10.80	**68,92**	**137,00**	**18,258**	**94.50**	1,76	**155,78**	0.521
P	**0.015**	0.068	**0.00006**	**0.0000**	**0.015**	**0,00001**	0.6869	**0.0000**	0,788

Discussion and conclusions

The results of the multivariable Hotelling analysis (Table 2) showed that the winners are more accurate then the losers in six out of nine technical elements of the tennis game in the total number of strokes hit inside the three target fields. Winners are more accurate in performing forehand cross court, forehand inside out, forehand inside in, backhand cross court, backhand down the line, and return.

Furthermore, this study suggests that the winners have less unforced errors than losers inside the first ten strokes of each point played, which can be concluded from higher number of total strokes hit by winners in all three target fields. There was no statistically significant difference in the elements at the net (0.68) between the match winners and the match losers. One possible explanation for the low number of strokes hit at the net is the fact that the matches were played on clay courts, which is the slowest surface on the professional tour (Burcar 1999). Therefore, it is evident that the winners were not better than the losers in elements at the net, since inside the first ten strokes it is very difficult for a player to get to the net and finish the point.

The serve is an offensive shot, and on slowest surface it is more difficult to use it as an advantage over opponent, as it is on faster surfaces. That is why there was no significant difference in element serve (0.78) between winners and losers of the match.

This study suggests that the best model of play on clay court is high accuracy of forehand elements (forehand cross court, forehand inside out, forehand inside in). Those elements keep the offensive position in the beginning of the point in order to prepare the attack on the opponent. The results show the significant difference between winners and losers of the matches in three basic elements of forehand, showing the relations of results of the top professionals with the model of play on clay court.

According to the study, the selected variables are very important to determine the difference between the players winning the match with the players losing the match on the slowest surface, red clay court. In order to become more consistent in his game, player should dedicate more time on practicing all nine selected basic strokes and should use the target areas to improve their model of play on clay courts.

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THE INFLUENCE OF WRESTLING TECHNIQUES ON THE FLOOR AND IN STANDING POSITION ON TOTAL BOUT DURATION

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Abstract

Total bout duration was shown to be one of the variables which best discriminated between successful and less successful national wrestling teams at European Championship in Belgrade in 2003 (Kuklidis, 2005). The aim of this paper is to determine the influence of wrestling techniques in parterre and standing positions on total bout duration. The sample was comprised of 219 wrestling bouts. The variable sample was comprised of 14 variables divided into three groups (parterre techniques, standing position techniques and total bout duration). Regression analysis results revealed the significant influence of prediction variables related to parterre holds on criterion variable, that is, total bout duration. Statistically significant influence on the criterion was observed in the following variables: total number of reverse waistlocks, total number of parterre lift overs and a variable represents other parterre techniques.

Key words: *Greco-Roman wrestling, situational efficiency parameters*

Introduction

Hierarchical structure of wrestling efficiency includes the following four groups of factors: basic anthropological characteristics, specific abilities, situational efficiency parameters of wrestlers and sports results as a measure of wrestlers' competitive efficiency (Baić et al, 2002). The total bout duration as one of wrestlers' situational efficiency parameters proved to be one of the most discriminating variables of highly successful, ordinarily successful and less successful national teams at European Championship in Belgrade in 2003 (Kuklidis, 2005). This variable is expected to be more or less stable, independent of frequent changes in wrestling rules, thereby deserving to be analyzed in more detail with regard to other situational parameters. The aim of this paper is to determine the influence of variables relating to parterre and standing position holds on the criterion variable which stands for total bout duration.

Methods

The entity sample was comprised of 219 wrestling bouts held at European Championship in Belgrade in 2003 wherein 161 wrestlers from 34 national teams participated. The variable sample was comprised of 14 variables divided into 3 groups.

The first group of variables was comprised of 6 prediction variables relating to techniques (holds) which were performed in parterre position: 1. total number of gut wrenches; 2. total number of reverse waistlock; 3. total number of parterre lift overs; 4. total number of get-ups from the ground position; 5. total number of counterattacks in the ground position; 6. total number of other techniques in the ground position.

The second group of variables was comprised of 7 prediction variable techniques (holds) performed in the standing position: 7. total number of shoulder throws; 8. total number of hip throws; 9. total number of twisting opponent throws; 10. total number of parterre takedowns; 11. total number of ankle trips; 12. total number of counterattacks in the standing position; 13. total number of other techniques in the standing position.

The third group of variables was comprised of one criterion variable relating to bout duration: 14. total bout duration.

All the data were obtained from FILA database (http://fila-wrestling.com), the website of the International Wrestling Federation. A multiple regression analysis was used complying with the aim of the paper and the basic descriptive parameters were consequently calculated. All data were processed by Statistica for Windows ver. 7.1.

Results

Basic central and dispersive prediction variable parameters relating to wrestling techniques performed in parterre and standing positions as well as criterion variable relating to the total bout duration are shown in Table 1.

Table 1. Descriptive variable parameters

Variables	N	AS	Sum	Min	Max	SD
Total number of gut wrenches	219	1,26	275	0	6	1,04
Total number of reverse waistlocks	219	0,46	100	0	5	0,89
Total number of parterre lift overs	219	0,20	44	0	5	0,70
Total number of get-ups from the ground position	219	0,03	7	0	2	0,20
Total number of counterattacks in the ground position	219	0,15	32	0	3	0,44
Total number of other techniques in the ground position	219	0,20	43	0	3	0,54
Total number of shoulder throws	219	0,04	9	0	1	0,20
Total number of hip throws	219	0,06	14	0	2	0,28
Total number of twisting opponent throws	219	0,10	22	0	3	0,41
Total number of parterre takedowns	219	0,55	120	0	4	0,77
Total number of ankle trips	219	0,16	35	0	4	0,49
Total number of counterattacks in the standing position	219	0,10	22	0	3	0,38
Total number of other techniques in the standing position	219	0,14	31	0	3	0,45
Total bout duration	219	340,72	74617	50	540	92,02

Legend: ES – entity sample, AM – arithmetic mean, Sum – total value – sum, Min – minimal result value, Max – maximal result value, SD – standard deviation

Table 1 clearly shows that the highest arithmetic mean in parterre position has a total number of gut wrenches variable which is present in 55% of all technique frequencies, followed by total number of reverse waistlocks variable with 20% of all techniques performed in parterre position. Total number of parterre lift overs variable as well as other parterre techniques variable are present in 9% of all performed techniques. Counterattacks in the ground position variable (6%) as well as total number of get-ups from the ground position variable (1%) are less present.

Total number of parterre takedowns variable has the highest mean value in standing position techniques with total of 48% of all standing position technique frequencies. It is followed by total number of ankle trips variable with 14 % then it is followed by total number of techniques in standing position variable with 12% of other standing position techniques. The other variables such as total number of counterattacks in the standing position, shoulder throws, hip throws as well as twisting opponent throws are present in less than 10% of all standing position technique frequencies. The average bout duration is somewhat shorter than regular bout duration (6 minutes = 360 seconds), and amounts to 341 seconds.

The influence of prediction variables which represent techniques performed in parterre position on the criterion – dependent variable (total bout duration) is shown in Table 2.

Table 2. Regression analysis of prediction variables representing techniques performed in parterre position and their influence on the criterion – dependent variable (total bout duration)

Regression Summary for Dependent Variable: Total bout duration						
Multiple R= ,34408565 R^2= ,11839						
F(6, 212)=4,74 p<,00015 Standard error of estimate: 87,6						
		St. Err.		St. Err.		
	BETA	of BETA	B	of B	t(156)	p-level
Intercpt			373,35	10,87	34,34	0,00
Total number of gut wrenches	-0,10	0,07	-9,19	5,82	-1,58	0,12
Total number of reverse waistlocks	*-0,23*	*0,07*	*-23,89*	*6,80*	*-3,51*	*0,00*
Total number of parterre lift overs	*-0,23*	*0,07*	*-29,84*	*8,72*	*-3,42*	*0,00*
Total number of get-ups from the ground position	0,03	0,07	14,33	29,96	0,48	0,63
Total number of counterattacks in the ground position	0,04	0,06	8,74	13,70	0,64	0,52
Total number of other techniques in the ground position	*-0,18*	*0,07*	*-30,18*	*11,21*	*-2,69*	*0,01*

Legend: Multiple R = multiple correlation coefficient; R^2 = determination coefficient; F = F-value; BETA = beta ponder; St. Err. of Beta = standard error of regression coefficient standardized prediction; B = non-standardized regression coefficient; St. Err. of B = standard error; t = t value; p-level = significance level; Intercept = dependent variable value per zero values of independent variables

The influence of prediction variables representing parterre techniques on the criterion variable – dependent variable, that is, bout duration is shown in Table 3.

Table 3. Regression analysis of the prediction variables representing techniques in standing position and their influence on dependent variable – total bout duration

Regression Summary for Dependent Variable: Total bout duration						
Multiple R= ,196115 R^2= ,038461						
F(7, 211)=1,20 p<,30086 Standard error of estimate: 91,7						
		St. Err.		St. Err.		
	BETA	of BETA	B	of B	t(156)	p-level
Intercpt			343,52	8,69	39,54	0,00
Total number of shoulder throws	-0,09	0,07	-41,21	31,55	-1,31	0,19
Total number of hip throws	-0,02	0,07	-7,62	23,02	-0,33	0,74
Total number of twisting opponent throws	-0,08	0,07	-17,44	15,52	-1,12	0,26
Total number of parterre takedowns	0,08	0,07	8,93	8,16	1,09	0,28
Total number of ankle trips	-0,13	0,07	-24,42	13,18	-1,85	0,07
Total number of counterattacks in the standing position	-0,03	0,07	-7,83	16,79	-0,47	0,64
Total number of other techniques in the standing position	0,03	0,07	6,54	13,85	0,47	0,64

Legend: Multiple R = multiple correlation coefficient; R^2 = determination coefficient; F = F-value; BETA = beta ponder; St. Err. of Beta = standard error of regression coefficient standardized prediction; B = non-standardized regression coefficient; St. Err. of B = standard error; t = t value; p-level = significance level; Intercept = dependent variable value per zero values of independent variables

Discussion and conclusion

The aim of the paper was to determine the influence of variables relating to holds performed in parterre and standing position on the criterion variable representing total bout duration.

The first prediction group comprised 6 technique variables, that is, holds which were performed in the parterre position: total number of gut wrenches; total number of reverse waistlocks; total number of parterre lift overs; total number of get-ups from the ground position; total number of counterattacks in the ground position; total number of other techniques in the ground position. The second prediction group comprised 7 technique variables, that is, holds performed in standing position: total number of shoulder throws; total number of hip throws; total number of twisting opponent throws; total number of parterre takedowns; total number of ankle trips; total number of counterattacks in the standing position; total number of other techniques in the standing position.

Results of regression analysis revealed a statistically significant influence of prediction variables relating to holds performed in parterre position on criterion variable – total bout duration. The following variables had a statistically significant influence on the criterion variable: total number of reverse waistlocks, total number of parterre lift overs as well as the variable representing other techniques in the ground position. The multiple correlation coefficient amounts to 0.34, whereas the determination coefficient amounts to 0.118 which accounts for 12% of common variance between prediction and criterion variables. This weak, but still statistically significant correlation between the prediction and criterion variables can be explained by the fact that most wrestlers fight at competitions avoiding spectacular wrestling holds which would lead to gaining an advantage in points before the end of the round. Rather, they wrestle in a passive way, without taking risks, until the end of bout (Baić et al., 2002). Yet, it is clear that a smaller number of apparently successful wrestlers end the bouts before the end of the last round by reverse waistlock, parterre lift overs or some other techniques. On basis of previous research (Kuklidis, 2005), it can be stated that such wrestlers belong to the category of wrestlers from very successful national teams, who mastered the most complex wrestling techniques such as reverse waistlock and parterre lift over. It seems that wrestling by using the mentioned techniques affects the completion of the bout before the end of the last round, which gives an advantage at competitions with multiple, consecutive bouts. These hypotheses should be investigated in a separate research focused on determining the differences between successful, ordinarily successful and very successful wrestlers using the variables for assessment of situational, technique and tactical parameters.

The second prediction variable group relating to variables of techniques performed in standing position did not result in statistically significant influence on the criterion variable – total bout duration, wherein none of the prediction variables did not have a significant partial influence on the criterion variable.

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DIFFERENCES BETWEEN SITUATION EFFICIENCY MODELS OF MALE HANDBALL TEAMS AT THE WORLD CHAMPIONSHIP IN TUNISIA IN 2005

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Abstract

The objective of the research was to define the differences between models of situation efficiency of teams in different competition groups. The research was conducted on a sample of 60 handball matches. The sample of variables encompasses the frequency of shooting efficiency parameters, assists and technical errors. The indicators of situation efficiency were introduced through parameters of descriptive statistics with the central and dispersion parameters. The use of the discriminant analysis determined characteristics of models of situation efficiency for each preliminary group. The use of the nonparametric method (Kruskal Wallis test) allowed a more exact and objective interpretation of the obtained results than the discriminant analysis. Taking into consideration the results of both methods, three models of situation efficiency with characteristical technical and tactical performance of players were determined.

Key words: *team handball, differences, models of situation efficiency, parametric method, nonparametric method*

Introduction

The successfulness of handball teams is determined by the level and structure of a large amount of capabilities, personality traits and by a net of technical-tactical knowledge of each player and their mutual interactions in the frame of known and unknown situations which originate in the handball match (Vuleta, Milanović et al., 2004). Observing the result successfulness of teams on behalf of previous research studies, it is possible to conclude that the result is best defined by the players attacking situation efficiency.

Recorded indicators of situation efficiency of own and opponent players in competition conditions allow coaches and experts a good preparation for forthcoming matches. Continuous recording and control of players efficiency contains analysis of relevant technical-tactical indicators so that the obtained results could be directly applicated in the function of distribution of training contents and loads, which should secure high quality work and progression of playing efficiency in all phases of a handball match (Vuleta 1997).

Previous research studies have been conducted by the use of regression analysis in context of determining the direct impact of each individual indicator of situation efficiency in relation to the set criteria (win or defeat, goal difference…). The existing cognitions in the space of situation efficiency have triggered the need for the research of models of situation efficiency.

All indicators of situation efficiency of one team form a model of situation efficiency, therefore the objective of this research is to analyze and define the differences between models of situation efficiency of teams in top level handball. Each team has its own way of playing and because of that their models of situation efficiency will also be different.

H_1 – there is no statistically significant difference between teams in four different competition groups of the preliminary round in the variables of situation efficiency

Methods

Sample of entities is composed of 60 matches (120 opponents) played by 24 national teams which were divided in four groups in the preliminary round at the 2005 World Handball Championship for Men held in Tunisia.

Sample of variables is made up of 14 variables which consist of frequencies of either successful shots (goals scored) or shots missed (goals not scored), assists and technical errors. Situational efficiency of players is described in Table 2. The variables were registered during the matches with the official IHF statistics monitoring system - WIGE DATA

6MUS	Pivot player position shot - goal scored
6MNE	Pivot player position shot - goal not scored
KRILOUS	Wing player position shot - goal scored
KRILONE	Wing player position shot - goal not scored
9MUS	Pivot player position shot - goal scored
9MNE	Pivot player position shot - goal not scored
7MUS	Penalty shot - goal scored
7MNE	Penalty shot - goal not scored
KONTRAUS	Pivot player position shot - goal scored
KONTRANE	Pivot player position shot - goal not scored
PROLAZUS	Pivot player position shot - goal scored
PROLAZNE	Pivot player position shot - goal not scored
ASIST	Assists
TEHGRE	Technical errors
SKUPINA	Preliminary group

Data processing methods. Central and dispersion parameters of the indicators of situation efficiency were determined through the use of descriptive statistics for the observed variables. Due to the bimodal and asymmetrical distribution of most variables, the differences between the models of situation efficiency in different preliminary groups were determined by the use of a parametric analysis method (Discriminant analysis) and a nonparametric analysis method (Kruskal-Wallis test).

Results

In the matches of the preliminary round a total average number of shooting was 51 with a successfulness rate of 55%. The average number of shots from backcourt players positions was 15 with a successfulness rate of 37%. The average number of shots from pivot players position also counts 15 but with a successfulness rate of 54%. Shots from wing player positions come to the average number of 6 shots per match with a successfulness rate of 54%, and average number of shots from fast breaks counts 5 shots per match with a successfulness rate of 77% and the average number of shots from breakthroughs was 3 with a successfulness rate of 75%. Teams had in average 3 penalty shots with a successfulness rate of 72%. The average count of assists per match is 15 and the count of technical errors is 15 per match.

Two discriminant functions were established on a high level of statistical significance at p=0.00. The first discriminant function explained 49,72% of the total variance with a canonical correlation of 0,68 and Wilk's lambda of 0,27. The second discriminant function explained 42,82% of the total variance with a canonical correlation of 0,65 and Wilk's lambda of 0,51.

Table 1. Central and dispersion parameters of variables for different preliminary round groups
AS - arithmetic means, SD - standard deviations

VARIABLES	A		B		C		D	
	AM	SD	AM	SD	AM	SD	AM	SD
6MUS	5,13	4,04	10,63	4,49	7,53	4,53	9,96	3,76
6MNE	3,76	2,35	8,96	6,21	5,06	2,43	10,10	4,58
KRILOUS	3,26	2,66	2,86	1,83	3,80	2,75	3,43	2,56
KRILONE	3,36	2,20	2,53	1,75	2,90	2,27	2,60	1,84
9MUS	5,87	2,40	5,63	2,63	7,50	3,20	4,03	2,96
9MNE	11,26	5,78	8,53	4,65	12,70	6,69	6,10	6,17
7MUS	3,23	1,92	3,26	2,33	3,16	1,89	3,36	2,14
7MNE	0,93	0,98	1,46	1,67	1,33	1,58	1,40	1,35
KONTRAUS	5,86	4,74	4,66	3,58	5,90	4,20	3,00	2,87
KONTRANE	1,93	1,96	1,63	1,42	0,93	1,01	1,33	1,26
PROLAZUS	4,53	2,87	0,86	1,07	0,86	0,81	2,06	2,82
PROLAZNE	1,53	1,77	0,16	0,37	0,13	0,43	1,03	2,42
ASIST	8,53	5,48	14,46	6,07	20,16	11,04	12,26	4,89
TEHGRE	17,06	7,37	12,30	4,44	16,00	6,41	15,30	4,82
UKUPNOUS	27,90	9,39	27,93	6,11	28,76	8,95	25,86	5,88
UKUPNONE	22,80	6,97	23,30	6,34	23,06	6,68	22,56	6,39

AM - arithmetic mean, SD - standard deviations

Table 2. Correlations between variables with the discriminant function and means of canonical variables

VARIABLES	I. DF	II. DF
6MUS	-0,38	-0,43
6MNE	-0,31	-0,65
KRILOUS	-0,04	0,08
KRILONE	0,13	0,12
9MUS	-0,12	0,49
9MNE	0,03	0,51
KONTRAUS	0,07	0,33
KONTRANE	0,23	-0,08
ASIST	-0,57	0,29
TEHGRE	0,17	0,18
GROUP	I. DF	II. DF
A	1,51	0,45
B	-0,45	-0,47
C	-0,92	1,12
D	-0,13	-1,09

Table 3. Kruskal -Wallis test results, differences between teams in different preliminary round groups

p-levels						
VARIABLES	GROUPS					
	A - B	A - C	A - D	B - C	B - D	C - D
6MUS	**0,00**	0,17	**0,00**	0,03	1,00	0,19
6MNE	**0,00**	0,38	**0,00**	0,00	0,89	**0,00**
KRILOUS	1,00	1,00	1,00	1,00	1,00	1,00
KRILONE	0,98	1,00	1,00	1,00	1,00	1,00
7MUS	1,00	1,00	1,00	1,00	1,00	1,00
7MNE	1,00	1,00	1,00	1,00	1,00	1,00
9MUS	1,00	0,26	*0,07*	0,31	*0,06*	**0,00**
9MNE	0,71	1,00	**0,00**	0,15	0,28	**0,00**
KONTRAUS	1,00	1,00	**0,02**	1,00	0,29	**0,01**
KONTRANE	1,00	0,34	1,00	0,47	1,00	1,00
PROLAZUS	**0,00**	**0,00**	**0,00**	1,00	1,00	1,00
PROLAZNE	**0,00**	**0,00**	0,17	1,00	1,00	0,77
ASIST	**0,00**	**0,00**	0,10	0,75	1,00	**0,00**
TEHGRE	**0,02**	1,00	1,00	*0,09*	*0,07*	1,00

p-levels - proportion of error made by accepting the hypothesis that the difference is statistically significant

Discussion

The number of goals scored per match is 27 and is well within range of the expected value because the value in the World championship in Portugal 2003 was also 27 (Gruić et al., 2005). In comparison with the preceding World championships it is possible to state that on the World Championships held in Tunisia teams had more assists, wing position shots, pivot position shots, breakthrough shots, fast break shots and also had less shots from backcourt players position. This indicates that the tendency of shooting from backcourt players position has decreased.

The first discriminant function has bipolar characteristics. The variables defining the negative pole are closely related because assists allow scoring from pivot position. This function distincts teams which dominantly shot from pivot positions from those which do not. The reason for a high number of attempted shoots from pivot position is that teams have a high quality pivot player and a conceptionally set game style in offence, where a high number of actions end with an assist to the pivot through air, and in the modern handball more often from the ground. To attack on deep defensive formation it is tactically right to play with two pivot players, what allows a higher possibility for cooperation respectively a higher number of assists to pivot players. It is not a surprise that many teams use two pivot players in offensive tactics against shallow defense formations, especially if the attacking team has two high quality backcourt players (shooters) because the defending team can not satisfy the principals of deepness (neutralization of backcourt players) and density (neutralization of pivot players) at the same time. The chance to shoot from pivot's position can also appear due to a successful execution of a block (vertical, diagonal or opposite) from the pivot, and his deblocking action in the newly opened space behind the defending players, which of course also requires a high quality assist.

The second discriminant function also has bipolar characteristics. It distincts the teams which dominantly shoot form backcourt players and fast breaks from those which shoot more from pivot position. Such distinction was expected due to the inability of teams to create conditions to score from pivot position, therefore the chance for scoring is seeked out through the shooting from backcourt players positions.

It is very important to stress that the variables which define shooting from wing players position have no significant impact on the structure of either discriminant function. This could be explained with fact that in the top level handball it is very difficult to create conditions to score from such positions, because of that the main role of wing players is orientated to a high percentage of successful realization from fast breaks.

The comparation of the results of both analyses allows the conclusion that the results of the parametric method are valid although the distributions of the used variables are bimodal or positively asymmetric. It is also possible to conclude that the results of the nonparametric analysis complete the results of the parametric method with certain points, which primarily refers to the shooting efficiency of players from breakthroughs.

Situation efficiency models of teams in group A. According to the discriminant functions the teams of this preliminary group had a below average number of shots from pivot position and below average number of assists. The teams also had above average number of shots from backcourt players positions and above average number of shots from fast breaks. These teams had created conditions for scoring goals from backcourt players positions by inducing a fast ball flow and

high numbers of crossings which where followed by pivot players blockings to assure promising position for scoring from backcourt players positions. Fast transitions from the first defensive phases to the first offensive phases (individual counter-attacks) in which the line players had key roles is also an important trait of teams in this group. The results of the Kruskal-Wallis test confirm the results of the discriminant analysis and complete them with the fact that teams in this group had above average number of shots from breakthroughs. It is possible to conclude that these teams players had a high level of condition and technical-tactical readiness which is demanded to perform such actions. In the view of contact game with the defensive players, attackers need to be highly conditionally trained - fast, agile, coordinated (feints), explosive (jump) and precise (shot). Teams of this group had a high number of technical errors which is a consequence of the development of the handball game (fast play). The stress in these situation efficiency models can be put individual technical-tactical performance of each player.

Situation efficiency models of teams in groups B and D. The results of the Kruskal-Wallis test point out that the teams of the preliminary group B have a slightly higher number of unsuccessful shoots from backcourt players position and less technical errors than the teams in the preliminary group D. Taking into consideration this differences the preliminary groups B and D are interpretated together, although their slight differences they share most characteristics. According to the discriminant functions the models of situation efficiency of these groups have above average number of shots from pivot's position(s) and an average number of assists. These models are also characterized by a below average number of shots from backcourt players position and from fast breaks. It is possible to state that the teams of these groups had a conceptionally set play strategy in which their offensive actions end by shooting from the pivot's playing potion in all attack phases. The below average number of shots could be explained by the lack of high quality backcourt players who could pose a serious threat by shooting from distance. The below average number of shots from fast breaks point out to the fact that teams of these groups had a low quality defense play and they had no chance to create counter-attacks or the attackers were prevented by a well organized anti counter-attack performance of defensive players. The stress in these situation efficiency models can be put on group and collective technical-tactical performance of players in all attack phases.

Situation efficiency models of teams in group C. According to the discriminant functions the teams of this preliminary group had an average number of shots from pivot player position and above average number of assists. These teams also had an above average number of shots from fast breaks and backcourt players positions. Fast transitions from the first defensive phases to the first offensive phases (individual counter-attacks) in which the line players had key roles an important trait of teams in this group. In addition to the fast first attacking phase it is possible to state that in the second attack phases (attacks on unorganized defenses) backcourt players had key roles. In the third attack phase teams of this group had dominantly ended their offensive actions from backcourt players positions, but in addition an average level of shots from pivot's playing position indicates that collaboration with pivot players in this group was also well developed. The stress in these situation efficiency models can be put individual technical-tactical performance of players (wing and backcourt players), however the significant role of group and collective and collective technical-tactical performance of players should not be neglected.

Conclusion

On behalf of the obtained results, three general groups of models of situation efficiency were established and therefore the differences between them. The conducted research confirmed results of previous researches, however the indicators of situation efficiency were analyzed by the use of a nonparametric method for the first time. The results obtained through the use of the nonparametric method proved more objective, and allowed a more concrete and exact interpretation of obtained results, therefore a new perspective is given for future researches in this field.

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RELATIONSHIP BETWEEN QUALITIES OF GAME SKILLS IN THEIR SEQUENCE AS A FACTOR OF WINNING IN VOLLEYBALL MATCH OF U15 BOYS

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Abstract

The aim of the paper is to analyze if the relationship between quality of game skills in their sequence, in concrete terms between service reception or field defense and attack, has an influence on the outcome of match sets. The research was carried out on the teams of young volleyball players taking part in the Slovak National U15 Championship 2006. The quality of game skills was assessed in 7 matches (16 sets) by 4, respectively 3points scale. The relationship between quality of game skills in their sequence and the outcome of sets was assessed by X^2-test. The results indicate a common significant relationship between quality of service reception or field defense and quality of following attack (X^2 =37.669, respectively 65.870; $p<0.01$). The relationship between qualities of game skills in their sequence from the view of the outcome of sets was very similar in both winning and losing teams. No significant differences were found.

Key words: *volleyball, boys U15, quality of game skills, sequence of game skills, won and lost sets*

Introduction

Game performance has a unique structure which is determined by the fact that there are always two teams or individuals that fight against each other. They have a common subject of the game, using which they try to overcome their rivals according to the character of the given game, i.e. they try to score more goals or achieve more points than their rivals by positioning the subject of the game to a certain place. To discover the structure of game and game performance of a team or a player is a complex and substantial problem for coaching praxis. For that reason researchers and coaches try to discover indicators to asses and find out why the team was successful or failed in the match (Hughes – Franks, 2002). In volleyball in all categories and performance levels seems above all the attack to be the most important indicator of win or lost (Přidal, 2002, 2008; Hughes – Daniel, 2003; Palao et al., 2004; Zetou et al., 2006; Šmahel, 2007). For volleyball game is typical nearly invariable sequence of game skills. Each rally starts with the service that is defended by opposing team with the reception and followed with the set and the attack, serving team tries to block the ball or start a counter-attack (dig, set, and attack). This sequence of game skills is repeated until the ball touches the ground or the referee stops the rally. Nestke (2004) speaks about „action chains" in which each intermediate action is the result of preceding and the cause for the subsequent one. Every immediately performed action, but not only the action preceding sets the conditions for the next. For the reason that the attack is the most important indicator of win or lost in volleyball match it is very useful to examine the relations between the qualities of game skills resulting in the attack. Results up to now underline the significance of the relationship between qualities of game skills in their sequence from the point of view of outcome of the set or match. Hughes – Daniel (2003) comparing elite and non-elite teams found out that the quality of serve reception and the defense was better in elite teams. Quality of setting in elite teams was depended on the quality of defense or serve reception, similarly it was found that the quality of attack depended on the quality of the set. Similar results were found for non-elite teams but the relationship was not so strong. Přidal (2002, 2007) analyzing the matches of elite boys U 17 came to the conclusion that in winning teams was the relation between game skills in the sequence ending with attack stronger than in loosing teams. Haník (2008) discovered that teams that lost points after a perfect serve reception lost the set. All these results show that in the winning teams are the relations between game skills in their sequence stronger than in loosing ones. Because there is no knowledge about this phenomenon in younger age categories we decided to analyze this problem in our paper. Its aim is to compare the quality of attack after precise and non-precise pass (serve reception or field defense) in won and lost sets in boys U15.

Methods

The game performance of 5 boys' teams participating in Slovak U15 Championship 2006 was taken in the analysis. The best 7 matches (16 sets) were analyzed. All the games were video-recorded and later analyzed. Results were collected on the analysis sheet that allowed following the qualities of the skills in their sequence separately in won and lost sets. The quality of selected game skills was assessed with 4point scale.

PASS (serve reception and field defense)

4 – Faulty pass, end of rally (excluded from subsequent analysis)

3 – Non-precise pass that allowed the setter only an emergency solution of the situation

2 – Less precise pass that allowed the setter to use only a limited repertoire of sets

1 – Precise, perfect pass that allowed the setter to use all repertoire of his sets (first and second tempo)

ATTACK

4 – Faulty attack, lost point

3 – Bad attack, easy situation for counter attack of the opponent

2 – Good attack, opponent returns a free ball

1 – "Ace", won point

An inferential and statistical analysis (Chi-Square Test) with a level of statistical significance $p < 0.05$ was used to process the data.

Results

When analyzing qualitative relationships between attack and serve reception or field defense in all sets of the monitored matches we discovered a significant relationship ($X^2 = 37.669$, resp. 65.870; $p<0.01$). The quality of attack in this age category is strongly dependent on quality of serve reception as well as field defense. With the decrease in quality of serve reception (Table 1), the relative occurrence of attacks decreases, with which the team obtained points, i.e. attacks assessed with degree 1. Linear dependence can also be found with "bad" attacks assessed with degree 3. The lower the quality of serve reception is, the lower the quality of attack. A remarkable and at the same time quite well-balanced is the occurrence of "good" attacks assessed with degree 2 (14.4 – 18.4 %) and faulty attacks, which meant a point for the opponent (17.5 – 22.8 %) after any qualitative degree of serve performance.

Table 1. Relation between qualities of serve reception and attack in their sequence in all matches

Attack/ Serve reception	1	2	3	4	Sum
	%	%	%	%	
1	44.2	18.4	19.9	17.5	100.0
2	34.9	16.8	25.5	22.8	100.0
3	18.0	14.4	48.6	18.9	100.0
Chi-square	*37.6688496 (p<0.01)*				

Except of one difference similar results were obtained also by the dependence analysis of quality of attack on the quality of field defense (Table 2). In comparison with the serve reception was the quality of the attack identical either after precise or less precise field defense.

Table 2. Relation between qualities of field defense and attack in their sequence in all matches

Attack/ Field defense	1	2	3	4	Sum
	%	%	%	%	
1	45.3	18.2	14.9	21.6	100.0
2	45.4	15.7	24.1	14.8	100.0
3	4.2	16.7	61.1	18.1	100.0
Chi-square	*65.8704871 (p<0.01)*				

Relationship between qualities of analyzed game skills in their sequence and outcome of sets in the U15 boy category is unimportant (Table 3 and 4). The quality of attack of both the winner and loser was comparable with a perfect ($X^2 = 1.5413$; $p>0.05$), as well as less precise and non-precise serve reception ($X^2 = 5.7129$ respectively $X^2 = 4.6191$; $p>0.05$). Thus both winning and losing teams had approximately the same quality of attack after a precise serve reception. Even though winning teams had more effective attacks and made also less mistakes in attacks after a less precise and non-precise serve reception, these differences were not significant.

Also relations between qualities of field defense and attack in their sequence and outcome of the sets do not indicate differences between winners and losers (X^2 =1.5413, X^2 =5.7129 respectively X^2 =4.6191; p>0.05) (Table 4). Even though losing teams have less successful endings and make more mistakes in attack after perfect and less precise field defense (10 % to 17 % difference) but these differences are not significant. Based on the obtained results, it seems that qualitative relationships in the sequence of game skills are not very important from the point of view of the outcome of sets in this age category.

Table 3. Relations between qualities of serve reception and attack in their sequence and outcome of the sets

Distribution of attack quality after perfect serve reception (1)					
Quality of attack	**1**	**2**	**3**	**4**	**Sum**
	%	%	%	%	%
Won sets	46.6	19.3	15.9	18.2	100.0
Lost sets	42.4	17.8	22.9	16.9	100.0
Chi-square	***1.541315***				
Distribution of attack quality after less precise serve reception (2)					
Quality of attack	**1**	**2**	**3**	**4**	**Sum**
	%	%	%	%	%
Won sets	45.3	15.6	21.9	17.2	100.0
Lost sets	27.1	17.6	28.2	27.1	100.0
Chi-square	***5.712931***				
Distribution of attack quality after non-precise serve reception (3)					
Quality of attack	**1**	**2**	**3**	**4**	**Sum**
	%	%	%	%	%
Won sets	25.5	15.7	45.1	13.7	100.0
Lost sets	11.7	13.3	51.7	23.3	100.0
Chi-square	***4.619156***				

Discussion

Significant relations between qualities of game skills, namely passes and attacks, in their sequences regardless of the outcome of sets or matches seem to be logical in this age category. Technical maturity of young players is not at such a level yet, that they would be able to balance the lower quality of the preceding game skill by the following one. Even though we omitted in our analysis one game skill in the sequence – the set, it seems that its quality corresponds with quality of serve reception or field defense and determines the quality of attack. This is proved by the fact that after precise passes, players attack more effectively than after less precise and non-precise ones. Attacking game of young players is also typical of low stability. They make mistakes after a perfect preceding game skill.

Table 4. Relations between qualities of field defense and attack in their sequence and outcome of the sets

Distribution of attack quality after perfect field defense (1)					
Quality of attack	**1**	**2**	**3**	**4**	**Sum**
	%	%	%	%	%
Won sets	50.6	18.1	10.8	20.5	100.0
Lost sets	38.5	18.5	20.0	23.1	100.0
Chi-square	***3.3595435***				
Distribution of attack quality after less precise field defense (2)					
Quality of attack	**1**	**2**	**3**	**4**	**Sum**
	%	%	%	%	%
Won sets	54.0	14.0	16.0	16.0	100.0
Lost sets	37.9	17.2	31.0	13.8	100.0
Chi-square	*4.3168636*				
Distribution of attack quality after non-precise field defense (3)					
Quality of attack	**1/2**		**3**	**4**	**Sum**
	%		%	%	%
Won sets	18.4		63.3	18.4	100.0
Lost sets	24.0		60.0	16.0	100.0
Chi-square	***0.4148095***				

This is proved by for example approximately the same number of wrong attacks after precise, less precise and non-precise passes. As it turned out, qualitative relations in sequences of game skills in connection with the outcome of sets have a different character in the category of U15 boys than in the category of slightly older peers (U17) of higher performance level (Přidal, 2002) and top players of the senior category (Hughes – Daniel,2003; Přidal, 2007 and Haník, 2008). Whereas in the category of cadets and men the winning team is usually the one, which is able to make use of precise passes, namely precise serve reception, to end rallies and obtain points by attacks, it is not so in the category of U15 boys. From the point of view of the outcome of the set it is unimportant whether they make use of precise serve reception for ending the rally by attack or not. Similarly unimportant is the usage of quality field defense for effective ending of attacks. Qualities of game skills, excluding blocks, have greater influence on the outcome of match (Šmahel, 2007). The discovered results were probably influenced by age regularities of the game performance, however, partly also by the performance level. While in the category of cadets and men top European and world teams were analyzed, in the category of pupils the national elite was investigated.

Conclusions

The game of young U15 volleyball players is typical of strong relations between qualities of game skills in their sequence. We specifically confirmed the significant relationship between the quality of the pass and of the attack. Unlike elite teams of older age categories, these qualitative relations did not predict the outcome of sets or matches. From the point of view of the outcome of the set it is unimportant whether the boys make use of precise serve reception or field defense for ending the rally by attack or not. The game performance of boys is subject to other patterns than adults players.

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Late Submissions

5th INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

"KINESIOLOGY RESEARCH TRENDS AND APPLICATIONS"

PHYSICAL EDUCATION AND SPORT ON WESTERNIZED MOVEMENTS IN THE LAST OTTOMAN PERIOD

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Abstract

Ottoman state in the last period stated out of "West" by not keeping up with the intellectual, politic and economic developments required by that age. Emperorship made a decision to change by leaving traditional attitude aside to get rid of this hard condition in which it is in 18th century. The ideas of being Western, catching West whose dominance was entirely accepted in that century, had been suggested as an only remedy of being got rid of, at once, this hard condition. It is stated that Western movements which will determine everythings in the comminity and culture of Ottoman with this idea and belief were started.

In this study too, it will be touched upon organizations and sport culture, reforms done in the field of sport and sport education through Westernized movements from the last period of Ottoman State until the announcement of Republic.

In this period, physical education course (Riyazat-ı bedeniye) introduced in military school curriculum fist time (1863). However, this course was limited only gymnastic exercises. First spor club was constructed in Otoman State (The Imperid Yatching and Boating Club, 1872) by Augustus Charles Hobart Hampten. Also, primal federative structuring implemented at the same period in Otoman State (İstanbul Futball Unio- İstanbul Futbol Birliği, 1903-1910). On the other hand, all of the organizational movements and fredooms were forbidden by II. Abdülhamid. Therefore, physical education and sports activities implemented only minority groups who lived in Otaman State and foreign population.

It has been thought that the investigation of sport histories and sport cultures of comminities had an important role to explain their current conditions. It will also be important to understand how sport concept developed and was constructed in Türkiye. In this perspective, it will help us that the answers given to the questions of how the sport functions, what are the organizational and institutional indicators of sport and which sports developed will help us to have an idea about the cultures of the communities through sport.

Key words: *Physical education and sport, Ottoman period*

INVESTIGATION OF HOPELESSNESS LEVELS OF PROSPECTIVE STUDENTS IN SCHOOL OF PHYSICAL EDUCATION AND SPORTS

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Abstract

In this study it has been aimed to determine the level students hopelessness and whether or not the level of hopelessness differ in terms of certain variables in Anadolu University senior class students who continue their education in the School of Physical Education and Sports. For this purpose, "Beck Hopelessness Scale" has been applied to senior class students who continue their education in academic year 2007-2008 in Coach Training, Physical Education Teacher Training, Recreation and Sports Management Departments in Anadolu University, School of Physical Education and Sports. Apart from this scale, an info survey has been used in order to gain valuable information from senior class students regarding the research. In the analysis of the data gained by 119 students in total answering the scales "Mann Whitney U Test" and "Kruskal Wallis Test" has been used. In this study the general hopelessness level of senior class students who took part in the research has been determined and it has been analyzed whether or not there is a relation in between the points they had from the scales and their gender and department variables.

Key words: *senior students, gender, hopelessness, various departments, physical education, coach, sports management*

A RESEARCH ABOUT COMPARISON OF BODY IMAGE PERCEPTIONS OF BEACH VOLLEYBALLERS AND TRIATHLON ATHLETES

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Abstract

The purpose of this study is to investigate between personel body image perception of athletes who participated 5. European Universities Beach Volleyball Championship & Beach Games and 9. Triathlon World Universities Championship in Türkiye. Also, investigated to significant differences between female and male athletes (female 53 and male 50). Fronzoi & Shields's (1984) Body Esteem Scale was administrated to 54 beach volleyballer and 49 athletes who participated these championships (N = 103). The mean scores and significant degree were calculated with SPSS. Independent samples t-test was computed to determine significant difference between body image perception of beach volleyballers and athletes and female and male athletes. The reliability alpha, which was designed to check the internal consistency of items, found ,9380. According to results of Independent samples t-test, there was a significant difference only one item (arms), between beach volleyballers and athletes. Also, according to results of independent samples t-test, there were significant differences 6 of 35 items between female and male athletes. These are; waist, energy level, thights, shoulders, chest or breasts and weight.

Key words: *body image perception, beach volleyballers, triathlon athletes*

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