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"SCIENCE AND PROFESSION – CHALLENGE FOR THE FUTURE"

Opatija, Croatia, September 7 – 11, 2005

Proceedings Book

Editors-in-Chief:
Dragan Milanović and Franjo Prot

Organizer:
Faculty of Kinesiology,
University of Zagreb, Croatia

Under the patronage of:
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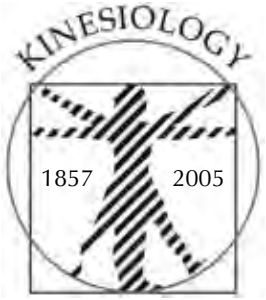

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Dear participants and readers!

In the year 2005, when the University of Zagreb is celebrating the 336th anniversary of its establishment and the Faculty of Kinesiology University of Zagreb its 46th anniversary, the International Scientific Conference on Kinesiology is being organized for the fourth time. Thus, the proclaimed intention of the organizer, the Faculty of Kinesiology, to make the Conference a traditional forum for kinesiologists to exchange findings, ideas, experiences and theories has become a reality. You will probably agree with us that, despite all the conveniences the modern communication technology has provided, a vivid dialogue, established in personal contacts of people who share similar vocational interests, is always a unique event and experience. We hope that the debates on how to foster excellence and joy in sport and exercise and on how to promote PE as an underpinning activity for sport, competitive and recreational alike, and life-long active life-styles, as well as discussions on numerous issues regarding human movement, health, exercise and business will bring fruitful results in form of new ideas and research projects.

The ever-growing body of kinesiology or sport science knowledge is continuously transformed into higher education curricula which allow graduates and masters of science to become well-educated professionals who have insights into the recent advances in kinesiology. In Croatia a highly specialized education and training of sport and PE professionals has a hundred-and-ten-year-old tradition. Based on that long tradition, the Faculty of Kinesiology has prepared two new university study curricula, adjusted to the Bologna Declaration and the European Credit Transfer System (ECTS) and has obtained the accreditation to organize them commencing in academic year 2005/06. The new university graduate and postgraduate doctoral study programmes will enable a higher level of knowledge of students and will promote a higher two-way mobility of both students and scholars. The curricula have assimilated the orientation of the members of the Faculty of Kinesiology that the mission of higher education institutions is viable only in the symbiosis of educational (professional training) and elite fundamental, developmental and applied research work in the fields of general and applied kinesiology and in the cognate and adjacent, mainly anthropological, scientific branches.

The motto of this year's Conference is "Science and Profession – Challenge for the Future". It suggests that the focus of attention is directed towards the inevitable connectedness between everyday practical issues and professions related to physical exercise and sport, on the one hand, and kinesiological research activities, theories, insights, findings and inferences on the other. The assembly of kinesiologists from 25 countries has gathered to discuss diverse biological, medical, biomechanical, psychological, sociological, cultural and economic aspects of a variety of kinesiological issues presented in 226 papers written by 300 authors.

Besides the contributing authors, much credit for the Conference scientific programme goes to the esteemed invited lecturers, both the plenary and the session introductory speakers, and chairpersons of particular thematic sessions, and the members of the Scientific Programme Committee. Thematically and methodologically related contributions have been divided into eleven thematic sections (APA and Sport for the Disabled; Biology and Medicine of Sport and Exercise; Biomechanics; Management of Sport; Physical Conditioning; Physical Education; Research Methodology; Sociology, History and Philosophy of Sport; Sport for All, Fitness and Health-related Activities; Sport Psychology; and Top-level Sport), which, in turn, represent recognizable groups of issues currently prevailing in the scientific research dealing with human movement, sport and exercise activities. Our special thanks go to the reviewers (62) who altruistically engaged their knowledge, effort, experience and time in making the conference papers consistent and good enough to enable creative clarification and communication of ideas. Although time restrictions made it impossible to afford in-depth reviews, the authors were requested to undertake revisions whenever it was possible in order to minimize the rejections. The selection and classification process was performed according to the quality criteria that primarily regarded novelty and the amount of information, and quality of structure and presentation. Due to the formal quality and lack of consistency of quite a number of papers, the original idea of reproducing them

as submitted proved hardly tenable. Therefore, a certain amount of copy-editing has been performed, though restricted to a minimum and simply in order to achieve a reasonable degree of formal consistency. This has been a demanding and complex process, performed under serious time pressure. We do apologise for any mistakes or inconveniences this might have caused.

The Proceedings Book is a reminder of the research findings accomplished in the field of kinesiology, or sport sciences, or kinetics, or kinanthropology throughout the past three years. The presented papers are a basis and a probable starting point for new ones since they cover a wide range of anthropological (understood in the widest sense), methodological and didactic investigations in the areas of physical education, competitive sport, physical recreation, and physical rehabilitation.

The organizer, the Faculty of Kinesiology tried to make the 4th Conference on Kinesiology comparable to the quality level of many conferences worldwide. The Dean of the Faculty and the presidents of the Organizing and Scientific Committee wish to express their deep gratitude to all the invited speakers, contributors (authors), members of the Scientific Committee, reviewers, members of the Organizing Committee, members of the Proceedings Book Editorial Board, and, particularly, to all the Conference Office executives who made the 4th Conference and the Proceedings Book possible.

Our acknowledgments go to the Croatian Academy of Sciences and Arts and to its president a Fellow of the Croatian Academy Milan Moguš, PhD, for their traditional patronage of the Conference. Their support is of great value to the Faculty because it is a significant recognition of the work done in the domain of kinesiology.

Recognition of the Conference has been also granted by the co-organizer, the Ministry of Science, Education and Sport of the Republic of Croatia.

We are convinced that the 4th Conference on Kinesiology will affirm all the effort exerted so far in the kinesiology and will open new challenges for the future and better cooperation between scientists and the professionals. To all the Conference participants we wish a productive and beneficial time and contacts. It is our hope that new research ideas and projects will emerge from it. We will welcome the forthcoming results at our next conferences. To those who were not able to actively participate in the Conference work this year, we offer these Proceedings as an invitation for cooperation of competent partners and for joining us at the 5th Conference on Kinesiology in three years time.

Prof. Mato Bartoluci, PhD, Dean of the Faculty of Kinesiology
Prof. Dragan Milanović, PhD, President of the Organizing Committee
Prof. Franjo Prot, PhD, President of the Scientific Programme Committee

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"SCIENCE AND PROFESSION – CHALLENGE FOR THE FUTURE"

NEUROMECHANICAL FUNCTION IN EXERCISE: EXPERIENCES FROM DIRECT IN-VIVO MEASUREMENTS IN HUMANS

Paavo V. Komi

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It is usually believed that stretch-shortening cycle (SSC) in human skeletal muscle is the only normal way of muscle function. Isolated forms of isometric, concentric or eccentric actions do not occur often in real life. Running, walking and hopping are typical examples in human locomotion of how external forces (e.g. gravity) lengthens the muscle. In this lengthening phase the muscle is acting eccentrially, then a concentric (shortening) action follows. The true definition of eccentric action indicates that the muscle(s) must be active during stretch. The combination of eccentric and concentric actions forms the muscle function called stretch-shortening cycle of SSC. This type of sequence in muscle function also involves the important features of preactivation and variable activation. SSC function has a well-recognized purpose: enhancement of performance during the final phase (concentric action) when compared to the isolated concentric mode. Characteristic to this phenomenon is very low EMG activity in the concentric phase of the cycle, but a very pronounced contribution of the short-latency stretch-reflex component. The stretch reflex contributes significantly to force generation during the transition (stretch-shortening) phase in SSC action such as hopping and running.

Knowledge on the function of SSC has increased considerably when direct in-vivo measurement techniques have been applied in natural movement situations. Two basic techniques have been used in these measurements: buckle transducer and optic fiber techniques. Both techniques have been applied in measurements of several activities, ranging from low speed walking to maximal hopping, jumping and running. A wide range of tensile forces (1.4 to 9.5 kN) have been recorded under these conditions. Achilles tendon (AT) and patella tendon have been explored more extensively. AT can sustain very high forces, which in some individuals can reach as high values as 9.5 kN, corresponding to 12.5 times the body weight. More important, however, is the observation that, especially during the early contact phase of running, the rate of AT force development increases linearly with the increase in running speed. This suggests that this parameter, instead of the peak force levels, should be used to characterise the loading of the tensile tissue. These direct force measurements can be complemented with simultaneous ultrasonographic recordings of the length changes in the fascicle and tendinous structures.

The common assumption in SSC activities has been that both the muscle fiber compartment and the tendon would change their lengths in phase. This assumption has been challenged, because muscle fibers have been estimated to stay at a constant length or they can even shorten while the whole muscle-tendon complex may be lengthening. These suggestions naturally question the applicability of the instantaneous force-length and force-velocity curves equally to both parts of the muscle-tendon complex.

Several studies have recently been performed to examine the fascicle and tendon length changes combining ultrasound (fascicle length) and optic fiber (tendon force) for the vastus lateralis (VL) and gastrocnemius (GA) muscles simultaneously using different types of jumps and effort intensities. The purpose was to examine further the hypothesis that in the eccentric phase of slow SSC actions the VL fascicle demonstrates much greater increase in length as compared to a faster SSC. The following important findings were observed: (1) the fascicle lengthening/shortening does not occur in phase in the two muscles: (2) the fascicle behavior, in addition to the expected effort dependence, is also very much muscle and joint dependent: and (3) these changes in the fascicle (and tendon) are also dependent on the type of muscle action and movement. Consequently, in multijoint action it is possible that the fascicles of some muscles may demonstrate differences from the "general" rule of lengthening (eccentric mode) and shortening (concentric mode). For example, if the VL fascicle is being lengthened in the braking phase of CMJ, GA may demonstrate either no change in length or even shortening of the fascicle.

Isolation of the fascicle and tendon of the muscle-tendon complex can reveal specific roles the tendon and aponeurosis play in performance potentiation in SSC. But their potential and individual contribution may be clearly dependent on the type of SSC movement and muscle in question. Thus it is difficult to generalize muscle mechanical behavior in SSC from single experimental conditions only. In addition, this generalization becomes even more difficult in studies of SSC fatigue.

Although the effects of exhaustive SSC exercise are somewhat similar in mechanisms to those occurring after intensive pure eccentric exercise, the SSC fatigue is much more problematic and complex due to the comprehensive way in which it loads the neuromuscular system: mechanically, metabolically and neurally. All these aspects are responsible for and characteristic of the bimodal trend of fatigue response reflecting their specific roles in characterizing the damage and inflammatory processes in the progress of deterioration and recovery of neuromuscular performance. Recovery from

exhaustive eccentric exercise is reportidly bimodal as observed both in animal and human experiments. This bimodality is observable also for stretch reflex after short and long lasting stretch-shortening exercises. These changes in stretch reflex as well as in H reflex are likely to be coupled with similar changes in mechanical response. From these factors the neural adjustments, although they are well coupled with the metabolic and mechanical influences, represent greatest challenges in understanding the detailed mechanisms involved. It is usually understood that the reduced neural input to the muscles, under the influence of SSC fatigue, is at least partly of reflex origin. Different pathways have been suggested involving both disfacilitation of the muscle spindle sensitivity and presynaptic inhibition of the α motoneurone pool. There are, however, several aspects that need to be explored for further understanding of the nature and the mechanisms of exhaustive and damaging SSC exercise. These include possible structural changes in the proprioceptors (especially in the muscle spindle), and inhibitory/excitatory changes that may take place in the higher centers of the sensory and motor pathways.

Key words: *muscle mechanics, stretch-shortening cycle, in-vivo muscle function, neuromuscular control*

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HUMAN BRAIN AND PHYSICAL ACTIVITY

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Abstract

Visual and biochemical methods enable an inside into the regional cerebral blood flow and metabolic responses in connection with physical exercise. We call this new interdisciplinary area "exercise-neuroscience". Physical activity has a positive influence on cognitive brain functions and age-related degeneration processes. Increased regional cerebral blood flow during dynamic work induces an increase in production of brain derived neurotrophic factors (BDNF) as well as of IGF-1 and oestrogen. Thus, physical exercise is a stimulus for the formation of synapsis and spines as well as for neurogenesis. Exercise also induces gene expression, thereby effecting brain plasticity. Small doses of physical activity as walking two hours/week can improve cognitive effects at the older untrained person. It can be suggested that physical activity can enhance brain performance capacity and brain health – just like it has been documented for the cardio-pulmonary-metabolic system many decades ago.

Key words: *Brain and Physical Activity*

Until one and a half decades ago, little was known of the acute and chronic influence of the various motor strains coordination, flexibility, strength, speed and endurance on the brain. The application of examination techniques such as positron emission tomography (PET), functional magnetic resonance tomography (fMRT) and others allowed haemodynamic and metabolic insights into smallest regions of the brain in connection with physical activity. This produced a new and fascinating target area for interdisciplinary research. We call it "exercise neuroscience" (22).

The human brain knows two critical periods: early child age and old age. In the former sector the surplus of neurones is reduced and a life adjusted synapsis structure is formed. The latter sector from middle age initiates increasing neuronal degenerative changes. Numerous studies during the last decade have proven the extraordinary importance of physical activity in regard to health and the performance of brain functions. Today we regard qualitatively and quantitatively suitable physical activity just as important for the brain as e.g. for the cardiovascular system (20, 22). The results found for man are largely supported by macroscopic and microscopic results of animal experiments. Therefore it can be ascertained today that physical training improves brain vascularisation (5), spine and synapsis production, neurogenesis, increases the resistance of neurones and cognitive functions (review in 22). The probability of cognitive malfunctions and dementia is reduced in connection with physical training.

Regional cerebral blood flow, regional glucose metabolism, neurotrophic factors and physical activity

For a long time the rule existed that autonomous regulation of cerebral perfusion did not permit modifications by physical activity. In our bicycle ergometer tests with 25 watts and 100 watts we however observed significant regional circulation improvements of different local intensity (18). In all probands the grey-matter flow was higher than the white-matter flow. Therefore, it is a little surprising that in connection with static exercise no alterations of the regional cerebral blood flow are to be observed (27). Either mild nor moderate or heavy isometric contractions of the leg- or of the arm muscles changed the regional cerebral blood flow.

We agree with the assumption of Rogers et al. (27) that the increase of cerebral blood flow in connection with dynamic muscular exercise may depend on stimulation of mechanoreceptors in the exercising tendons and muscle and of cortical planning of the movement with influences on the effect of central activation.

It has been demonstrated that cerebral blood flow and the cerebral metabolic rate of glucose utilisation (CMRglu) are coupled in response to various mental activities. In our investigations, performed with the method of PET and the application of ^{18}F-fluorodeoxyglucose, we did not observe a significant change of CMRglu and several cortical areas in 4 different slices parallel to the orbito line from the cerebellum to the centrum semiovale. In contrast to this finding the CMRglu increased in the visual cortex by 9 % (19). This indicates uncoupling between local CMRglu and CBF under exercise in different areas. The reason may be a metabolic intervention for example by lactate or keton bodies (11).

We formed the hypothesis that the increased regional cerebral blood flow might have the task of transporting the rising production of biochemical substances as compact and fast as possible to peripheral target areas. This hypothesis

has been ascertained. Experiments with rats during treadmill exercise showed that the growth factor IGF-1 similar to insulin found in the blood is increasingly absorbed by neurones in the better circulated regions. These neurones spontaneously increase their electric activity and sensitivity for afferent stimuli. The neuronal c-fos is strongly increased in the cell nucleus only 30 minutes after the exercise commences. C-fos is the sum of 36 transcription factors and probably contributes to the storage of information and also takes part in the fixing of behaviour engrammes in the frontal lobes. The IGF-1 increasingly absorbed during the running process apparently initiates activation processes and thus produces neuroprotective strategies (10).

Only a few days after treadmill exercise the rats show an increase in their brain derived neurotrophic factor (BDNF) and the mRNA also increases highly significantly especially in the hippocampus (1, 17). The BDNF-mRNA is a plastic structure that is connected rather to cognitive functions than motor activity. This especially affected neurones in the dentate gyrus, in the hilus and in the CA3-regions and was accompanied by an increase in BDNF-protein amounts. This symptom was also observed in the cerebellum and cortex (4). The nervous growth factor (NGF) and fibroblasts growth factor 2 (FGF-2) also increased significantly (17).

If physical activity has a positive effect on the BDNF-gene-expression, learning can also profit from it. The hippocampus is the organiser of long-term memory. Alzheimer's disease strongly affects this type of memory.

Sufficiently high BDNF-values in the brain are a prerequisite for maintaining neuronal functions and for long life. Aerobic dynamic muscle work increases the expression of BDNF-receptor synapsin 1, of growth related protein (GAP-43 mRNA) and of cyclical ANP/calcium response element binding protein (CREB), which serves as mediator in the signal-transcription coupling.

The results of these experiments lead to the conclusion that a minimum amount of neuromuscular activity is required in order to secure normal values of BDNF as well as the potential for neuroplasticity.

Beta-endorphines and exercise

A constancy of beta-endorphines (beta-end) during an exercise intensity up to 60 % of the individual maximum oxygen uptake is to be observed (12). A higher exercise intensity caused in our examinations an increase of Beta-end analogous to that of the arterial lactate level (2, 12). An exercise of longer duration than 50 or 60 min also initiated an increase, the lactate level did the same. When the maximal O_2-uptake was reached, the beta-end level attained three fold of the rest value.

In double-blind cross over designs we investigated the significances of endogenous opiates on pain and mood. Pain threshold was measured with a technique of dental electrical stimulation. It increased significantly after exercise until exhaustion. Naloxone, an opiate antagonist, abolished this phenomenon. Psychological questionnaires reviewed mood changes to an euphoric state.

Synapsis and neurone regeneration in connection with BDNF and exercise

Physical activity influences other genes in the brain apart from BDNF. The medial septum which has cholinergic and GABAergic relations to the hippocampus participates in the increased production of BDNF in connection with physical activity (10). A mechanism modulated by acetylcholine (Ach) supports the BDNF-gene-expression in the hippocampus (39). It can be assumed that this action is also subject to a regulation made by physical activity. A strong participation of the medial septum with activity dependent regulations of the BDNF-gene-expression is definite (10, 36).

The BDNF-gene-regulation also includes a monoamine induced signal. This signal travels via the tyrosinkinase, which conveys the biological effect of neurotrophin 3 (NT-3) via according receptors. NT-3 regulates the proliferation of neuronal precursor cells and enhances the survival of specific neurone populations (29). Antidepressant medication that boosts the transmission at monoaminergic synapses also increases the BDNF-gene-expression in the hippocampus (28). In combination with physical exercise this effect is increased additionally. The signal system induced by noradrenaline may be of particular importance to the BDNF-gene-expression (23).

As mentioned above, physical activity stimulates the absorption of IGF-1 from the blood into the brain. This especially affects the hippocampus and the frontal brain. In close connection to this the amount of newly generated neurones rises in the hippocampus. Physical exercise proved to be the strongest stimulus for the generation of new neurones. The pharmacological suppression of the IGF-1-absorption from the bloodstream largely blocked the generation of new neurones (8).

It can therefore be established that physical exercise with aerobic dynamic muscle activity increases brain plasticity and has direct influence on the quantity and quality of neurones and synapses. Neuronal connections can be strengthened and their efficiency can also be enhanced by an increased synaptic capacity and the adding of new neurones (3, 14, 25, 26, 37).

Body periphery and brain functions

Animal experiments carried out in the 1980s and 1990s proved that the organisation of the cerebral cortex is subject to constant changes in the macroscopic and microscopic area that are functionally triggered by the body periphery and partly also controlled by it. As Elbert et al. (13) were able to show, few days of training suffice for re-organising the cortex. If the exercises are practiced with one hand the cortical representation of the other also changes. In the corresponding experiments this could be reduced by 25% within only a few days. The respective inactive area soon participates in the processing of information from neighbouring areas. These practically penetrate the area that was rendered inactive. Accordingly after amputations parallel changes of the cortical map in regard to somatosensory and motor cerebral cortex occur (7, 15, 32).

From the body periphery estrogen has an influence. The hormone has a protective effect against neurodegenerative changes. Physical work leads to an increase of the estrogen level. Studies by Cotman and Berchthold (9) showed that especially in women the brain related positive influence of physical activity is due to the presence of estrogen. After a two-month estrogen extraction physical activity was not able to produce an increase of BDNF-mRNA or protein in the hippocampus of a female rat. If the physical training was however combined with estrogen supply the result was a stronger increase of BDNF-protein (16).

In contrast to well-dosed physical training, overexertion of longer duration leads to dendrite atrophy and spine reduction. Corticosteroids probably play a part in this process. Animal experiments showed that these hormones reduce the BDNF-availability in the hippocampus (4). At the same time an atrophy of the hippocampus is to be observed. If physical training of the rats lasting several weeks is abruptly terminated, the BDNF values fall below initial resting values (38). This result apparently correlates with that depressive effect that is often observed in high performance athletes when their high performance training is abruptly terminated due to e.g. an injury ("sport withdrawal symptoms"). The symptoms of so-called overtraining probably also correlate with altered brain plasticity. In this context the frontal cortex may play a special role due to the hierarchical structure and organisation of brain and body functions (22).

Three weeks of running leads to both an increase and decrease of numerous genes in the hippocampus of rats (24). Many of these affect the synaptic functions and plasticity through their connection with membrane-transport mechanisms and synapse growth. This leads to the conclusion that physical activity has a very strong regulating effect in the entire brain physiology (9).

Physical activity influences psyche and depression

Psychological stress can possibly lead to depression, which is probably accompanied by a reduction of the BDNF-mRNA level in the hippocampus. The effects of mental stress on cardiovascular and sympatho-adrenal reactions can be reduced by aerobic dynamic activity (6, 28). The combination of physical work and antidepressant medication led to a significant increase of BNDF-mRNA level in the hippocampus, which were far greater if physical work was included than with medication alone. Which individual factors may be responsible for this at cell level is still unknown (35).

General aerobic dynamic endurance and its cognitive effects on the aging brain

Age-related modifications to the brain commence at about the age of 50 to 60. They affect among other things the reduction of dendrites along with spines. The latter constitute the area of human short-term memory. The reduction of their number and the subsequent quality reduction of short-term memory is the first functionally apparent age-related change. In experiments with male test persons aged on average 69 +- 3.5 years, we employed O-15-butanol-PET-scans to examine behaviour patterns and efficiency when learning and testing word-pairs with a high visual content but without any semantic relation. We compared the results to those obtained with younger men with an average age of 24 +- 3.6 years and were able to deduce that with increasing age identical intellectual performance coincides with the activation of larger brain areas. If older test persons had however undergone endurance training for more than 25 years, the results were more similar to those of younger men and showed significant differences to those of untrained test persons of the same age. The apparent training effect was the activation of smaller brain areas under identical mental performance. Therefore the brain is probably also susceptible to a similar training-related economisation process known to us in the cardiovascular field after training (30, 31).

Marathon runners with an average age of 70 years that still regularly performed 65 km per week at the time of the tests, showed reduced adrenaline suppression under dexamethasone 90 minutes after an injection of corticotropin-releasing-hormone (CRH). After 20 weeks of aerobic training (3x walking per week with a duration of 30-60 min) older untrained patients showed no changes in the hypothalamic-hypophyseal-adrenaline and gonadal axis function. However, the training did produce a significant improvement in cognitive tests and general well-being of the test person (33, 34).

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TRENDS IN PHYSICAL EDUCATION AND SOCIETY: CHALLENGES FOR THE PHYSICAL EDUCATION PROFESSION

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Abstract

The turn of the year 2000 millennium coincided with alleged inactivity crises, obesity epidemics, concerns about drop-out rates from sport amongst young people as well as real and perceived reductions of school physical education across the world. The overriding purposes of this paper are to indicate trends in physical education since the 1999 Berlin Physical Education World Summit, address some societal changes (sedentary lifestyle patterns, obesity trends in sport, impacts of Information Communication Technology, legislation, litigation and environmental issues), and make considered suggestions to bring about amelioration of policies and practices in the provision and delivery of quality physical education programmes. The suggestions and concluding comments refer to 'messages' that need to be heeded and focus on strategies to assist in the process of conversion of 'promises' into 'reality' and so contribute to fostering lifespan engagement in physical education-related activity.

Key words: *Trends in school physical education; societal change; messages and challenges for the physical education profession; quality physical education; framework of standards.*

Introduction

Around the turn of the millennium, international surveys (see Hardman & Marshall, 2000; and Hardman, 2002) exposed inadequacies in school physical education provision and delivery and revealed geographically widespread concerns about common trends and issues, which were acknowledged by international organisations such as UNESCO and the Council of Europe:

- "Twenty one years after the proclamation of the International Charter, physical education and sport at school…did not yet seem to be national priorities and were often the target of budget cuts" (Kaisa Savaloinen, UNESCO,1999)
- "… the crux of the issue is that there is too much of a gap between the promise and the reality" (De Boer-Buqiccio, 2002).

Since the Berlin Physical Education World Summit (November 1999), MINEPS III Punta del Este Declaration (December 1999) and Council of Europe Informal Meeting of Sports Ministers (Warsaw, September 2002), the developments in school physical education policies and practices across the world have been diverse: there has been an array of individual and institutional endeavours to improve the quality of physical education provision and so enhance the experiences of children in schools; and equally there is evidence to generate continuing disquiet about the situation. Essentially, the situation is typified by little change in some regions and by 'mixed messages' in others as illustrated by the following exemplars.

In several central and eastern European countries, democracy has made politicians prone to ideology and 'wish-listing'; however, the realities of implementing 'idealistic' curricula have not been properly thought through, as their realisation requires financial investment, new pedagogical and didactical interventions and relevant infrastructure. In Poland, the stipulated five hours of compulsory physical education for all schools (Physical Culture Act 1996) are unrealisable because of economic rationalism, whereby financial realities have intervened to produce an average of just less than three hours of physical education per week as standard practice. Economic realities have led to reduced budget allocations in Canada. In provinces such as British Columbia, where 'generalist' practitioners with little or no training in physical education teach most elementary school physical education classes, cuts in numbers of advisory consultants and curriculum co-ordinators has impacted adversely. Consequently, innovative active lifestyle curricula, which need the assistance of relevant professionals to implement them, are left to gather dust on shelves (Turkington, 2002). However, a recent announcement to invest $15.5 million in more physical education curriculum time by the British Columbia government may signify a turning point in developments. At the present time in the United States, there is an educational environment that stresses accountability and achievement in core, so-called, 'academic subjects'. President Bush's *No Child Left Behind Elementary and Secondary Education (NCLB) Act* (2002), neglected in omitting some subjects such as physical education and health, to address the debilitating condition of the nation's youth and did not acknowledge any link between health, physical activity and academic performance. The Act has created unintended negative consequences by contributing to increased marginalisation of physical education in many states (Keyes, 2004) with mandated time not

being met (e.g. Illinois, Maryland, New Jersey, Washington and Wisconsin) and waiver programmes allowing exemption from mandates.

The Physical Education Curriculum and its Delivery: Quality Issues

A major issue is that of the relevance and quality of physical education curricula around the globe. In some parts of the world physical education curricula are undergoing change with signs that its purpose and function are being redefined to accommodate broader life-long educational outcomes. Nevertheless, there remains an orientation towards sports-dominated programmes, in which competitive performance-related activity has a significant role. Such sustained orientation raises issues surrounding meaning and relevance as well as quality of programmes provided and delivered. Numerous examples testify to perceived negative impacts; suffice it here to provide illustrations from the English-speaking world.

A small private school primary physical education teacher in **Toronto** notes: "…Last year many of our gym periods were marred by intense and destructive competitions". Whilst in the **Bahamas**, the "current popular persuasion is to provide added emphasis on elite athletes for interscholastic programmes rather than on general PE for the entire student body" (Government Official, cited in Hardman and Marshall, 2000). Persistent media headlines in the **United States** variously draw attention to questionable quality in physical education practice:

- So just how bad is your child's gym class? P.E. programs often poorly run, provide few health benefits (The Associated Press, Jan. 17, 2005)
- Experts Dissatisfied With PE Classes (The Associated Press, Jan. 17, 2005)
- Obesity Up, Phys Ed Down (Turner, 2005).

A Californian student's comment that "…I don't think we should have to take that (PE) class. It doesn't help me in any way with preparation for my future life. It's really a waste of time. I don't learn anything there. I don't even get a chance to do much" (p.21) caused Griffey (1987) to assert that teachers "have failed to provide an experience that they (the students) perceive as meaningful" (p.21). The failure to provide a meaningful experience was perhaps behind the Manitoba Minister of Education's remark that "the attitudes of society (have) not been positively affected by their physical education experience within the school" (cited in Janzen, 1995, p.8). It is a remark that is underlined by many individual experiences in schools: a Lansing State Journal reporter records that his

> "school gym class experience was one long, drawn-out horror show"…with teachers showing no interest in him as he did not belong to the athletically gifted; they were "too busy lavishing all of their positive energy on the gifted jocks". The only form of attention received was "never-ending shouts of emasculating and degrading insults at my every effort" (and) gym class was responsible for many agonizing and demoralizing moments of my life" (Ford, 2003);

a 'seasoned' teacher remembers his

> "PE teacher shouting, when it was my turn to run the hundred yard dash, 'Oh, Reynolds is up, someone get me a calendar to time him!' I learned to hate PE. Through High School and College, I 'let myself go' physically, hating to participate in sports, and that turned into hatred of exercise" (Reynolds, 2001);

and a Scottish individual's recounts his experience of spending his

> "teenage years dreading games, shivering on rugby fields and subject to all manner of rebuke for my ineptitude at the game from staff and schoolmates. In my final week at school I finally confronted my physical education teacher and challenged him as to why I'd been made to endure this torture. "Well son", he replied, "at least you know now that you can't play rugby, and that's what we call an education" (Anon, cited in Kay, 2005).

Under these circumstances credence can be given to a Michigan State elementary school physical education teacher's lament that there

> "is a VERY negative subject matter bias towards physical education based on decades of poor physical education programs. These people do not TRUST us! They see no value in what we do and can only make decisions based on their personal experience" (Vickroy, 2003).

Quality of provision embraces not only curriculum content but also delivery. Examples from around the world suggest lack of commitment to teaching and pedagogical and didactical inadequacies in some countries:

- "…PE is often taught by unqualified teachers…" designated as "remote control teachers, who provide a ball, sit by a tree or stay in the staff room. (At) the end of the lesson, the teacher blows the whistle and the pupils return to the classroom" (PE Teacher, Malaysia, cited in Hardman and Marshall, 2000)
- "… Very often teachers take children outdoors and leave them to do their 'own thing'. Some teachers will take the children and play a game with some children and leave others unsupervised. Most sessions are done haphazardly" (St Vincent Government Official, cited in Hardman and Marshall, 2000)
- "We still have coaches/teachers who only worry about summer vacation, and they roll out the ball for nine months waiting until they can go golfing again. This is a huge reason PE has such a bad name" (United States High School PE Teacher, cited in Hardman and Marshall, 2000).

In the domain of pedagogy and didactics, research (Egger, 2001) found teachers and students differentially perceive the quality of a lesson and they differentially attach value to, and evaluation of, the same experience of physical

education. Students' personal interpretations of what physical education is about, what it does for them or what it means are important factors mediating the effect and efficacy of a curriculum. Central to children's interpretations of physical education is an understanding of its relevance to them. Giving voice to children and their perspectives is receiving more research attention. Groves (2001) argues that if real voice is given to students, then the teacher enhances possibilities for providing a meaningful and relevant experience in physical education. The essence of Egger's (2001) study was about students being able to take more responsibility for their own learning. Brettschneider (2001) reinforces the resonance of being an independent learner through his observations on young people's lifestyles; they are increasingly shaping their own biographies, in a personal context of gaining independence within a societal environment of decline of established institutions. What various research studies are demonstrating is a shift towards student-centre learning, in which, apart from greater interaction and negotiation in the teaching/learning process, there is increased emphasis on the learner being responsible on what and how learning occurs.

Societal Changes

Changes in society and concomitantly in values and norms over the last 40 years have impacted and continue to impact on **life-style behaviours and patterns** in numerous and varied ways. The development of **sedentary lifestyles** has coincided with widespread reduced opportunities at school for daily physical activity especially in economically developed countries. As children's amounts of vigorous exercise and energy expenditure have decreased, so their engagement in television viewing and electronic games has risen steeply. Paradoxically, computer simulation software offers opportunities to 'participate' in a range of physical and sporting activities without leaving the comfort of the armchair. Sedentary lifestyles and concomitant 'activity (more accurately 'inactivity') crisis' over the last decade in many economically developed countries, have been linked in regular reports with an obesity epidemic and related rising health costs. The US National Center for Disease Control (CDC) in its Report on physical activity noted:

> "… Our nation's young people are, in large measure, inactive, unfit, and increasingly overweight… Ultimately this could have a devastating impact on our national health care budget. In the short run, physical inactivity has contributed to an unprecedented epidemic of childhood obesity that is currently plaguing the United States" (CDC, 2000, p.1).

In Michigan, USA, the economic cost of physical inactivity cost the State nearly 9 billion dollars in 2002 (Vickroy, 2003). UK obesity-related health care and wider economy costs are estimated at over £7 billion per year (Meikle, 2004).

Some attempts to tackle rising levels of obesity demonstrably show some governments' piecemeal efforts and sending out contradictory messages. In England a government ban on advertising on vending machines in schools was later followed by a Department of Culture, Media and Sport Minister's scheme, the Cadbury's *Get Active* campaign, in which schools could claim sports products in exchange for vouchers on chocolate wrappers. Similar contradictory messages are seen in the Scottish Executive-backed *YoungScot* discount card, which was automatically distributed to every secondary school pupil in Scotland and offered youngsters special deals at McDonald's, KFC and local chip shops. The contradictions are also seen in contraction of playing fields and parks numbers by one sixth in the last 20 years and in Public-Private Partnerships that have blocked the path to exercise with organisations promoting physical activity unable to afford new rents charged by companies, which manage the school grounds. As if the fall-out from the *No Child Left Behind* enactment was not enough in the United States, in the same newspaper article in which the Health and Human Services Secretary announced that "… We are eating just too darn much and we're going to do something about it", the Bush administration announced that funding for the *VERB* campaign, a CDC project to promote physical activity among 9-13 year olds, would be cut from 36 million dollars to 5 million dollars (Herzog, 2004). Given the positive propensities of physical education, a more appropriate enactment than *No Child Left Behind* would be *No Child Left on Their Behind*!

A second area of societal change, which has important consequences for the physical education profession, is that of **trends in sport**, outside and beyond schools. Since the formal articulation of Council of Europe policy principles in the 1970s, which were adopted and further developed by UNESCO in its Charter on Physical Education and Sport in 1978, sport has increasingly been more broadly defined to encompass various forms of physical activity from spontaneous, unorganised physical exercise, through recreational physical activity to high level competition, in all levels of which the broadest possible sections of the population could engage in sport regularly, in accordance with each individual's aptitudes and interests. The ideological model of 'Sport' ('for All') has an orientation to personal motivation and to participation. This orientation is consistent with present-day self-realisation and active life-styles concepts for which school physical education curricula are considered to be significant contributory determinants. In the sociologically termed 'post-modern society', self-realisation is a key ingredient in the process of individualisation. In this context, physical activity is internally differentiated and boundaries from achievement maximisation and competition to fulfil a range of new functions (pleasure, fun, adventure and excitement, body sensation, recreation and health) are extended. Changes in leisure patterns, spectacular/individualised, are evident as new technologies compete for the attention of potential participants. Additionally, socio-psychological developments also impact on leisure pattern behaviours: peer pressures are replacing the importance of adults as socialisation agents and formal, organised sport is becoming secondary to informal, unorganised sporting activity as young people become more discerning in what they are looking for.

There are several other trends, which pose challenges for the physical education profession. Here, I draw attention only to technology, legislation, litigation and environmental issues. Within the teaching/learning process, Information Communication Technology (ICT), ranging from television, digital camcorders, video players, music sound systems, overhead projectors to digital computer technology, has come to have a significant role in schools. Its impacts have grown considerably and physical educators should not ignore the advances made. Indeed in England, the National Curriculum for Physical Education strongly advocates the application and development of students' ICT capability through the use of ICT tools, for which physical education teachers should be prepared to a level of competence. With the use of ICT in teaching there comes a shift in the role of the teacher, who becomes more a facilitator of learning rather than the only information resource.

Inclusion and **equity** have become globally important issues over the past 20 years and many countries now have **legislation**, more often than not embedded in anti-discrimination laws related to disability, gender and race amongst others, in place. Here, I shall restrict my observations to gender issues. In some countries or some areas within countries, it is admitted that females are excluded or have limited opportunities in physical education because of reasons embedded in cultural interpretations of religion. This is particularly applicable amongst Muslim communities. Cultural factors or beliefs concerning the effects of exercise on females such as rendering the female body un-feminine are also referred to in different parts of Europe as causal factors in gender disparity in physical education provision. Limited opportunities in terms of number and type of activities available for girls in physical education programmes (girls have fewer activities on offer) are cited in some countries and cultures as being non-too discrete forms of gender inequity. Apart from cultural constraints, other reasons for these inequities are seen to lie with inappropriately or inadequately prepared teachers as one cause of gender inequities in some countries (Hardman and Marshall, 2000).

Within the setting of education, there is increasing evidence that physical educators are being subjected to **litigation** procedures in cases, for example, where students have suffered injury, when engaged with curricular or extra-curricular activity. Parents and students have become much more aware of the law and their legal rights, especially when issues such as negligence, risk and duty of care arise. Increasingly, we read of teachers being sued for negligence in teaching situations (imprecise or unclear instructions, inadequate safety precautions, failure to correct faulty technique etc.). Litigation procedures are much in evidence for injuries etc. sustained during participation especially in activities such as contact sports, gymnastics and outdoor adventure/risk pursuits. Clearly, possibilities of litigation procedures have considerable implications for physical education teachers both directly where individual and groups of students are concerned and indirectly where 'third party' considerations have to be taken into account. Risk assessments are almost becoming a day-to-day essential.

Another area of heightened awareness is that of **environmental considerations** and particularly in situations where activity may be occurring in ecologically sensitive areas, usually in natural surroundings. The issues revolve around access for physical activity and preservation of the natural habitat and participation in outdoor adventure type pursuits, which need to achieve a balance between activity and protection of the habitat.

Messages and Challenges for the Physical Education Profession

The summary overview of issues and trends contain a number of messages that need to be heeded and, which give rise to a number of challenges for the physical education profession. Despite my comparativist's reservations about prescriptions to bring about amelioration of policies and practices, some adaptable 'universalities' or a set of global standards, can be considered for 'local' application.

Definition

There are dangers in interchangeable and often prescriptive use of the terms 'physical activity' (the health agenda and obesity issue) and 'sport' (the medals winning syndrome) synonymously with 'physical education'. Indeed, a British Columbian Curriculum Co-ordinator posits whether it is the

> "erosion of physical education; if physical activity is the direction our profession is moving towards, then why do we need PE teachers and why teach PE? School boards could save tens of thousands of dollars by not hiring PE teachers and just hiring PA directors. Are we a dying breed?" (Young, 2005).

Underpinning strategic development of quality physical education is the notion of the cultivation of physically educated persons, which gives rise to a definitional issue. Arguably, 'physically educated persons' might be described as being physically literate, having acquired culturally normative skills enabling engagement in a variety of physical activities, which can help to maintain healthy well-being throughout the full life-span; they participate regularly in physical activity because it is enjoyable; and they understand and value physical activity and its contribution to a healthy lifestyle. Thus, socialisation into, and through physical activity, has to be a core component of the physical education teacher's sphere of pre-occupation. Notably, the link with lifespan activity engagement implies that physical education, therefore, does not begin and end in schools.

For socialisation into life-span physical activity engagement, the school physical education curriculum and its delivery need to be conceptually and contextually re-appraised. The widespread practice in physical education curricula to provide experiences, which merely serve to reinforce achievement-orientated competition performance sport is a narrow and unjustifiable conception of the role of physical education. In this context, it is unsurprising that pupil interest in physical education declines throughout the school years and youngsters become less active in later school years. As I have argued previously (Hardman, 2003), for many children (boys and girls), such programmes do not provide personally meaningful and socially relevant experiences and they limit participatory options rather than expand horizons and thus, are contrary to trends and tendencies in out-of-school settings amongst young people. Collectively, such "joyless experiences" (McNab, 1999) acquired from unwilling engagement in competitive sport-related physical education are a 'turn-off' and only serve to increase the 'drop-out' rate of participants from school-based and post-school sports-related activity. If physical education is to play a useful role in the promotion of active lifestyles, it must move beyond interpretations of activity based upon performance criteria. The current frame of reference should be widened. The preservation of physical education in its old state is not the way to proceed. Its content has little relevance to young people's life-style context and there are considerable discrepancies between what occurs in physical education lessons and what is going on outside and beyond the school. It is time to move into the 21st century!

Quality physical education programmes are the foundation of the participation pathway and as Malina (1996) indicated positive activity experiences and habits formed during childhood are more likely to lead to an increased tendency to participate in those activities in wider community settings. The corollary is that negative experiences while young are likely to reduce those experiences later in life. A school's role then extends to encouraging young people to continue participation in physical activity, through the provision of links and co-ordinated opportunities for all young people at all levels and by developing partnerships with the wider community to extend and improve the opportunities available for them to remain physically active. Hence, the need for wider community-based partnerships, but physical education should be seen as the cornerstone of systematic physical activity promotion in schools and recognised as the foundation base of the inclusive participation pyramid. However, with only up to two hours per week time allocation (in many countries it is frequently less), physical education cannot itself satisfy physical activity needs of young people or address activity shortfalls let alone achieve other significant outcomes. Mutually respecting and integrity protecting partnerships at all levels with shared values and agreement on roles and responsibilities are necessary to facilitate full lifespan inclusion and engagement. Bridges do need to be built, especially to stimulate young people to participate in physical activity during their leisure time. Many children are not made aware of, and how to negotiate, the multifarious pathways to out-of-school and beyond school opportunities. PETE programmes should address these facilitation and intermediary roles of the physical education teacher. Of course it would be naïve to assume that the physical education professional could take on and fulfil all of these responsibilities. Support is fundamental to the realisation of such ideals. It can be achieved through the collaborative, co-operative partnership approach involving other professionals and committed, dedicated and properly mentored volunteer individual and group enthusiasts. Personnel functioning in partner institutions should have appropriate skills and competences, which might be acquired through some special training. There needs to be a clear recognition of the respective contributions of the partners and of the different qualifications of those who deliver it - teachers, coaches etc. There are risks to physical education as some governments seek increased provision outside of the school. Indeed, The French government in 2004 reduced numbers of trainee teachers in recognition that sports club 'animateurs' can fulfil the éducation physique et sport' teacher role and in recent years a number of other countries (for example Sweden, Portugal and some of the Länder in Germany), have entertained notions of locating physical education, in whole or in part, outside the main school curriculum, delivered essentially in local sports centres at lower cost thus, compromising the educational integrity and identity of physical education in schools. In the current socio-political climate this is perhaps inevitable but partnerships with community agencies do carry a number of opportunities. The physical education – sport relationship is not necessarily a problem *per se*, but the nature of the relationship certainly can be. The tensions generated by the Janus face characteristics of 'Sport' (elite performance outcomes v. grass roots recreational outcomes) need to be resolved. Are physical education teachers employed to produce elite sports performers or highly specialized physical recreationists? No, of course not, because primarily they are educators and facilitators. However, in pursuit of the optimum development of young people, they do have responsibilities for creating awareness of opportunities for activity engagement outside school settings. Thus, at the very least, their professional preparation should embrace familiarisation with pathways for participation in wider community multi-sector provision and the achievement of personal excellence.

If children are to be moved from 'play stations' to play-grounds' (Balkenende, 2005), any re-conceptualisation and reconstruction of physical education, which contribute to the creation of the 'physically educated' or 'physically literate' person, do need to be accompanied by improvements to raise the quality of teaching and learning processes. The pedagogical and didactical shifts alluded to earlier in this paper have important consequences for physical education teacher education (PETE) both at initial and in-service training levels. Physical education delivery will benefit from re-orientation towards placing more responsibility on students for their learning with the managerial responsibility of the teacher progressively transferred to pupils. The enhanced pupil involvement generated by this process will assist in facilitation of opportunities for individual meaningful and socially relevant experiences Hardman, 2003). Reflective

practitioners will translate into reflective students! Initial and in-service training/further professional development should properly address these pedagogical developments. This is particularly important in primary/elementary schools, preparation for which is often generalist rather than specialist. Here the employment of 'Curriculum Co-ordinators' with specialist knowledge and expertise to act as mentors, provide advice and guidance to non-specialist colleagues particularly on curriculum development and delivery, will help to enhance the physical education experience of children.

School physical education should be a core part of a balanced curriculum with adequate resources and time allocation. "Quality Physical Education" (QPE) has become a much used term in many countries but rarely has its nature and scope been defined. One 'universality', which might help define QPE, arguably comprises the following characteristics:

- serves diverse needs of all children/students in schools; this implies a balanced and coherent curriculum, sufficient in width and depth to be challenging to all, delivered so as to ensure differentiated learning tasks and teaching styles or interventions appropriate both to the students and to the tasks
- is formatively/developmentally based and progressively sequenced with clearly defined aims and learning outcomes
- provides opportunities and experiences for enhancement of knowledge, understanding and movement skills in a variety of physical activities
- fosters creativity
- promotes safe behaviours and management of risk-taking and other challenges
- promotes positive self-concepts and social interaction, a range of psycho-social qualities, and morally sound values and behaviours
- provides for enjoyable engagement

In turn, these characteristics lead to what might regarded as positive outcomes of QPE programmes:

- student commitment to physical and sporting activity
- understanding what and how to achieve through informed use of principles
- understanding of essential role of physical education in contributing personal well-being and to a balanced healthy, active lifestyle
- confidence to engage in physical/sporting activity in a variety of capacities and settings as well as take initiative
- acquisition and application of a range of skills and techniques with good body control and movement
- willing participation in different types of physical/sporting activities
- reflective thinking, appropriate decision-making and taking, and adaptive behaviours
- determination and commitment to achievement and improvement
- development of stamina, suppleness, strength and flexibility
- demonstration of enthusiasm for, interest in, and enjoyment of participation.

Whilst QPE is related to quality of teachers and teaching, relationship with students, activities and facilities, an important issue for its delivery is the amount of **curriculum time allocation.** There is considerable scientific evidence to suggest that at least 30 minutes daily moderate to vigorous physical activity is necessary to sustain a healthy active lifestyle. In Europe, the European Physical Education Association (EUPEA) recommends daily physical education in the early years of schooling (elementary grades, up to 11 or 12 years of age and 3 hours (180 minutes) per week in post-elementary (secondary/high schools) grades. In the United States, the National Association for Sport and Physical Education (NASPE) recommends a minimum of 150 minutes per week for physical education in elementary schools and 225 minutes per week for middle and high school students. *Recommendations* by the Council of Europe Committee of Ministers on 30 April 2003 included a significant reference to physical education time allocation: an agreement to "move towards a compulsory legal minimum of 180 minutes weekly, in three periods, with schools endeavouring to go beyond this minimum where this is possible" (Council of Europe, Committee of Ministers, 2003) and a call for one hour of daily physical activity in or out of school settings.

A **framework of standards for teachers** needs to be established with a base of at least minimal expectations of all teachers with responsibility for delivery of physical education programmes. Various models for standards can be framed. The framework currently implemented in England and, particularly its inherent principles, especially as it also serves to identify areas for further professional development could be adapted for application in other countries to suit different national contexts. Essentially the framework comprises a matrix of hierarchical order of qualifications, experience and positions held (newly qualified teachers to head-teachers) and areas of standards expected (variously at micro, meso and macro levels) under a series of headings:

- knowledge and understanding (of the subject physical education)
- planning and setting expectations (e.g. effectiveness of planning, identification of objectives, content, lesson structures relevant to students being taught; clear learning targets; and building on prior attainment)
- teaching and managing student learning (e.g. technical competence in teaching; good standards of control and discipline; and use of appropriate teaching methods/interventions)

- assessment and evaluation (of learning outcomes; monitor formative progress; and provide constructive feedback)
- student achievement (acquisition of knowledge, skills and understanding; and secure progress towards targets)
- relations with parents and wider community (preparation and presentation of reports to parents; understand need to liaise with other welfare responsible agencies)
- managing own performance and development (responsibility for own professional development and responsibilities, reflective practice, keep up to date with subject developments)
- managing and developing staff and other adults (establish effective working relationships with colleagues etc.)
- managing resources (selection and use of learning resources), and strategic leadership (with experience demonstrate competence in policy formulation etc.).

The importance of the compelling case for school physical education (improved healthy well-being and physical fitness, weight control, movement knowledge/motor skills development, enhanced self-concepts, stress management, psycho-social development, disease prevention, speedier illness/injury rehabilitation, enhanced cognitive function/academic performance and protection against the ageing process etc., etc.) has not been well understood or articulated beyond the community of physical educators. **Communication** of the accumulated evidence to support compulsorily required physical education in schools needs to be presented clearly, concisely and simply to relevant authorities and agencies. The value of communication to ALL components of society, teachers, parents, and government officials cannot be over-estimated. Therefore, communication strategies should be considered. Media communication initiatives should involve the use of local levels of public relations' exercises and so reach the realms of the underprivileged, which television and elite magazine advertising campaigns as luxury means of communication cannot, and do not, reach.

A counter to the trends in increases in, or rather should I say increased awareness of, health and social behavioural problems and the rise in physical inactivity, is **research**. The messages from research and good practice need to be widely disseminated through appropriate media channels. Mediatisation of the messages of 'getting the rear into gear' are important to reach the full range of social institutions, communities and individuals and their respective implementation settings. The physical education teacher needs to be trained as a reflective practitioner who is able to engage in action research, interpret and apply findings. Properly resourced INSET/CPD courses and programmes also have an important role here and, (I do not hesitate to argue this), should be made compulsory on a regular basis in the name of personal, professional and career development).

In many countries, and especially **in economically developing nations**, there are broad-scale disparities in involvement in physical and sporting activity, many of which relate to deprived socio-economic conditions. Increased opportunities for participation in physical activity/sport should occur through long-term strategies designed to create programmes and services integrated with life-span skills. Helping less privileged others to help themselves is important here. In summary strategies could encompass the following:

- pooling of resources for physical education and sport with other community partners in private and voluntary enterprises and especially in impoverished areas
- promoting innovative physical education programme initiatives that integrate life skills with opportunities for physical activity
- maximising human resources by utilising senior and older students and suitably qualified individuals as activity facilitators in elementary schools
- developing community out-reach programmes
- promotional efforts should be concentrated at grass-roots community levels rather than on elite sport competitions, which more often than not leave the man-in-the street on the street and outside of the arena.

ICT can offer considerable advantages for use in teaching (including materials) and learning as well as in the management and administration of physical education-related matters in schools. For the latter, computers allow continuous modification and updating of curriculum programme schemes and lesson plans, records and assessment data bases, student achievement profiles etc. E-mail communication enables direct and rapid communication with colleagues and with other schools. Internet access provides up to date information, which means that teachers can keep abreast of developments and can establish their own school web site. Heart-rate monitors and other equipment to assess health and fitness not only provide accurate results but also help to maintain student motivation, as do CD ROMs for the latter. Real value can lie in enhancement of teaching/learning by use say of a digital camcorder for recording performance for individual or class analysis thus, contributing to development of student observational and evaluation skills, enhancement of tactical and strategic contributions to team play etc.; it also facilitates possible links with media studies subjects for recording/editing techniques.

With anti-discriminatory **legislation** (any legislation aiming to foster inclusion and equity is to be welcomed), **increasing litigation procedures and heightened awareness of environmental considerations**, it seems logical that teacher education courses in general and physical education courses in particular at initial and in-service stages should include units on fundamentals of law as applied to physical activity situations and settings as well as those units, which help to develop and raise awareness of how participation in physical activity in sensitive habitats need not conflict with

protection, preservation and conservation of those environments; integration with other subjects is central to good practice here.

The Illusory and Actual Physical Education Teacher

So as a newly qualified, enthusiastic, committed young professional PE teacher do I turn up at school on my first day, dressed in my all-weather track-suit, worn over my swimming trunks, games kit, driving my go-kart with a trailer containing clothing and equipment for American rules football, badminton, basketball, boules, cricket, handball, hockey, netball, rugby, squash, soccer, tennis, volleyball and multifarious other games, for dance, gymnastics and track and field activities, martial arts, combat sports as well my mountain bike, inline skates, cross-country and downhill skis, snow and sail boards, sand yacht, kayak, sailing dinghy, snorkel and deep-sea diving equipment, parachute, micro-light craft and ICT facilitation, carrying my manuals on old and new teaching and learning methods, legislation and litigation with guidance on risk assessments, empowerment of children, communication and interpersonal communication skills, especially on negotiation with students about what they are to do that day etc., texts on research and its application and armed with information to raise awareness of out-of-school and beyond school opportunities and providers? No! Of course this is both unrealistic and impossible. What I need to be armed with is a range of competencies and strategies to optimise the personal and social development of all students and enable them to make informed decisions on the need for, and relevance of, continuing physical activity engagement and choices as to when and where this can be continued in the wider community of which they are destined to be part.

Concluding Comments

The physical education profession needs to heed the perceived continuing concerns about the subject's situation in schools and the consequences for life-long physical activity engagement, the societal changes, which have consequences for the nature and scope of the overt and discrete physical education curriculum in and beyond schools as well the pedagogical and didactical developments in teaching and learning enhancement. Essentially, practitioners have to be reflective and proactive and to be prepared for flexible career patterns to accord with the various changes and developments, which relate to the now widely accepted longitudinal applicability of physical education as a life-span process. Implicit is that Physical Education Teacher Education should contain career management courses and that initial and INSET/CPD should contribute to the flexible role of the teacher in the school as community in a partnership context of out-of-school and beyond school communities.

The principle of partnerships embracing multi-sectoral policies is an essential feature of the policy framework of the World Health Organisation's (2004) *Global strategy on diet, physical activity and health* as well as UNESCO and Council of Europe policy principles. In many countries, physical education in schools, school-based extra-curricular sport and physical/sports-related activity outside and beyond schools have been considered as separate entities and yet they are one and the same part of the whole: they share common goals! Physical educators are strategically well placed to reach the widest range of young people with positive experiences in, and messages about, participation in physical activity and they have key roles to play as facilitators and intermediaries between the school and wider local communities. They should identify and develop pathways for young people to continue participating in physical activity outside school and ensure that information is available to them within school on the opportunities available in the local community.

The Berlin Physical Education Summit *Agenda for Action for Government Ministers* (1999), the MINEPS III Punta del Este *Declaration* (1999), the Council of Europe's Warsaw Meeting *Conclusions* (2002), UNESCO's *'Round Table' Communiqué* (2003) and the MINEPS IV Athens Declaration (2004) together with the WHO *Global Strategy* and various national governments' initiatives amongst others demonstrate that there is now an international consensus that issues surrounding physical education in schools deserve serious consideration in order to solve existing and future problems. Countries, via the relevant agency authorities, should identify existing areas of inadequacies and should strive to develop a **basic needs model** in which physical education activity has an essential presence and is integrated with educational policies supported by governmental and non-governmental agencies working co-operatively in partnership(s). Satisfaction of these basic needs requires high quality physical education programmes, provision of equipment and basic facilities, safe environments and appropriately qualified/experienced personnel, who have the necessary relevant knowledge, skills and general and specific competences according to the level and stage of involvement together with opportunities for enrichment through continuing professional development. It is necessary that monitoring of developments in physical education across the world be maintained. The Council of Europe's ministerial *Conclusions* and the UNESCO 'Round Table' *Communiqué* as well as the WHO *Global Strategy* have called for monitoring systems to be put into place to regularly review the situation of physical education in each country. Indeed, the Council of Europe referred to the introduction of provision for a pan-European survey on physical education policies and practices every five years as a priority! (Bureau of the Committee for the Development of Sport, 2002a; 2002b). "Promises" need to be converted into "reality" if threats are to be surmounted and a safe future for physical education in schools is to be secured. Otherwise with the Council of Europe Deputy Secretary General's intimation of a gap between "promise" and "reality", there is

a real danger that the Informal Ministers' meeting's agreed *Conclusions* will remain just that – more "promise" than "reality" in too many countries across the world and compliance with Council of Europe and UNESCO Charters will continue to remain compromised.

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GLOBAL TRENDS IN THE DEVELOPMENT OF SPORTS TOURISM

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Introduction

Sports tourism includes holiday travel to play sport, travel to destinations to watch sport, and travel to sport attractions (Hudson, 2003). Tourism and sport have not only become two very popular global social activities which have developed remarkably from the 20th century onwards, but both activities have become a part of our global culture. Although tourism and sport have their roots in the ancient times, and the links between them exist since then, tourism theory has only recently started to consider sports tourism as an interesting field of academic research. There is an increasing number of books and articles that tackle this topic (De Knop, 1992; De Knop & Van Hoecke, 2003; Dreyer, 1994; Bartoluci, 1995; 1999; 2002; 2004; Gammon & Robinson, 1997; Bartoluci & Čavlek, 1998; 2000; Green & Chalip, 1998; Gibson, 1998; Cockerell, 1999; Čavlek, 1999; 2002; Standeven & De Knop, 1999; WTO & IOC 2001; Hinch & Higham, 2001, 2004; Ritchie & Adair, 2002; Weed & Bull, 2004). With the recent research that has indicated positive impacts of tourism and sport on economic development the interest among academics and practitioners for these inter-related activities is steadily on the rise. The WTO and IOC study (2001) indicates that the contribution of sport to the GDP of industrialised countries is between 1 and 2%, and the contribution of tourism is between 4 – 6%. The absence of reliable statistics hinders better understanding of tourism and sport relations.

Although every development has its evolution, what has been happening with tourism development in the last 50 years can be more described as a revolutionary process. The extraordinary growth of international tourism arrivals from 25 million in 1950 to 760 million in 2004 (according to WTO estimates) leads to the conclusion that tourism development moved from being an evolutionary into a being revolutionary process. In the same period international tourism expenditure grew from 2 billion US$ to 523 billion. No other economic activity in the world has recorded an average annual growth rate of more than 7% in the observed period. According to WTO estimates tourism nowadays accounts for some 8% of the world exports through international tourism expenditure on goods and services which is even ahead of automobile industry, fuels, IT technology, food and chemicals. As tourism development has very much changed during the years, which has quite a lot to do with changes in people's life styles, interests and habits, the role of sport and recreation in contemporary tourism development has also changed. Sport has become an important activity within tourism, and at the same time tourism is fundamentally associated with many types of sport (Hinch & Higham, 2004:18). While the volume of international travel has been steadily rising at quite remarkable rates of growth, "the geographical extent and volume of sport-related travel has been growing exponentially" (Faulkner, Tideswell, Weston, 1998:3) and has become one of the fastest growing types of tourism recording estimated growth rates at about 10% per year (Hudson, 2003). According to a study of North American convention tourism bureaus it has been indicated that sport accounts for 25% of all tourism receipts (Research Unit, 1994). Another study (Research Unit, 1997) calculated that the direct contribution of sport tourism activities to overall tourism represents 32%.

Over the past few decades tourism and sport have proved that both are complementary parts of the leisure industry and that their products therefore have complementary features (Gibson, 1998). Hudson (2003) stresses that considering all kind of sport tourism activities that can take place in urban and non-urban settings, indoors and outdoors, and in all types of climatic conditions and seasons, the opportunity for growth appears unlimited. The fact that tourism and sport are inter-dependant and that there are many areas of common interests (De Villiers, 2001) justifies the reason why global trends in tourism development can be generalised and linked to global trends in sports tourism development.

Global Trends in Tourism in Reflection to Sports Tourism Development

The history teaches us that we can predict future developments by analysing the past events. Trends can therefore be considered as frameworks based on past developments which help us to extrapolate forecasts for the future development. Since tourism is a multifunctional phenomenon which is influenced by many social and economic factors, and which at the same time influences changes in different social and economic domains, it is necessary to observe the changes in many areas of human activity such as economy, technology, policy, etc.

Global Economic Trends

The economy and exchange rates are usually the main factors that influence global tourism movements. If WTO's data on international tourist arrivals are analysed, the following theory may be formulated: "despite many crises in the past tourism really declines when the main tourism generating countries are confronted with serious economic crises combined with other factors, and not when tourism receiving countries are hit by different types of crises" (Čavlek, 2003:

36). Since the economic performance of the main generating countries in the world considerably improved in 2004, and the economies of some of the emerging markets have been much stronger, WTO predicts the highest rates of tourism growth since 1977 (WTO 2005). Therefore terrorist attacks in some holiday destinations and tsunami left no perceptible impact on tourism in 2004.

WTO's research (2002) indicates that when the world economic growth exceeds 4%, the rates of tourism growth are even higher, but when the economic growth in the world drops below 2%, tourism performs even worse. Since WTO projected world tourism arrivals to grow at 4.3% per year and to reach 1.6 billion by 2020, and international tourist spending is expected to grow at 6.7% per year, these statistics lead to the conclusion that economists did not see the reason to predict the serious slow-down of the world economy in the near future.

As the results of the well-known market survey *Reiseanalyse RA 2005* of the holiday travel behaviour of Germans (their travel-related attitudes, motivations and interests) confirm that holiday trips remain one of the most important parts of Germans' way of life. But, not just of Germans. Holidays have become a part of our culture – I travel – therefore I exist! As RA 2005 results indicate, in developed countries holidays have become consumer priorities, right after food and health. As travelling on a holiday has become a style of living, for majority of people in the developed countries it means that they will not refrain from travelling even in times of crises in different parts of the world. Global economic trends indicate that people still spend money on holiday travel, but just avoid destinations affected by certain types of crises. The redistribution of tourist flows also happens under the influence of exchange rates. Therefore, at the moment, destinations in the euro zone experience a strong competition from less expensive destinations elsewhere in the world. This is the reason why one should not overlook the dynamics of change that can be observed in long-term comparisons. An already clearly visible trend is that "traditional" holiday destinations like Italy, Austria and to some extent Spain are slowly loosing market shares, while at the same time "new" destinations like Turkey, Croatia, countries in Eastern Europe and long-haul destinations are gaining the market shares. In this respect the "upswing" of the world economy and the influence of exchange rates can have a very positive impact on sports tourism which targets the segment of the market with a higher income, as well as on the popularity of some destinations and some sports activities in these destinations. This can nevertheless have a strong impact on many companies' policies if other trends are combined with these economic trends like dynamic packaging relevant for tour operating companies, low-cost airlines, shorter holiday stays but more holiday breaks, late bookings and a high price sensitivity, etc.

Global Demographic Trends

One of the most tremendous global trends applies to population growth. In the last 100 years the world population has grown from 1.6 billion to over 6 billion. At the same time the developed countries are facing the rapid trend of "aging population". As the population ages, the amount of leisure time available increases. In 2001 18.5% of the population in Florida was aged 65 or over. Italy reached this stage in 2003, Japan is predicted to reach it in 2005, Germany by 2006, UK and France by 2016, Canada by 2021, and the entire US by 2023 (Smith, 2001:14). It has been estimated that by 2040 over half of population in the developed world will be over fifty.

Population 60+ is actually becoming the driving force of tourist movements in the main tourism generating markets of the world. Although there are some negative relationships between sport participation and age, research made in this field indicates an upward trend towards increased physical activity participation among senior citizens (Hudson, 2003). However, one has to bear in mind that elderly population often has some disability problems, and therefore this has to be of major concern for all of the companies which are and will increasingly be targeting this mature market segment.

This demographic trend will have significant implications on management and marketing strategies of travel and tourism companies since these clients' profile is significantly different from the younger clients' profile. As rightly pointed out by Smith (2001) "junior" matures (age 55-64) will also become a large market segment in the next decades. This market segment is an especially important segment since this population travels more often, chooses destinations further from home, tends to stay longer on holidays, combines two or more destinations in one trip, wants to participate in more activities, among which sport activities are high on their priority list, and spends more per trip. The future sport tourism travellers are expected to be more experienced and they will be increasingly looking at holiday travel as a means for enhancing the quality of their own lives.

The research for the WTO and IOC conference on sport tourism in 2001 also indicated that the three main tourism source markets in Europe showed a significant increase in sport-oriented holidays. German tourists account for some 55% of sport-oriented trips a year compared to total outbound travel. On the Dutch market the share is just slightly lower (52%). French tourists seam to be less motivated by sport activities while on holiday and therefore the share amounts only 23%. According to the British data 20% of all tourists from Great Britain are directly involved in sport activities during their holidays, while 50% of holidaymakers participate in some incidental sport activities (Ritchie & Adair, 2002:3).

Population growth goes together with the urbanisation trend and with the hindrance to social and economic growth, as well as with diminished environmental quality (Gartner, 2004). All this cannot stay without a significant impact on tourism development and within it on shifting the trend towards more activity-based holidays in a healthy environment.

Global Technology Trends

Considering the growing number of sport holiday offers, the role of information when planning a holiday motivated by sport activities is becoming increasingly important. On the other hand, there is no need to prove that technology increases profitability, can increase the level of services for consumers and reduce employment costs which is all ideal for creation of tourism and sport products. At the same time the increasing use of the Internet is reducing the boundaries of space and time for work and leisure. The future holiday travellers are expected to have a higher disposable income and increased comfort levels in using the Internet, computers, and new technologies with many taking advantage of online continuing education programmes (Smith, 2001).

With more information those clients will be able to obtain through the Internet and other new technologies the costs of market entry will drop. Still, the new forms of media do not replace the "old" means of information – they rather supplement them, as the results of RA 2005 indicate. However, suppliers will be forced to use new market strategies when trying to reach the traveller with a higher level of knowledge, searching for new experiences and individualized holiday services. The significance of the Internet for tourism is increasing quite dramatically. According to RA 2005 results, in January 2001 only 15% of the German population used the internet to plan their holiday. In 2005, this has more than doubled. This will all reflect itself on objectives of travel and will increase the need of education of professionals able to render high quality services in sports tourism activities too. "This entails understanding and welcoming the changes occurring within the travel and tourism industry and delivering the enhanced education and training needed to make environmentally, socioculturally, and economically viable." (Smith, 2001:15).

Tourism study programs are facing an urgent need to adapt their courses to incorporate fields of tourism and sport multidisciplinary study which are of highest priority for newly structured niche market segments. A step forward can be achieved only with very close co-operation of educational institutions, tourism and sport industry.

Global Trends in Sport-Related Holidays

Sport tourism has definitely become "a trendy" form of holiday. The broad interest in a variety of different types of sport activities is another indicator that the demand for future sport tourism will at least remain stable.

Tourism sociologists have already identified shifts in tourism trends from the traditional ones such as rest, relaxation, and therapy to more "extravagant" forms which include active and adventure type of holidays. "The Adventure Travel Society reports that adventure tourism is growing at an annual rate of 10 to 15%. Most adventure travellers are North Americans, Japanese, Thai and Western Europeans." (Hudson, 2003:14). Although the definitions of adventure holidays vary, it is understood that adventure holidays incorporate a high level of sport activities in practical engagement of the tourist. Adventure holidays are usually divided in two groups: soft adventure and hard adventure. Since hard adventure encompasses an element of risk, a study has indicated that adventure travellers are more likely to be men than soft adventure travellers (60% of hard adventurers vs. 51% of soft adventurers). Hard adventurers also spend more than soft adventurers.

Skiing is still one of the most popular soft adventure types of sport tourism activity. The contemporary ski market is estimated to include some 70 million skiers worldwide (Hudson, 2003). However, skiing has lately decreased in popularity, but the trend of snowboarding is at the same time gaining in popularity. Therefore, most ski resorts have adapted to this type of demand.

The size of marine tourism which comprises marine sports such as boating, sailing, fishing, diving, surfing, windsurfing, parasailing, waterskiing, jet skiing, canoeing, kayaking, and jet boat riding is difficult to assess. However, this type of tourism can also be assessed through tourism statistics in general, since this type of tourism is a part of overall tourism. There is no doubt that marine tourism contributes to a particular country economy. A survey indicates that the economic contribution of marine tourism in Australia accounts for approximately 2% of GDP (Hudson, 2003, as cited in Driml, 1996).

Golf tourism cannot be described as "elite" sport anymore, since the growing number of golfers worldwide proves that this sport is moving to the development stage of mass participation of golfers. It has been estimated that some 60 million people play golf (Hudson, 2003). United States have a share of 44% in the world market, Japan 25%, and Europe 12%. "The value of golf tourism grew by 8% in 1998-1999 alone and is currently worth an estimated $ 10 billion annually (Not including earnings in the Far East). Golf therefore represents the largest sport-related tourism market." (Hudson, 2003:165).

At the end it has to be pointed out that the popularity of different sports is changing from year to year and that the global trend mentioned here will have a significant impact on transformation of some sports from professional to recreational and vice versa. However, the popularity of sport activities during holidays will definitely shift the clients' decision making process more "from places to stay to places to play".

Conclusion

Sport and tourism have developed into two mutually interdependent social and economic phenomena of the modern society. They both have become socio-economic forces that require constant renewal and adaptation to contemporary tourist needs. Tourism has promoted some sporting activities as well as various sport activities have promoted tourism travel and sporting leisure activities. Therefore it could be stated that tourism and sport render services to each other.

There are many positive impacts of tourism and sport on our society. However, economists try to prove the positive impacts of both of these activities on the world economic development. There is still misunderstanding and underestimation of economic impacts of sports tourism on the economic development in general. One of the reasons lies in the lack of reliable statistics that could reflect the economic effects of sport and tourism related service. Economic theory still lacks methodology and applications for assessing the contribution of both of these activities to economic growth and employment. Therefore academics in both of these fields have to combine their knowledge and foster research in these emerging fields of social and economic development.

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PHYSICAL INACTIVITY: THE MAJOR PUBLIC HEALTH PROBLEM OF THE 21ST CENTURY

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Sedentary habits are highly prevalent in most countries of the world. In the U.S. approximately 25-35% of adults are inactive, meaning that they have sedentary jobs, no regular physical activity program, and are generally sedentary around the house and yard. This amounts to 40 to 50 million individuals exposed to the hazard of inactivity. Given that sedentary and unfit individuals are at approximately two-fold higher risk for many health conditions than those who are moderately active and fit, the population attributable risk (PAR) of inactivity is high. In fact the PAR of inactivity is arguably one of the highest of all the conventional risk factors. In the Aerobics Center Longitudinal Study (ACLS) moderately fit men live six years longer than unfit men, and high fit men live three years longer than the moderately fit men. Thus, there is a nine-year difference in average longevity between low and high fit men, which further underscores the magnitude of the public health problem of inactivity. An example from the ACLS is that in 3,293 obese men (BMI ≥30.0), 27% of the deaths might have been avoided if none of the men had prevalent cardiovascular disease at baseline whereas 44% of the deaths might have been avoided if none of the men had been unfit. The independent relative risks for death are comparable for prevalent cardiovascular disease (RR=2.4) and for low fitness (RR=2.3), but approximately half of the obese men were unfit and only about one-sixth had cardiovascular disease. Over the past few decades we have largely engineered the need for physical activity at home, on the job, and during leisure-time out of the daily lives of most people in industrialized societies. To address the major public health problem of physical inactivity we will need to consider and evaluate societal, environmental, and individual approaches to making physical activity more common for more people more of the time.

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GENETIC AND NEURAL FACTORS IN ADAPTATION OF MUSCULOSKELETAL SYSTEM

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Abstract

The aim of the study is to demonstrate that the delayed onset of muscle soreness (DOMS) due to the eccentric exercises is not necessary result in long lasting strength reduction. Instead, there is a rapid neural adaptation which is followed by a relatively fast regeneration of the damaged muscle tissue due to gene regulation. The knee extensor muscle of ten trained and untrained male subject was subjected to muscle stretch during seven days. We found that the average torque production during training sessions increased gradually despite of the elevated creatine kinase and lactate dehydrogenase activity and lower testosterone concentration in the blood. Because the electrical activity increased during the seven day stretching treatment, we concluded that the increased neural drive compensates the negative effect of the muscle damage due to the eccentric training which seems necessary to the initiate the upregulation of the myogenic genes.

Key words: *eccentric exercise, DOMS, electrical activity, hormones, genes*

Introduction

Numerous studies demonstrated that muscle stretch results in specific symptoms called delayed onset of muscle soreness which is associated with the signs of muscle damage and alteration of muscle metabolism. The eccentric training is followed by reduced strength exertion capability of the muscle for several days which can be attributed the degenerative process in the muscle. However, the mammalian skeletal muscle has the ability to complete a rapid and extensive regeneration in response to severe damage.

Muscle regeneration is characterized by two phases: a degenerative phase and a regenerative phase. The initial event of muscle degeneration is necrosis of the muscle fibers. This event is generally triggered by disruption of the myofiber sarcolemma resulting in increased myofiber permeability. Disruption of the myofiber integrity is reflected by increased serum levels of muscle proteins, such as creatine kinase, which are usually restricted to the myofiber cytosol (Frieden and Lieber, 2001; Schwane et al., 1983; Clarkson and Sayers, 1999). In human and animal models, increased serum creatine kinase is observed after mechanical stress (e.g., extensive physical exercises). Several mechanical factors such as initial and/or final fiber length (Hunter and Faulkner, 1997; Talbot and Morgan, 1998), strain (Brooks et al., 1995), force (Brooks et al., 1995; Warren et al., 1993), speed or velocity (Warren et al., 1993), number of actions (Hesselink et al. 1996), and total work (Hunter and Faulkner, 1997) during eccentric actions have been proposed as factors to determine the level of eccentric exercise-induced muscle damage. However, a most recent study stressed that DOMS induced by eccentric exercise is rather myofibril remodeling than myofibril damage.

There are several models to study the effect of muscle stretch on the degeneration and regeneration process. It is demonstrated that static chronic stretch of the muscle results in upregulation of myogenic genes and proliferation of satellite cells, and finally sarcomerogenesis (Caiozzo et al. 2002). Dix and Eisenberg (1990) observed that static chronic stretch resulted in rapid longitudinal growth of muscle fibers by increasing the number of sarcomeres in series. This finding might suggest the presence of a length sensor that has a set point of a constant resting length of the muscle.

It is well documented in the literature that strength can be increased within a short time period by neural adaptation (Sale 1988; Kamen et al., 1998). Muscle stretch on an active muscle may stimulate the fast motor units predominantly which results in a more frequent recruitment of these motor units during force development. If there is an early neural adaptation of the muscle then the EMG activity during isomeric and eccentric voluntary contraction should be elevated and it can be assumed that force remains unchanged or can even increase despite the muscle cell degradation due to the intensive eccentric exercise. Also it can be assume that one eccentric exercise session is not enough to facilitate the nervous system.

Therefore we aimed to study the effect of everyday eccentric training lasting several days on delayed onset of muscle soreness and its influence on muscle contractile characteristics, and neural adaptation. We hypothesized that one week eccentric training with medium angular displacement may result in the DOMS phenomenon, but muscle strength reduction will not be considerable because the early neural adaptation which helps to maintain the high intensity training despite the muscle soreness.

Methods

Subjects. Ten trained subjects (age: 24. 6± 5.4 years; bodyweight: 77.8± 8.8 kg; body height: 1.82.5±4.3 m) volunteered to study. They signed a written consent prior the experiment in which they were informed about the experiment. None of the subjects suffered knee injury or abnormities previously. Prior testing and training the subjects were familiarized by the procedure.

Instrumentation. A custom-built computer-controlled dynamometer (Multicont II, Mediagnost, Budapest and Mechatronic Kft, Szeged, Hungary) was used to collect torque-time, joint position-time, and angular velocity-time data during knee extension. An electric servo-motor (Mavilors AC Servo-motor, M10, Spain) controlled the dynamometer's stainless steel lever arm (600 x 50 x 10 mm). The load cell is a custom designed unit designed and manufactured specifically for this application. It is similar to two disks connected to each other by eight radially positioned thin ribs. It is made of high tensile strength steel and due to its unique shape it is sensitive only to torque loads. There are four strain gauges glued to the flexible ribs of the load cell (Sensitivity: 0.5 Nm, maximum torque: 500 Nm).

The joint position was measured with a built in potentiometer of the driver with a resolution of 0.01 rad. Velocity was computed by differentiating the position-time data. The pre-programmed electrical servomotor controlled velocity. During concentric contraction the velocity varied less than 0.05 rad • s^{-1}. The torque, angular displacement and velocity were recorded by a personal computer following analogue to digital conversion at 0.5 kHz and were stored for later analysis.

Procedure. The subjects were seated on the dynamometer with their back against the dynamometer's seat back reclined so that the hip joint was 1.9 rad. Crossover shoulder straps, a lap belt, and a wide strap across the thigh stabilized the torso and prevented hip extension. The dominant leg was attached through an ankle cuff to the dynamometer's lever arm. The apparent knee joint centre of rotation was aligned with the lever arm's centre of rotation. The knee extensors of the subjects were stretched under voluntary contraction during seven consecutive days, 6 times 15 contractions with one minute rest between, in each day. The subjects were instructed to perform isometric torque as fast as possible at a knee joint angle of 20 degrees, and when the torque reached 50 Nm the driver started to flex the knee automatically. The subjects were asked and motivated to resist against the lever arm with the highest effort. We applied constant speed during muscle stretch which was 60 degrees/s. The range of motion was 80 degrees. Torque, angular displacement and angular velocity was recorded and in the function of time, stored and analysed later. Maximum isometric torque, torque and velocity variables from concentric contraction and stretch shorten cycle was determined during tests which was carried out prior and after the first training session, and prior of each training session. The last testing was carried out three days after the last training. Electrical activity of the vastus lateralis and medialis was recorded using a telemetric Noraxon EMG apparatus during test exercises and analysed having finished the experiment. EMG_{rms} values were determined at isometric, concentric and eccentric contractions.

A 100 ml venous blood sample was collected from the ante-cubital fossa, pre- and post exercise on the first day, and post-exercise on days 2, 3, 4, 8 and 11. Serum samples were stored at ±20 °C prior to measurement (in duplicate) of creatine kinase (CK) and lactate dehydrogenase (LDH) activity, total testosterone and cortisol level.

Statistical analysis. Mean and standard deviation (SD) were computed for the measured and calculated values. The curve parameters obtained under the four experimental conditions were compared with a repeated measures analysis of variance followed by Tukey's post-hoc contrast. The probability level for statistical significance was set at $p<0.05$.

Results

The subjects had no severe muscle soreness during the first two-three days. Mean maximal soreness was 5.2 ±3.0 24 h after the exercise. However, the pain increased when the muscle was stretched during the first two or three set of each training session. The CK level increased 3.8 folds after 24 hours and remained elevated till the end of the training session. After three day rest the CK level retained to the baseline. The serum LDH concentration increased significantly in the first day in pre- and post-exercise comparison. After 24 hours LDH activity was significantly lower than that of post-exercise value of the first training, but still significantly higher than the baseline value (Table 1).

Table 1. Means and (SD) for creatine kinase (CK) and lactatedehydrogenase (LDH) concentration in the serum. Asterics indicate significant difference between pre-and post-exercise comparison the baseline values.

	pre	post	24h	48h	72h	Day 7	Day 10
CK (U/L)	202,5	259,7*	779,9*	716,2*	762,6*	594,4*	337,1*
	(140,0)	(161,1)	(332,2)	(359,4)	(328,2)	(321,6)	(257,3)
LDH (U/L)	287,0	399,3*	339,9*	339,1*	352,2*	361,8*	363,9*
	(47,2)	(85,3)	(74,7)	(68,0)	(62,8)	(68,5)	(116,6)

The daily average torque production during stretch (M_{ec}) increased gradually from the first (207.6±34.3 N) to the last treatment (262.76±6.7 N). In the third day M_{ec} (229.6±53.3 N) was significantly greater compared to that of the first training day. Concerning the test exercises, the maximum isometric torque (M_{ic}) was significantly depressed at the end of the first and second training with 26% and 15%, respectively. Thereafter M_{ic} increased gradually and after the third training leveled the baseline. At the last test the subjects produced significantly higher M_{ic} (12 % improvement) than prior training. The electrical activity during isometric contraction increased gradually and the EMG_{rms} values were significantly greater compared to the baseline value. Similar elevation of EMG_{rms} was observed during stretch-shorten cycle. The joint stiffness decreased significantly during the first two days then increased gradually. The joint stiffness was significantly greater after the experiment than at pre-training test.

A significant reduction was found in testosterone concentration during the first threes days. Thereafter the testosterone level increase gradually but still after three days rest the concentration was well below the baseline. The cortisol was slightly, but not significantly elevated during the seven day treatment. The T/C ratio decreased gradually and reached the lowest level after the second training session (41.6 % decrease) then started to increase gradually, but it does not retain pre-training level.

Discussion

To fulfill the aim of the our study seven days eccentric training was apply which was supposed to produce the DOMS phenomenon, but not significant reduction of muscle force because of the neural adaptation. We found mild average muscle soreness which was expected since the angular displacement during eccentric exercise was only half that of the maximum range of motion of the knee joint. This result is in a good agreement with the findings of Nosaka and Sakamoto (2001) demonstrating that relatively short muscle stretch induces smaller muscle soreness than the large one. It can be assumed that medium angular displacement during eccentric contraction does not result in large length change of the knee extensors and as a consequence the length change of the sarcomeres is small. If the length change during static stretch does not exceed 15 % of the sarcomere length the increase of number of sarcomeres is restricted because the length sensors are not stimulated (Caiozzo et al. 2002). In this case the initiation of the sarcomerogenesis can be attributed to the increased muscle tension rather than the muscle lengthening. The increasing force production of the muscle during eccentric contraction can be attributed to the recruitment of new (most probably fast) motor units and the increasing firing rate of the working motor units. If the force generation of the sarcomeres increases the length of the sarcomeres remain unchanged and most probably the Z discs are stretched, or rather overstretched which results in the structural change of the muscle and creatine kinase leakage from the muscle cells to the blood flow. Yu et al. (2004) consider this process as myofibril remodeling which involves several gene expression alterations.

In the present study creatine kinase concentration increased and reached the maximum after 24 hours and remained elevated during the training period of seven days. If the creatine kinase is a marker enzyme of the myofibril remodeling rather than the marker of muscle damage then we can assume that the regular, every day stretching does not disturb the muscle regeneration. On the other hand our result suggests that elevated creatin kinase is not related to the muscle pain and soreness.

In most of the researchers studying the effect of strength training, especially the eccentric exercise, reported reduced isometric strength 24-72 hour after the treatment and in many cases the strength remained depressed several days having finished the training. We calculated the average torque production at each repetition and then calculated the average force production of one training session (90 contractions). We found that the average torque during eccentric contraction did not decrease despite of the muscle soreness and elevated creatine kinase and LDH level. Instead, the torque was ten percent greater in the third day (48 hours) and it increased gradually. The strength of the knee extensors was 26 percent greater in the seventh day compared to the first training. Since the subjects were trained athletes and familiar with the muscle stretch, the improvement in torque production cannot be attributed to learning effect. Also, the increased eccentric torque cannot be attributed to the muscle regeneration and the early sarcomerogenesis.

The isometric torque after the first and second training was significantly depressed, but in the third training the isometric torque was identical with the baseline value and after the seventh training the isometric torque was ten percent greater than the torque before the experiment. The elevated torque production is most probably is due to the increased electrical activity of the vastus lateralis, medialis and rectus femoris muscles. The EMG activity increased gradually during both isometric contraction and stretch –shorten cycle. It seems that the muscle soreness and the increased creatin kinase and LDH level does not influence negatively the neural drive. It is very probable that the prolonged eccentric exercise decrease the threshold level of the greatest motor units which becomes sensitive to be recruited.

One could expect that intensive eccentric training might result in the elevation of total testosterone hormone level in the blood and depression of the catabolic hormone, i.e., cortisol. Instead, we found that the testosterone decreased in the blood and a slight, but not significant increase of cortisol was observed. The T/C ratio decreased indicating a catabolic process, which conflict with the most probable alteration in gene expression which may initiate the proliferation of sarcomeric proteins, which result in the muscle fiber hypertrophy.

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BIOMECHANICS IN ELITE SPORT PERFORMANCE

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Introduction

Biomechanics in sport is distinguished as a research field by two central investigational goals: first, the avoidance of injuries and, second, the improvement of the level of performance. This contribution will predominantly concern itself with possibilities of utilizing sport biomechanics in the direct training process of top class sports. The areas in which biomechanics can be applied in the training and teaching process are very diverse. First to be ascertained via biomechanical methods are those characteristics which essentially influence performance. The second area lies in determining individual, current performance levels and in examining performance progress and in the third area feedback systems should be provided during the training session in order to minimize intervention times. The quality of the training process can also be improved by the use of specific training devices and exercises. And, last but not least, biomechanical investigations should also assist the athlete's efforts of optimising the equipment.

Biomechanical Performance Diagnostics

Biomechanical technique analysis and performance diagnostics are essential measures to enhance the quality of training and the performance of the athletes. Scientifically secured knowledge concerning performance-determining characteristics is hardly present in complex outdoor sports like ski racing, cross country skiing or ski jumping. Descriptive biomechanical analyses attempt to quantitatively characterize athletes' movement techniques using kinematic, kinetic and electromyographic methods. The results of such investigations lead to a better understanding of movements used and provide coaches and athletes valuable support in directing training goals.

Example 1: Ski Jumping: Performance Limiting Factors

The main purposes of biomechanical investigations in ski-jumping are to assess enhancing and limiting factors. Biomechanical studies deal with aspects concerning technique in hill jumps (e.g. in-run position, take-off motion, flight position, landing technique) and simulated take-offs in dry-land training, respectively, the optimisation of hill profiles and improvements of the material (skis, boots, jumping-suits etc.). The most important methods used for these investigations are kinematics, kinetics, electromyography and computer simulation. This paper presents some studies on biomechanical methods used to enhance performance in ski-jumping.

The take-off is attributed the highest significance in ski-jumping as optimal initial conditions for the subsequent flight can be created only in this phase. Positive correlations with jump length were observed for vertical release velocity and for ballistic parameters, as 'production of a great angular momentum' and 'high leg-extension velocity'. The combination between rapid leg extension and adequate eccentric force application cause high performance in ski-jumping. These results were found by using both, univariate and multivariate approaches. Studies using kinetic methods (force plates integrated into the take-off table and insoles equipped with sensors) indicate that high force production in a short amount of time is advantegous for long jumps. Data show, however, subject specific force and force distribution profiles. Consequently, force application during take-off has to be optimised individually.

Performance diagnostics in simulated take-offs: Simulated take-offs are widely used for performance diagnostics in ski-jumping. Data show very high consistency for elite ski-jumpers regarding kinematic and kinetic variables along with subject specific characteristics. Consequently, accurate measuring systems have to be provided for performance diagnostics in ski-jumping simulated take-offs. Furthermore, the different boundary conditions between hill jumps and simulated take-offs (e.g. friction, aerodynamic forces, pre-stretch) have to be considered.

Considerations for performance enhancement in simulated take-offs: Data from simulated take-offs have to be interpreted with respect to the boundary conditions differing from hill jumps. The most distinct differences are high friction, no aerodynamic forces, no additional pre-stretch and longer take-off duration in simulated take-offs compared with hill jumps. The shorter take-off duration in hill jumps can be explained primarily by the uncompleted leg extension at release (60–80 ms), supporting lift (30–60 ms), footware (20-30 ms) and the (usually) unnecessary preparation to take-off (50-90 ms).

To assess the performance limiting factors in simulated take-offs the vertical take-off velocity in simulated take-offs was correlated with the explosive force (maximal force rate) during take-off and the peak force and peak explosive force during isometric leg extension with a knee angle of 90°, 110° and 130°. The correlation was found to be higher

concerning explosive power in isometric leg extension and increased with decreasing knee angle. The explosive force at the beginning of the take-off phase seems to be one of the main performance limiting factors in ski-jumping.

Explosive force in ski-jumping: Studies show that the explosive force in hill jumps and simulated take-offs depend on the initial take-off position (in-run position), a counter movement prior to take-off, the aerodynamic lift, the ratio of FT fibers and specific power training. Based on the high correlation of explosive force with vertical take-off velocity (which itself highly correlates with jump length) the named aspects have to be considered to enhance performance in ski-jumping. Detailed analyses of ski-jumping related data show that subject specific and optimizing aspects and solutions have to be aimed to maximize ski-jumping performance.

Validation of Sport Specific Tests

The efficiency of the training also depends on the quality of performance tests available. If possible, valid and standardised tests should be built into the training process for all performance-relevant features of the sport in question.

Example 2: Reliability and validity of a specific upper body testing device and concept for the cross-country skiing Sprint

The introduction of Sprint, Team Sprint, mass start competitions, the improvement of equipment and technique allowing athletes to ski at higher speeds, led to new and altered demands in the training and testing of cross-country (XC) skiers. Especially in Sprint competitions using the classical style the major used techniques are double poling (DP) and DP-Kick, while six under the best eight, including rank 1 to 3 of the WC in Drammen 2005 used DP in all the runs up to the final. Several investigations have shown that upper body performance and strength capacities have a close connection to XC ski race performance (e.g. Mahood, 2001). Especially for the Sprint disciplines, specific maximal strength and strength endurance are generally defined as important sources of performance, while positive effects of specific upper body maximal strength training on endurance performance was already been shown (Hoff, 2002). Such stress the great importance of specific training and diagnostics of strength capacities for the XC skiing Sprint. Specific standardized test concepts for traditional XC skiing have already been developed, while test concepts especially for the XC skiing Sprint are rarely, difficult to simulate in a controlled laboratory situation and mostly are not investigated on reliability and validity. The aim of the study was the development and analysis on reliability and validity of a test concept serving for diagnostics of specific upper body strength capacities for the XC skiing Sprint.

Methods: 31 elite XC skiers of the Austrian, Slovakian and Suisse National and Student-National Team volunteered as subjects in the study. 19 subjects performed two times the so called "Two-phase Test" (2PT) for determination of specific upper body strength capacities including a "4 repetition maximal test" (4RT) and a "40 repetition test" (40RT), using a DP imitation (DPI) on a rollerboard (Lindinger, 2004) to check for reliability. 31 subjects performed both the 2PT and a 50-m DP sprint speed test (DP_{50}) on a tartan indoor track to check for validity of the 2PT for determination of maximal DP sprint speed. 20 subjects performed the 2PT and a 1000-m DP test (DP_{1000}) on the treadmill, to check for validity of the 2PT as predictor of DP Sprint performance over race distance. The 4RT includes four DPIs with maximal velocity for determination of maximal values in all measured parameters. After a break of 2 min, the subject had to perform the 40RT with maximal speed at each of the 40 reps (all-out). Velocity and force variables were measured. In the 40RT, the mean of the 40 reps and a strength endurance index (SI=Difference mean 40reps to max 4RT in %) was calculated. The DP_{50} was performed on an indoor tartan track. 50-m time was measured by fix installed light sensors. In the DP_{1000} subjects had to perform the 1000-m with maximal velocity from the start (all out). By help of a speed control device (Wiege-Data, Leipzig, Germany) treadmill speed could be regulated by the athlete. Time for the 1000-m (t_{1000}) and SI (Difference mean velocity over the 1000-m to maximal velocity at start) were measured.

Results: Measured parameters of the 4RT showed high to excellent reliability (r = 0.83 to 0.99, P<0.001). All mean values of the 40RT showed excellent reliability (r >0.97, P<0.001) except for SI showing just moderate to high reliability (r = 0.71 to 0.87, P<0.001) with the highest value for peak velocity (v_{peak}). All parameters of the 4RT correlated highly to 50-m time (r = -0.75 to -0.92, P<0.001), while highest correlation was found for v_{peak}. Velocity and Force variables of the 4RT correlated moderately to t_{1000} (-0.6 to -0.73, P < 0.01). Mean values of the 40RT correlated moderate to highly to t_{1000} (-0.76 to -0.81, P<0.001) again showing the highest value for v_{peak}. SI of the 40RT correlated moderately to SI of the DP_{1000} (0.62-0.79, P<0.01).

Discussion/Conclusion: High to excellent reliability, except for test-retest correlations of SI, was found for the 2PT. This might be explained by the fact that in the calculation of SI, two variables measured in separate test modes were used for calculation. Thus, small variability in those variables might cause a higher variability in the calculation of SI. The high relationship of maximal velocity and force variables measured in the 4RT to 50-m and 1000-m DP sprint performance showed on the one hand the high specificity of the DPI, already shown by Lindinger (2004), and on the other hand that the 4RT alone serves as a simple, reliable and valid test concept for diagnostics of upper body and continuative DP performance in XC skiing. v_{peak} measured in the 2PT showed the highest correlation of all variables to 50-m and 1000-m

Sprint performance. Hence, v_{peak} seems to be the most stable and highest Sprint predicting variable measured in the 2PT. Just moderate correlation was found for SI of the 2PT to SI of the DP_{1000}. This might result on the one hand out of the just moderate to high reliability of SI in the 2PT and assumed but not measured in DP_{1000} and on the other hand in the fact that performance in DPI is restricted to upper body performance while the function of the lower body as in DP was excluded. In the future, testing data should be used to determine standards and norms in order to reveal deficits, enervations and athlete development and in this way serve as an instrument for guiding or control the training.

Equipment Improvement

Example 3: Binding Plates in Alpine Skiing

Since the introduction of modern carving skis a binding plate was also developed which is fixed between the ski and the binding system. This binding plate has, among others, the following functions:

- Binding plates have a many layered influence on the turn behavior of the ski. Single element plates have in the mid-region of the ski an additional stiffening effect. Relative to the location of the screws and material selection this effect is specific. This stiffening in the mid-region results in a change in the skis‘ eigen-frequency and of the associated eigen-forms. With two element plates which do not hinder the torque moment degree of the ski and allow for longitudinal compensation, the intended characteristics are only slightly impinged upon by the ski manufacturer.
- When dampening materials are utilized, vibrations in the high frequency range which are transmitted from ski to skier are markedly reduced. Certainly here one must take care that the use of too strongly dampening materials can be at the cost of transfer rigidity. This is to say that steering motions by the skier are not completely transferred to the ski because a part of these forces are absorbed by the dampening layer of the binding plate, similar to the effect of a shock absorber of an automobile. In this case the skier perceives the system as slow and ‚without life‘.
- Ski boot-snow contact: Above all in racing very great edging angles are necessary due to the high velocities and tighter turning radii. On steep slopes in this there is a very great danger that contact between boot and snow occurs and the skier falls in consequence. Raising the standing plane by means of the binding plate allows the skier greater edge angles and thereby reduces the danger of falling.

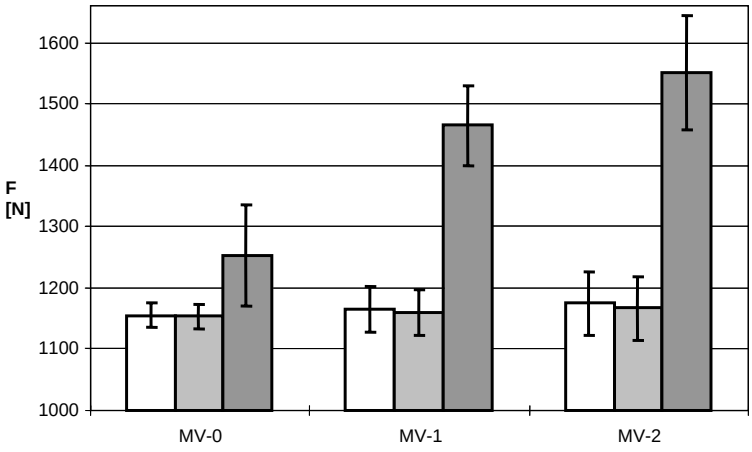

Fig. 1: Ground reaction forces depending on standing height (MV-0: no plate; MV-1: plate 1 cm; MV-2: plate 2 cm; white: F complete steering phase; grey: F steering phase without last 200 ms; dark grey: F last 200 ms of steering phase)

Ski racers are convinced to be able to race faster using so called risers. So in a further project we had to prove this hypothesis and to try to find the mechanism which might increase the racer’s performance. In a field test three different riser heights (0 cm, 1 cm, and 2 cm) were used. The course was standardized by gates. 12 runs, using the different ski systems alternatively were performed by a world cup racer. The following parameters were measured: running time, ground reaction forces normal to the ski, anterior/posterior moments or lateral moments respectively.

There was a significant decrease of the running time in dependence on the riser height. No significant differences for forces and moments could be found between the different riser heights analysing the whole turn. But if the turn is divided into a steering phase and a very short edge changing phase, the values of the steering phase remain nearly constant, whereas the values of the edge changing phase decrease significantly using higher risers. Therefore risers help to reduce running time as the edge changing can be managed in a shorter time period.

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HOW IMPORTANT ARE GENETIC FACTORS FOR TRAINING?

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Introduction

It is well known that brothers and sisters with the same parents inherit different traits from different ancestors on both sides of the family. For example, there may be differences in eye color, height, cholesterol level, fitness level, or the ease with which one loses or gains weight. Only identical twins have the same genetic background because they are duplicates of the same person. Non-identical or fraternal twins are as different genetically as any other two siblings.

Genes are part of DNA molecules in every cell of the body. The genotype is the total combination of the thousands of genes within the body, that is, the genetic potential of a person. However, not all of the genes in the genotype are necessarily used or expressed to their full potential. The anatomical, biochemical, physiological, and behavioral characteristics of a person at any given time represent the extent to which the various genes are expressed; these characteristics are known as phenotypes. Examples of phenotypes include brown hair, green eyes, a resting heart rate of 60 beats/min, a maximal oxygen intake (VO_2max) of 50 mL • kg^{-1} • min^{-1}, and a body weight of 75 kilograms.

Genes affect how a phenotype is expressed now, as well as how it will respond to a change in environment. While one's eye color is set for life, one might reduce blood pressure with medication, increase VO_2max with training, and lose weight by dieting. The speed of any change and the extent to which changes in phenotypes occur are affected by one's genetic background. For a particular phenotype, there are people who are superior responders, average responders, poor responders, and non-responders to a change in the environment. Thus, there are people who gain or lose weight or who improve their fitness faster and to a greater extent than others.

It is this variation in phenotypes and how they respond to changes in the environment that allows scientists to study the role of the genes. For instance, if all participants improve their VO_2max by 14-16% after 12 weeks of standardized exercise training, then it is clear that genes play a minor role and the change in environment (training) is more important. On the other hand, if there is a large variation in adaptations to the same training program, genes may be important.

The variation within a given phenotype in a population is influenced by the variation due to genes, the variation due to environment, and the interaction between these two sources of variation. One way to study variation is to study families with biological and adopted children to see the influence of genes on various phenotypes when the environment is similar. If there is little difference among these children before or after an intervention, then environment is more important. On the other hand, if the responses of biological children are similar to those of the parents but the responses of adopted children are not, then genes are more important. Another way to compare variations is to study twins living in the same home. With identical twins, the genetic background is the same and the environment is similar, whereas fraternal twins have a similar (but not identical) genetic background and a similar environment. If there is less difference between identical twins than there is between fraternal twins, this suggests that genes play a big role. On the other hand, if the differences between identical twins are similar to differences between fraternal twins, then genes are less important. One can also look at identical twins separated early in life and living in different environments. Regardless of the environment, research shows that identical twins tend to be more similar before and after an intervention than are fraternal twins or other siblings, showing that genes have an important influence (Bouchard, Malina & Pérusse, 1997).

To better understand the roles of genes and the environment, consider their effects on three factors: physical activity, fitness, and health. The genotype can influence the extent to which one is physically active, physically fit, and healthy. Environment (physical and social environment, as well as one's lifestyle) also can affect activity, fitness, and health. In addition, there is an interaction among these factors because 1) activity can affect fitness, 2) fitness can affect activity, 3) activity can affect health, 4) health can affect activity, 5) fitness can affect health, and 6) health can affect fitness. The genotype also can influence these interactions, e.g., how much and how fast physical activity affects fitness or health.

Examples of Genetic Effects

There are many traits (phenotypes) for which the effects of the genes have been determined (Bouchard, Malina & Pérusse, 1997; Bouchard et al., 1992). Genes have a large effect on height, length of trunk, and length of arms and legs. It is known, for example, that tall parents tend to have tall children. Of course, within a family of tall parents, one child may be shorter because its height was inherited from the maternal grandmother's side of the family. In contrast, there is only a small-to-moderate effect of genes on circumferences, girths, and breadths of various body parts because the environment can play a larger role in determining these measures. For example, waist circumference can be changed by diet or exercise, and weight training or inactivity can change muscle size.

Genes have a large influence on muscle size and composition (percentage of fast-twitch and slow-twitch fibers). Because muscle strength is closely related to fiber composition, genes also have a large effect on strength. On the other hand, the activities of enzymes important in energy metabolism and the number of mitochondria within a given amount of muscle tend to be less influenced by genes because they can be modified by different types and amounts of physical activity. To summarize, the effect of the genes in muscles is great relative to structure (e.g., contractile proteins and size) but not necessarily to function. In the case of the phenotype "muscular endurance," which is affected by both structural and functional factors, the genetic effect is only moderate.

Similarly, size of the lungs (a structural measure) is affected greatly by the genes, but such functional measures as rates of airflow are not. In the cardiovascular system, there are large genetic effects on the size of the heart, as well as the size and structure of the coronary arteries. Blood pressure tends to be less affected by genes because it can be modified by body weight, diet, stress, and other factors.

Relative to exercise, genes have a large effect on VO_2max, maximal heart rate, and maximal lung ventilation. Evidence suggests that cardiovascular endurance (e.g., the total amount of work that one can perform in 90 min) is even more strongly affected by genes than is VO_2max; this is probably because many physiological and biochemical variables are involved in endurance exercise, and genes can affect each of them (Bouchard et al., 1992).

There are people who genetically have a high or low level of fitness (as indicated by VO_2max), but they may or may not be physically active. In other words, fitness and activity are not necessarily the same. There are people who train regularly but are not very fit, whereas others do little regular activity but are reasonably fit. It is true that people must be very active to have high levels of fitness and that people with very low levels of fitness tend to be very inactive. However, for most people in the middle of these two extremes, fitness cannot be judged by an individual's level of physical activity and vice versa. Nevertheless, persons who are regularly active are capable of doing more exercise than inactive persons, even though both may have the same VO_2 max or the same level of strength, because training by itself produces changes in the various systems of the body.

Genetics and Training

Depending on the sport or activity, many systems in the body are involved. For example, distance running involves the cardiovascular, respiratory, neuromuscular, metabolic, hormonal and thermoregulatory systems. Each of these systems can be affected by a number of genes. Also, there are many interactions among the genes and between these genes and the environment. Because of this complexity, it is unlikely that scientists can make champions by altering only one or two genes.

Identical twins with similar levels of activity tend to have similar levels of fitness. When identical twins undergo the same aerobic, anaerobic, or strength training program, they exhibit similar adaptations to the training (Bouchard et al., 1986). On the other hand, fraternal twins or siblings with similar levels of activity vary more in their fitness and have a greater variation in their adaptations to the different types of training.

To examine VO_2max adaptations to different types of training, we carried out a standardized, 12-week endurance training study with 29 male university students (Dionne et al., 1991). Subjects trained three times a week for 30-45 minutes on a cycle ergometer at a constant intensity of 75% VO_2max. After training, the rise in VO_2max ranged from 40 mL • min^{-1} to almost 1,000 mL • min^{-1}. This study was done in the fall semester, after which students went home for 4 weeks. We asked the nine students who had the greatest improvement in VO_2max (~ 9 mL • kg^{-1} • min^{-1}) to return for another 12 weeks of training. For the second program, subjects did interval training three times per week at an average intensity of 75% VO_2max (3 min at 60% VO_2max and 3 min at 90% VO_2max) for 30-45 minutes. During the 4 weeks of inactivity, the VO_2max of the four superior responders who agreed to return had decreased and were similar to the levels when they began the first training program. After the interval-training program, these students again showed a superior training response. Of the nine students in the first study who had the smallest improvement in VO_2max (~ 3 mL • kg^{-1} • min^{-1}), only one agreed to return for more training. His VO_2max also had decreased over the vacation, and he again had a very poor response to the additional interval-training program. Thus, there are phenotypes that respond differently to continuous or interval training.

The HERITAGE Family Study (Bouchard et al., 1995) was a very large investigation of how genes influence adaptations to exercise training and involved 484 Whites from 99 families and 260 Blacks from 105 families at four centers. All subjects were healthy and sedentary. After taking many tests associated with fitness and risk factors for cardiovascular disease and diabetes, subjects trained and were retested. The standardized training program consisted of exercise on a cycle ergometer three times a week for 20 weeks. Subjects began training for 30 minutes at the heart rate associated with 55% VO_2max. Each two weeks thereafter, either duration or intensity increased so that they trained during the last 8 weeks for 50 minutes at the heart rate associated with 75% VO_2max (Skinner et al., 2000).

The first question asked was whether the families had similar levels of VO_2max and other phenotypes before training began. Relative to VO_2max, there were families in which all members had lower, average or higher values. In this case, heredity explained about 40% of the variation (Bouchard et al., 1998).

Because there was a large variation in the response to training, the second question asked was whether families responded similarly to training. Although the average increase in VO_2max was 19% and was similar at all four centers, about 5% of the subjects had little or no change, and about 5% had an increase of 40-50%. This large variation occurred at all ages and at all levels of initial VO_2max and was similar for Blacks and Whites and for women and men (Skinner et al., 2001). In other words, there were superior, average and poor responders to training at all ages (17 to 65 years), in both races, in both sexes, and at all levels of initial VO_2max. In this case, 47% of the variation in the response of VO_2max to training was explained by heredity (Bouchard et al., 1999).

The third question asked was whether the changes in VO_2max were related to the initial values. There was essentially no relation between initial fitness and its response to training, as the correlation coefficient between VO_2max before training and the change in VO_2max after training was only 0.08. It appears that one set of genes affects the initial level of VO_2max and another set of genes affects the response of VO_2max to training.

We also examined whether there were any non-genetic variables measured before training that would differentiate between superior responders and poor responders. We found no variable or combination of variables that would distinguish between these two groups (Skinner et al., unpublished). Because we have DNA samples from all subjects, we are now screening for genetic markers that may be associated with responses to training.

Based on the information available now, it is not possible to predict how a given individual will respond to training. Breeders of racehorses have tried for many years to predict which horses will be successful. What they say is that "we take the best, mate them with the best, and hope for the best." In other words, out of 10 offspring of two excellent horses, a few will be excellent, a few will be above average, and a few will be below average. Horse breeders cannot predict which horses will be in which category. Of course, we do not breed humans for competition, so the possibility of accurately predicting which humans will be champion athletes is even lower.

Many athletes reach a point at which they must train more and harder to obtain fewer and fewer benefits in terms of performance. When athletes reach this point, it is possible that they are approaching their genetic limits. As mentioned, there is no way to predict where this limit is.

Whether a given person will be a champion appears to be associated with 1) the actual state of a number of complex phenotypes before training, 2) proper training, rest, and nutrition, and 3) the ability of these phenotypes to adapt to the training, rest, and nutrition. Thus, a person can begin with low, average or high values of VO_2max and other phenotypes and have poor, moderate or superior responses to training, rest, and nutrition. It is probable that elite athletes are those who begin with high levels of the characteristics (phenotypes) needed for success in their particular sports and also have superior adaptations in those characteristics after training. Only a small percentage of the population has genetically high levels of the phenotypes needed for success, not all of these will train, and only a small percentage of those who do train will be superior responders.

Practical applications

- Genes do influence the initial level of one's characteristics (phenotypes), as well as how fast and how much these phenotypes can change in response to training, nutrition, and other environmental factors. Athletes who have immediate success in a new sport probably have relatively high qualities of at least some of the genetically determined phenotypes required to be a champion in that sport.
- Superior responders to sports participation probably have early success and positive feedback from competition.
- Potential athletes should try various sports to see which ones they enjoy and in which ones they have success. These factors are probably a better guide for selection than any laboratory analysis of one's genetic background.
- It is not possible to predict who will be a champion. Nevertheless, coaches can and do select candidates based on the characteristics required for success in that sport. The genes influence many of these characteristics.
- Other aspects of some sports (e.g., tactics and technique) are not affected by the genes. Champions at the elite level must be experts at tactics and technique in addition to possessing the necessary genetically determined attributes for success in their sports. Nevertheless, less genetically gifted athletes who are talented in tactics and technique may be successful at non-elite levels of competition.

Summary

As a general rule, genetic influences are stronger on the structural components of the body than on the functional components, which can be influenced more by training and other environmental factors. Although genetic background—heredity—can influence one's success in a particular activity or sport, this background is probably too complex to be fully known or understood. The effect of a magical altering of one or two genes by genetic engineering probably will be low because many genes are involved, there are interactions among different genes, and there are interactions among genes and the environment. Thus, it is unlikely that genetic engineering can reliably produce champion athletes.

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CREATING A PERFORMANCE PROFILE USING PERTURBATIONS IN SOCCER

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Abstract

It is proposed that soccer teams exhibit rhythms, until the usual stability is disturbed by extreme elements of high or low skill. Should the resulting instability or 'perturbation' lead to a shot on goal, then the outcome is termed a critical incident. Recent research (Hughes et al., 1997) confirming the existence of perturbations in soccer suggested that teams have characteristic ways of creating scoring opportunities although insufficient data prevented comprehensive analysis of individual teams. The aims of this study were twofold; firstly, to confirm that previously researched perturbations could be reliably identified and classified in association football. Secondly to create a normative profile for an individual team whereby the means stabilise, allowing the portrayal of characteristic ways of creating scoring opportunities.

Fifteen games involving Arsenal Football Club were analysed from the British League seasons 2002/2003 and 2003/2004, post-event from video. It was found that the 12 perturbations previously identified Hughes et al. (1997) were consistently identified and classified. Arsenals characteristic patterns of play were identified, highlighting important coaching information in attack and defence. From the eleven matches used to compile a normative profile, a total of 212 shots were analysed with goals scored, on average from every 5 Arsenal shots. Lost control was the most efficient attacking perturbation (42.9% shots resulted in goals) and foul the least (10%). In defence Arsenal conceded, on average from every 7.5 shots but appeared to show vulnerability to attacking runs, with 75% of those perturbations resulting in goals.

Although total shot frequency stabilised satisfactorily after 8 matches, the significant ($p<0.05$) change in tactics between the game states caused the data to show high variability. Further attempts to integrate these tactical variations into profiling produced limited but more consistent success than the method previously introduced by Hughes et al. (1997). Conclusions in support of Hook and Hughes (2001), suggested that elite soccer teams exhibit qualities preventing the accurate prediction of future match outcomes.

Key words: *Performance profile, perturbations, critical incidents, soccer.*

Introduction

The physics of open (complex) systems seeks to explain how regularity emerges from within a system that consists of many degrees of freedom in constant flux. There are common ideas in the related theories for complex systems (e.g. Thom, 1975; Soodak and Iberall, 1978; Haken, 1983; Iberall and Soodak, 1987; Glass and Mackey, 1988) is the inherent property of self-(re)organization in response to changes in the elements that comprise the system, or to changes in the constraints that surround the system. In essence, small changes *to* the system can prompt large (nonlinear) changes *in* the system as it reorganizes. Kelso, Turvey and colleagues have been instrumental in applying these types of theories to the experimental analysis of perception and action (see Kelso, 1999).

Match play sports exhibit rhythms when competitors perform at equal levels. A perturbation exists where the usual stable rhythm of play is disturbed by extreme elements of high or low skill. In soccer, should the resulting instabilities in playing patterns lead to a shot on goal, then the outcome is termed a critical incident.

"If we study a system only in the linear range of its operation where change is smooth, it's difficult if not impossible to determine which variables are essential and which are not."

" Most scientists know about nonlinearity and usually try to avoid it."

"Here we exploit qualitative change, a nonlinear instability, to identify collective variables, the implication being that because these variables change abruptly, it is likely that they are also the key variables when the system operates in the linear range."

(Kelso,1999)

Research confirming the existence of perturbations by McGarry and Franks (1995) in squash identified particularly weak or strong shots that place one player at a recognised disadvantage to another.

Squash however is regimented in structure, requiring alternate shots and definitive passages of play ending in points; conversely team sports contain unlimited periods of possessions with irregular scoring patterns. Hughes et al. (2001b, p.23) had suggested that concentrating upon the critical aspects of soccer play "could make the ensuing analyses not

only easier but more relevant". A perturbation in soccer is hence defined as an incident that changes the rhythmic flow of attacking and defending; for instance a penetrating pass, change of pace or any moment of skill that creates a disruption in the defence.

Hughes et al. (1997) attempted to confirm and define the existence of perturbations in association football; twelve common attacking and defending variable were identified from English football that led to scoring opportunities. These twelve causes were shown to occur consistently, covering all possible eventualities and had high reliability. After further analyses of the 1996 European Championship matches (N=31), Hughes et al. (1997) attempted to create a profile for nations that had played more than five matches. Although the work supported English League traits for successful and unsuccessful teams, there was insufficient data for the development of a comprehensive normative profile. Consequently, although failing to accurately predict future performance, Hughes et al. (1997) had introduced the method of using perturbations to construct a prediction model, and had identified 6 attacking skills and 6 defensive skills that contributed most to the creation of perturbations..

In match play, teams may alter tactics and style according to the game state/nature; for instance a team falling behind may revert to a certain style of play to create more goal-scoring chances and therefore skew any data away from an overall profile. Consequently, although Hughes et al. (1997) had classified perturbations, the method had failed to distinguish between the game states, which prevented the generation of stable and accurate performance profiles.

In some instances, a disruption in the rhythm of play may not result in a shot, owing to high defensive or a lack of attacking skill. Developing earlier work on British league football, Hughes et al. (2001b) analysed how international teams stabilised or 'smoothed out' the perturbation. Hughes et al. (2001b) identified 3 categories of perturbation that did not lead to shots on goal; actions by the player in possession, actions by the receiver and interceptions. Although Hughes et al. (2001b, p.32) highlighted the requirement for improved technical skill, by combining the data of many teams the conclusions provided little benefit for coaches of specific teams and highlighted the need for analysis of individual "team 'signatures' ".

Previous research has confirmed the existence and definition of perturbations in soccer, and has identified the opportunity for the profiling of individual teams (Hughes et al., 1997, 2001b). Identifying the strengths and weaknesses of specific teams may provide coaches with information to improve their own team's strategies, whilst also providing a tactical advantage gained from predicting opposition patterns of play.

Aim of the study

The objectives of this particular study were twofold:

1. To confirm that the perturbations, previously researched in soccer could be reliably identified and classified for the analysis of association football.
2. The perturbation data for Arsenal Football Club will be used to create a normative profile, whereby the means stabilise, allowing the portrayal of characteristic ways of creating goal-scoring opportunities.

Limitations and delimitations

Gathering as many matches as possible of one particular team demanded using cup and league matches where opposition quality and style of play may fluctuate. Ideally each consecutive match, regardless of television coverage would be analysed; but because such coverage was unavailable, the matches were recorded over the course of two seasons.

This study assumed that team selection did not impact on the creation of a normative profile; adjusting the profile to account for individual player appearances would multiply the variables beyond the capacity of this study. The league structure of the Premiership dictates fixtures between teams of differing strength; Arsenal, one of the leading teams in Europe is bound to play teams of poorer quality. This study assumed that the variations in opposition strength were accounted for in the profile by notating a considerable number of matches. Other extraneous factors such as the weather and referee are assumed to have no measurable effect on performance profiling.

Definition of terms

A perturbation is defined as an incident that changes the rhythmic flow of attacking and defending play in a soccer match. A perturbation occurs when the usual stable rhythm of play is disturbed by extreme elements of high or low skill.

In soccer, should the resulting instabilities in playing patterns lead to a shot on goal, then the outcome is defined as a critical incident.

The 'nature' of a game is defined as the state of the match; winning, losing or drawing.

Methodology

Purpose of the study

The purpose of the study was to develop a hand notation system that would satisfy the research question; the data from the notation system needed to show all perturbations leading to shots in attack and defence for Arsenal football club. The study also attempted to determine the number of matches required to produce a stabilised normative profile using perturbations in defence and attack for Arsenal Football club.

Equipment

E-180 VHS videocassettes

Samsung SV-651LVideo Player Cassette recorder

Panasonic Television

The printed hand notation sheets

Personal Computer

System design

The method used post event analysis, as the speed of the game seldom allows the analyst sufficient time to record the degree of information required in a live situation. The system design was similar to that of previous researchers (Hughes et al., 1997; Hughes et al., 2001b) but modified to provide more comprehensive information on the perturbation location, players involved and time. It was considered that this information provided greater scope for the profiling of individual team strategy.

Results were collected using especially printed analysis sheets (appendix A), an extract of which is shown in figure 1.

Time	*Player #*	Perturbation	Location	*Shooter #*	Shot Location	Result

Fig. 1. Extract of notation sheet

Data were entered into all the columns for every shot attempted during the match. The time column records the match time of the event, the 'Player #'and 'Shooter #' columns represent the player who committed the perturbation and shooter, respectively; the player's shirt number and the role (i.e. midfielder) he played within the team were notated. The perturbation name is noted in the corresponding column; it was decided to use the 12 perturbations that Hughes et al. (1997) had identified which are defined in table 1.

Shot and perturbation location were noted in the corresponding location columns; it was decided to notate the location where the ball was struck for the perturbation or shot, rather than body position. The pitch was divided into twelve sections (figure 2), in order to increase the accuracy of this variable, frame-by-frame motion analysis, with freeze frame and jog shuttle was used and the pitch divisions based upon existing pitch markings as far as possible.

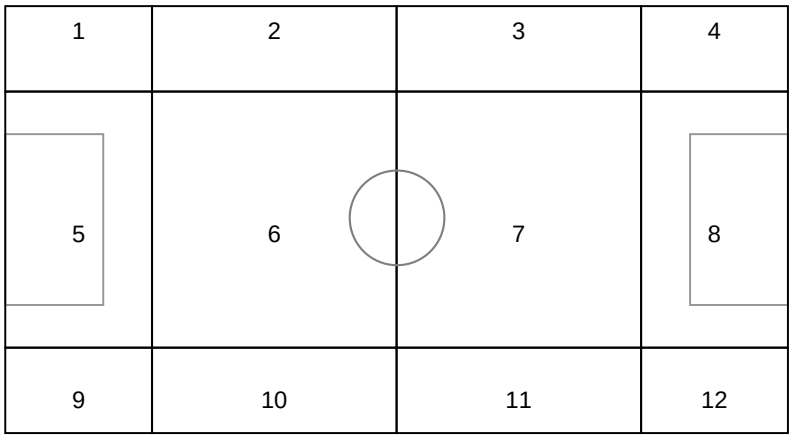

Fig. 2. Example of 12 cell division of football pitch

Table 1. Operational definitions of perturbations

Attacking perturbations	
Run	Player with or without possession of the ball, runs with no obvious change of pace and without attempting to dribble past an opponent.
Dribble	Player in possession of the ball attempts to dribble past an opposing player using skill.
Pass	Player in possession of the ball makes a deliberate attempt to transfer ball to another player using any part of the body.
Skill	Player in possession of the ball uses extreme skill to control the ball.
Tackle	Player without possession, attempts, and succeeds in tackling opposition player, gathering possession.
Change of pace	Player with or without possession of the ball, runs with an obvious change of pace but without attempting to dribble past an opponent.
Defensive perturbations	
Lost control	Player loses control of the football; contributing to a loss of possession.
Miss tackle	Player without possession, is unsuccessful when attempting to tackle an opposition player, and does not gather possession.
Bad pass	Player in possession of the ball makes a deliberate attempt to transfer ball to another player using any part of the body. The pass is inaccurate or poorly directed; contributing to a loss of possession.
Positioning	A defensive player, not in possession, poorly positions himself with respect to the attacking players; allowing the attack excessive space leading to a scoring opportunity.
Deflection	A defending player unintentionally deflects the path of the ball
Foul	Player with or without possession of the ball fouls an opposing player conceding a free-kick/penalty.

The end result of the shot on goal was recorded using the following key:
H - High but not wide of the goal frame
W - Wide but not high of the goal frame
HW - High and wide of the goal frame
S - Saved by the goalkeeper

Reliability & validity

Because of the nature of the data the operator needed to spend considerable time training on the system to ensure consistency in evaluating the appropriate actions. Once an appropriate level of skill with the system was deemed to have been attained, the system was validated and tested for reliability using the test-retest method for intra-observer reliability; inter-observer tests of reliability had previously been presented (Hughes et al., 1997). Three randomly chosen matches were notated three times each, with a period of one week between the sessions of data collection to negate memory effects. The results were analysed using percentage error calculations.

Percentage difference calculations were used to evaluate the system reliability for intra-operator observations, an explanation of which is shown below (Hughes et al., 2001a).

$$\% \text{ difference} = (\text{No. of differing observations} / \text{Total no. of observations}) \times 100$$
$$= (\Sigma (\text{mod} (V_1 - V_2))/V_{TOTmean}) \times 100$$

Where 'mod' is the modulus, Σ the sum of and $V_{TOTmean}$ the mean of the total variables measured.

Limits of agreement

Percentage error was calculated for total shots, location and each perturbation; it was necessary to pre-determine the levels of confidence required for the system to be deemed reliable. It was agreed that a 10% error (90% level of confidence) would be sufficient for total perturbation frequency, and 20% (80% level of confidence) would be sufficient for individual perturbation frequencies; allowing accurate results whilst accounting for small errors in method and notation. It should be noted that the low confidence level for individual perturbations reflects the quantity of data collected; variables with very low frequencies are prone to greater variation than larger data sets.

Subjects

All games were collected from Sky Sports (Sky Satellite Broadcasting) and the BBC, recorded onto E-180 VHS videocassettes. Fifteen games involving Arsenal Football Club were notated from the British League seasons 2002/2003 and 2003/2004 (table 2).

Procedure

At the point from which a shot took place, the tape was rewound to the beginning of the team's possession. From observing the passage of play again the skill causing the perturbation could be identified; when a number of perturbations are observed to cause the critical incident, the first (initial) perturbation was notated. Blocked shots were not notated

Table 2. Subject population

Match No.	Teams	Date	Competition
1	Arsenal vs. Chelsea	08/03/03	FA Cup 2002/2003
2	Arsenal vs. Everton	23/03/03	Premiership
3	Chelsea vs. Arsenal	25/03/03	FA Cup 2002/2003
4	Arsenal vs. Sheffield Utd.	13/04/03	FA Cup 2002/2003
5	Arsenal vs. Manchester Utd	16/04/03	Premiership
6	Bolton vs. Arsenal	26/04/03	Premiership
7	Arsenal vs. Leeds	04/05/03	Premiership
8	Arsenal vs. Southampton	17/05/03	FA Cup 2002/2003
9	Arsenal vs. Manchester Utd.	10/08/03	FA Charity Shield
10	Middlesbrough vs. Arsenal	24/08/03	Premiership
11	Manchester City vs. Arsenal	31/08/03	Premiership
12	Arsenal vs. Newcastle	26/09/03	Premiership
13	Southampton vs. Arsenal	29/12/03	Premiership
14	Leeds vs. Arsenal	04/01/04	FA Cup 2003/2004
15	Arsenal vs. Chelsea	15/02/04	FA Cup 2003/2004

since previous research (Hughes et al., 2001b) had described the blocking of shots as a means of 'smoothing' out the perturbation. The time and perturbation name was recorded with other information on the data sheets.

Games 1-11 were used for data processing with the final four retained to test the accuracy of the normative profile when predicting future performance.

Data processing

The technique for processing data was slow, precise and methodical to ensure the figures collected were reliable whilst reducing the chance for human error. The raw data were processed and analysed using spreadsheets, display the data whilst highlighting important areas such as overall and variable specific mean stabilisation and convergence.

The collected data were analysed using chi-square tests to determine whether there were significant differences between the attacking play of Arsenal between each game state and to detect if the predicted distribution of perturbations were significantly different than the actual values.

Results and discussion

Reliability data

Table 3. Perturbation frequency by trial

Perturbation	T1	T2	T3
Run	5	7	7
Change of Pace	1	0	0
Pass	14	15	15
Dribble	7	5	6
Skill	2	2	1
Tackle	1	1	1
Foul	8	8	8
Deflection	4	4	4
Out of Position	13	10	10
Lost Control	1	1	1
Miss Tackle	7	9	9
Bad Pass	5	6	6
Total	**68**	**68**	**68**

Table 4. Location frequency by trial

Location	T1	T2	T3
1	5	6	5
2	4	3	4
3	3	3	3
4	1	2	2
5	12	12	12
6	19	18	18
7	8	7	7
8	12	12	12
9	1	2	2
10	1	1	1
11	1	2	2
12	1	0	0
Total	**68**	**68**	**68**

The three matches used for reliability tests were grouped together to produce sufficient frequencies for analysis (Table 3). It should be noted that several variables have very low frequencies (change of pace, skill, tackle and lost control) therefore the accuracy of these variables may appear disproportionately poor.

Table 4 shows the differences between perturbations for each trial, including overall percentage error. Although the errors started at a high level (17.6%), by the final comparison they dropped to a figure (2.9%) well below the 10% previously stated as an acceptable level of error.

This study was specifically interested in individual perturbations and therefore required reliability to be tested at a finer level. Of the 12 perturbations, change-of-pace and skill possessed very poor reliability; however both variables had very low frequencies. Future investigations would require a larger data set in order to make definitive conclusions regarding the reliability of individual perturbations.

Perturbations in attack ➔

Table 5. Goals and the frequency of perturbation skills in attack

Perturbation	Frequency	No. of goals	Ratio
Run	20	4	5:1
Dribble	15	2	8:1
Pass	20	6	3.3:1
Skill	4	0	-
Tackle	6	1	6:1
CoP	1	0	-
Miss Tackle	7	1	7:1
Foul	10	1	10:1
Deflection	7	1	7:1
Positioning	12	3	4:1
Lost Control	7	3	2.3:1
Bad Pass	6	0	-
Total	115	22	5:1

CoP – Change of Pace

Table 6. The means and limits of error by game in chronological order.

Game	Shots	Cum. Mean	Mean (11)	-10%	+10%	-5%	+5%
1	19	19.0	10.5	9.4	11.5	9.9	11.0
2	12	15.5					
3	4	11.7					
4	9	11.0					
5	7	10.2					
6	5	9.3					
7	22	11.1					
8	11	11.1					
9	5	10.4					
10	12	10.6					
11	9	10.5					
Sum	115						
Mean	10.5						
St. Dev.	5.7						
SD/Ave %	54.8						

From the eleven matches used to compile a normative profile, a total of 115 shots on goal were observed, of which 22 resulted in goals (table 5). Goals were scored, on average from every 5 shots. Such a low shot to goal ratio contrasts with previous studies by Reep and Benjamin (1968) and Hughes et al. (1997) who recorded much higher approximate shot to goal ratios (10:1 and 12:1 respectively), however Hughes et al. (1997) recorded blocked shots, some of which failed to even reach the goal. Whilst Reep and Benjamin's (1968) analysis used many teams of varying standards which may have skewed the data to a higher overall ratio than the single successful elite club used in this paper.

The perturbations that produced the highest frequency of goal attempts were the pass and run skills, which produced 20 shots (17.4% of total) each. It should be noted that the pass and run skills are interlinked; if an attacker makes a good run, the player still needs to be picked out with an accurate pass if the move is to be successful. These data compare favourably to previous research by Hughes et al. (1997) who recorded 40% of all shots and 48% of all goals resulted from the pass and run perturbations.

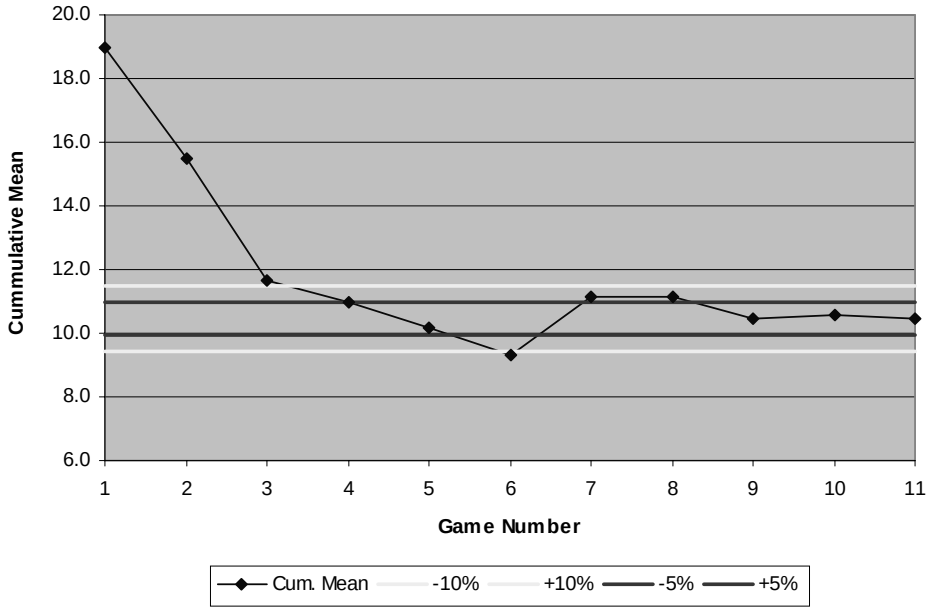

Fig. 3. Cumulative mean frequency of shots by game in chronological order

Although the greatest frequency of goals were scored from the pass skill, the perturbation that provided the most efficient form of attack was lost control wth a goal resulting from every 2.3 (42.9%) perturbations, compared to an overall average of 5:1 (20%). These data support previous work (Hughes et al., 1997) which found lost control the most efficient goal-scoring perturbation. The high efficiency of the lost control variable may result from the perturbation occurring closer to goal, for instance a goalkeeper losing control of a shot creates an excellent goal scoring opportunity.

Table 6 displays the total number of shots from eleven games played by Arsenal. From these data, cumulative means were calculated for the total number of critical incidents in each game. The cumulative mean stabilised to within +/- 10%

of the overall, eleven match mean after 8 matches. Although reverse chronological analysis produced greater variation, random distribution showed stability after 6 matches (fig. 4). In general however, these data compare favourably with research by Hughes et al. (1988) who suggested 8 matches are sufficient for the creation of a normative profile for shots in soccer.

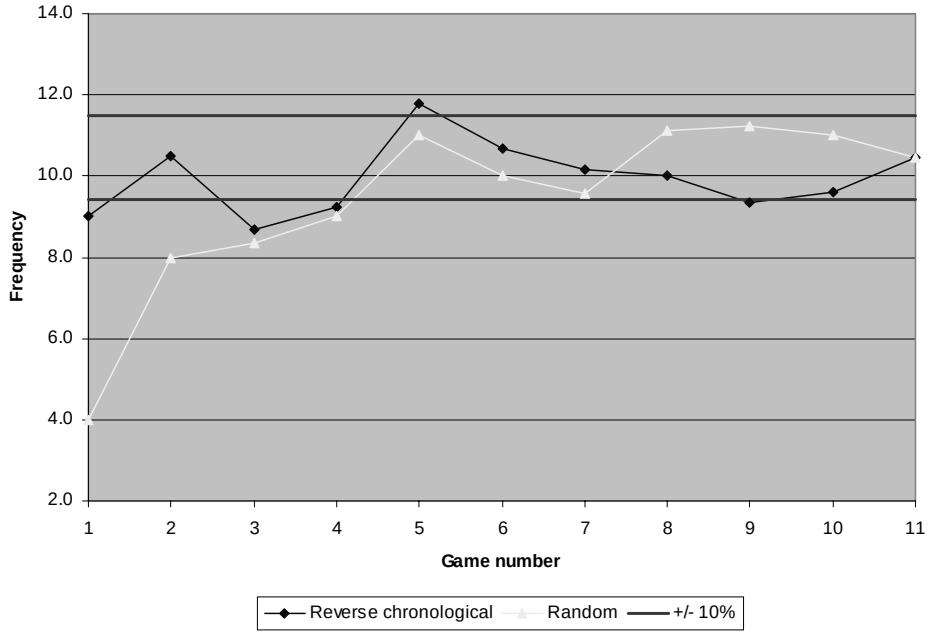

Fig. 4. Cumulative mean frequency of shots in reverse chronological and random order

Table 7. Perturbation cumulative means by game and limits of error.

Perturbation	Cumulative means by game											Mean (11)	+10%	-10%
	1	2	3	4	5	6	7	8	9	10	11			
Run	3.0	1.5	1.7	1.5	1.4	1.5	1.7	1.8	1.8	2.0	1.8	1.8	2	1.6
Dribble	1.0	2.0	1.7	1.3	1.0	1.3	1.6	1.6	1.4	1.4	1.4	1.4	1.5	1.2
Pass	3.0	2.0	1.7	2.0	1.8	1.5	1.9	1.9	1.7	1.9	1.8	1.8	2	1.6
Skill	1.0	1.0	0.7	0.5	0.4	0.3	0.6	0.5	0.4	0.4	0.4	0.4	0.4	0.3
Tackle	1.0	1.0	0.7	0.5	0.6	0.5	0.6	0.5	0.4	0.4	0.5	0.5	0.6	0.5
Change of Pace	1.0	0.5	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Miss Tackle	1.0	1.0	0.7	0.5	0.6	0.5	0.6	0.6	0.7	0.6	0.6	0.6	0.7	0.6
Foul	3.0	2.0	1.3	1.3	1.2	1.0	1.3	1.1	1.1	1.0	0.9	0.9	1	0.8
Deflection	1.0	1.0	0.7	1.0	0.8	0.7	0.6	0.6	0.6	0.5	0.6	0.6	0.7	0.6
Positioning	1.0	1.0	0.7	0.8	0.8	0.7	1.0	1.0	1.0	1.0	1.1	1.1	1.2	1.0
Lost Control	1.0	1.0	0.7	0.5	0.4	0.3	0.6	0.8	0.7	0.7	0.6	0.6	0.7	0.6
Bad Pass	2.0	1.5	1.0	1.0	1.0	0.8	0.7	0.6	0.6	0.6	0.5	0.5	0.6	0.5

Indicates number of games for stable mean

Whilst the data appear to stabilise, the accuracy of the profile should be questioned because of the great variation between individual matches (total shots range from 22 to 4) and the high standard deviation, which equated to 54.8% of the overall mean. Such inconsistency could be the result of the varying tactical strategies applied when winning, drawing or losing; a problem already identified by Hughes et al. (1997).

Although figures 3 and 4 demonstrated the convergence and stabilisation of the total shot frequency, it was necessary to demonstrate the convergence of individual perturbations to confirm the validity and accuracy of the performance profile (Hughes et al., 2001a). Table 7 demonstrates the variation between perturbations; the foul and lost control variables show prolonged variation, only stabilising by the final two games, whereas the pass and dribble perturbations stabilised to within 10% after only 7 matches. Due to the relatively small frequency of some variables, calculations of cumulative mean inevitably showed prolonged variation; for instance change of pace needed to stabilise to within +/-0.01 of the overall mean to be considered stable.

The highest frequency of goals occurred between minutes 31-45 and 61-75, although when the data was contextualised using shot:goal ratio's, the most efficient period was the middle third of the second half (minutes 61-75) when, on average every 2.2 shots resulted in a goal (Fig. 5.) although 20 shots occurred during the first 15 minutes of the match, only 2 of those resulted in a goal, perhaps as Luxbacher (1993) suggested, the high ratio could be the result of high concentration of the defending goalkeeper at the start of the game, or that the attacking players require time to settle into the match as Hughes (1980) proposed. A reversal of these factors may also explain the favourable attacking ratios later in the game; as attackers become relaxed and gain confidence, so the defence lose concentration, allowing greater opportunity to score. A graphic representation of these data is displayed in figure 5.

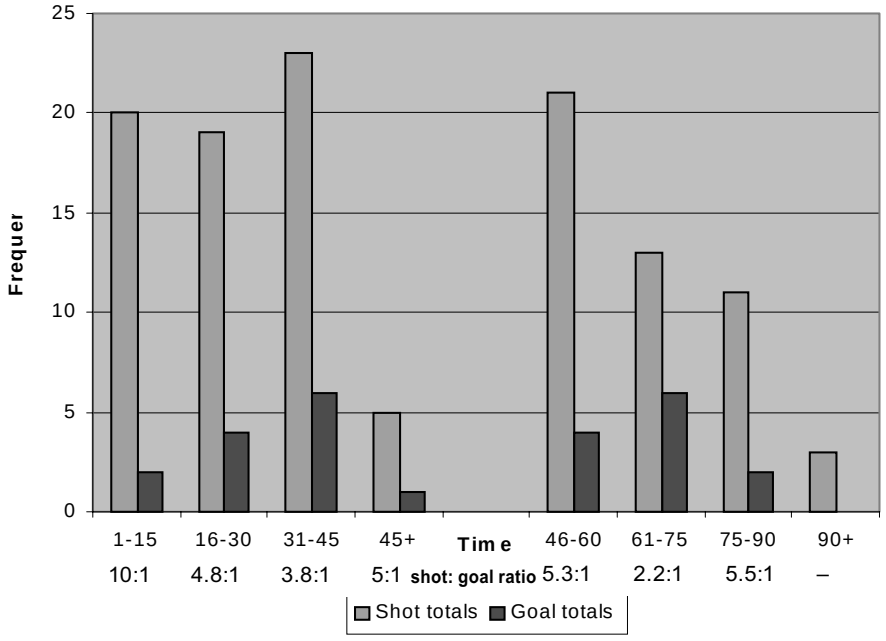

Figure 5. Shot and goal distribution by time

A total of 58.3% of all shots occurred in the first half of the matches analysed, suggesting Arsenal endeavour to create a lead in the first half of games upon which they will consolidate in the second period, a strategy explained by Gray and Drewett (1999).

These data serve to highlight Arsenal strengths and weaknesses rather than suggest future strategies; (for example) just because a team concede from every 4 shots during a period of the game does not mean that Arsenal should attempt to shoot (and expect to score) from unrealistic positions during that time. Instead these data could provide information to help coaching staff develop the fitness/concentration of players during specific periods of the match.

Table 8. Distribution of shots by nature.

Game Nature	Time	Shots	Goals	Average mins p/shot	Average mins p/goal	Shot: goal ratio
Winning	420	41	6	10.2	70	7:1
Drawing	402	44	10	9.1	40.2	4:1
Behind	168	29	6	5.8	28	5:1
Overall	**990**	**115**	**22**	**8.7**	**45**	**5:1**

Figures 6 and 7 describe the distribution of perturbations by nature; when winning 71% of all shots are created by just 3 perturbations; running (24.4%), dribbling (24.4%) and passing (22.0%). When losing, the tackle, foul and positioning perturbations supplied 17.4% of shots each, compared to the minimal contribution (<5%) they make when the team is winning.

A chi-square test of the data revealed significant differences between the patterns of play; when winning, losing and drawing. It is apparent that Arsenal are reluctant to dribble with the ball when trailing (perhaps for fear of losing possession), and pressurise the opposition to dispossess them of the ball, induce fouls and exploit bad positioning. These data support the assertions of a number coaching texts (Gray and Drewett, 1999; Hughes, 1980) who suggested winning teams will have great pressure exerted on their defence, and are therefore expected to concede a greater number of scoring opportunities than when pressure is reduced. In contrast, when winning matches Arsenal almost exclusively used passing,

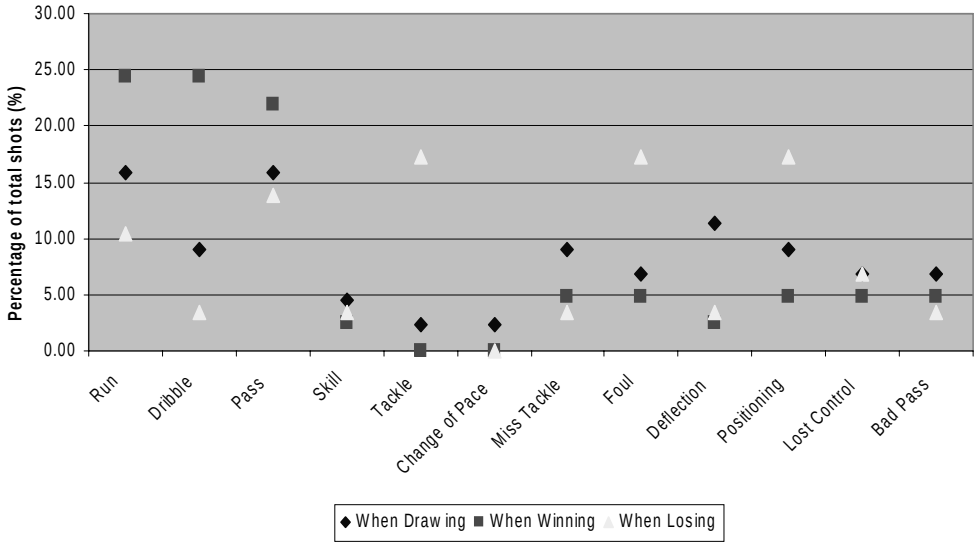

Fig. 6. Distribution of Arsenal perturbations by nature.

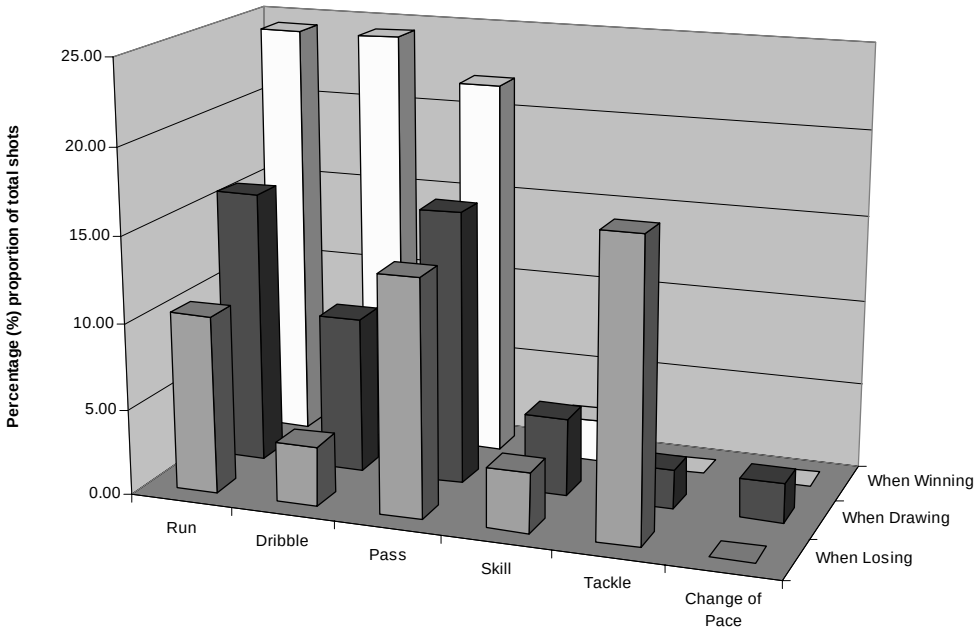

Fig. 7. Proportion of attacking perturbations by nature

running and dribbling to create shots on goal; this could be the result of increased confidence and composure, or simply indicative of a high standard of play where attempts are more frequently created than resulting from defensive errors. These data support assertions by Hughes et al. (1997) that successful teams display a wide range of tactical awareness; when one style of play is not producing goals the team is able to change tactics to produce goal scoring opportunities.

Analysis of location data revealed a strong central preference for attack; 71.9% of all perturbations occur in areas 5 and 6 (fig. 8). There is a small variation between the 1st and 2nd halves, with 6.3% of second half perturbations originating in Arsenal's own half, compared to 1.5% in the 1st half. These data support the earlier suggestion made in this paper, that Arsenal spend the second half of games defending a lead and therefore play more football in their own half.

Contrary to Hughes' (1980) suggestion that teams attack primarily using width, fig. 8 shows that just 17.4% of all perturbations occurred on the wings. Whilst these data appear to conflict with coaching literature, Arsenal are a team built around creative passing football rather than delivering telling crosses into the box from wide positions. It should be noted that the method recorded the original perturbation only; although shots may have been created from width, the perturbation may have occurred in the centre (for instance a good pass from central midfield to the wing).

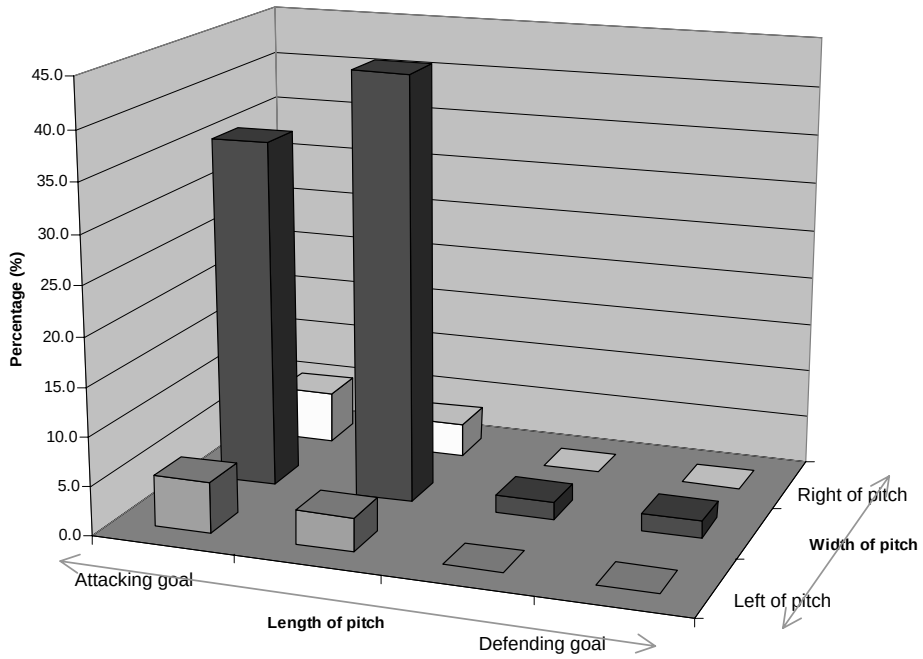

Fig. 8. Location of perturbations in attack

Table 9. Chi-square results for comparison of game states.

Comparison	χ^2
Winning and drawing	48.38
Winning and Losing	188.42
Drawing and Losing	66.75

Note. The change of pace perturbation was excluded from the calculation because of insufficient frequency. (For df = 10, chi-square must exceed 18.31 to reach the 95% level of confidence).

Perturbations in defence

From the eleven matches used to compile a normative profile in defence, a total of 97 shots on goal were observed, of which 13 resulted in goals (Table 10). Goals were scored, on average from every 7.5 shots. Although this is a higher ratio than that observed for Arsenal in attack, the ratio compares favourably with that presented by Reep and Benjamin (1968) who recorded approximate shot to goal ratios of 10:1. The multitude of teams which formed the analysis of opposition play explained the higher ratio compared to Arsenal's shots; the opposition teams had a poorer standard of player compared to that of Arsenal.

The perturbation that produced the highest frequency of goal attempts was the pass skill, which produced 27 shots (27.8%) (Table 10). The lost control perturbation again had a low shot to goal ratio (2:1); perhaps because these losses of possession occur nearer the goal, presenting a better chance of scoring than may occur through other perturbations. Yet the skill with the greatest scoring efficiency is run, suggesting that Arsenal fail to mark players running with/without the ball into Arsenal territory. Because the pass and run perturbations are interlinked (as discussed previously in section 3.2) the high ratio for passing (27:1) and low for running (1.3:1) must be treated with caution. However these data and conclusions highlight Arsenal's strengths and weaknesses which may aid coaches in improving defensive and attacking strategies for future performances.

Table 10. Goals and the frequency of perturbation skills in defence.

Perturbation	Frequency	No. of goals	Ratio
Run	4	3	1.3:1
Dribble	4	1	4:1
Pass	27	1	27:1
Skill	4	0	-
Tackle	5	0	-
Change of Pace	0	0	-
Miss Tackle	11	0	-
Foul	9	1	9:1
Deflection	4	1	4:1
Positioning	16	5	3.2:1
Lost Control	2	1	2:1
Bad Pass	11	0	-
Total	**97**	**13**	**7.5:1**

Table 11 displays the total number of shots from all of Arsenal's opponents; the cumulative mean of defensive shots stabilised to within +/- 10% of the overall, eleven match mean after 7 matches, and remained within 5% of the overall mean thereafter. Figure 9 shows a graphic representation of these data. Further examination of the data revealed a standard deviation of 3.0, which equated to 33.6% of the overall mean, compared to the higher variability witnessed for attacking shots.

Table 11. The means and limits of error for frequency of shots by Arsenal by game.

Game	Shots	Cum. Mean	Mean (11)	-10%	+10%	-5%	+5%
1	9	9.0	8.8	7.9	9.7	8.4	9.3
2	6	7.5					
3	14	9.7					
4	5	8.5					
5	5	7.8					
6	13	8.7					
7	9	8.7					
8	11	9.0					
9	8	8.9					
10	8	8.8					
11	9	8.8					
Sum	97						
Mean	8.8						
St. Dev.	3.0						
SD/Ave %	33.6						

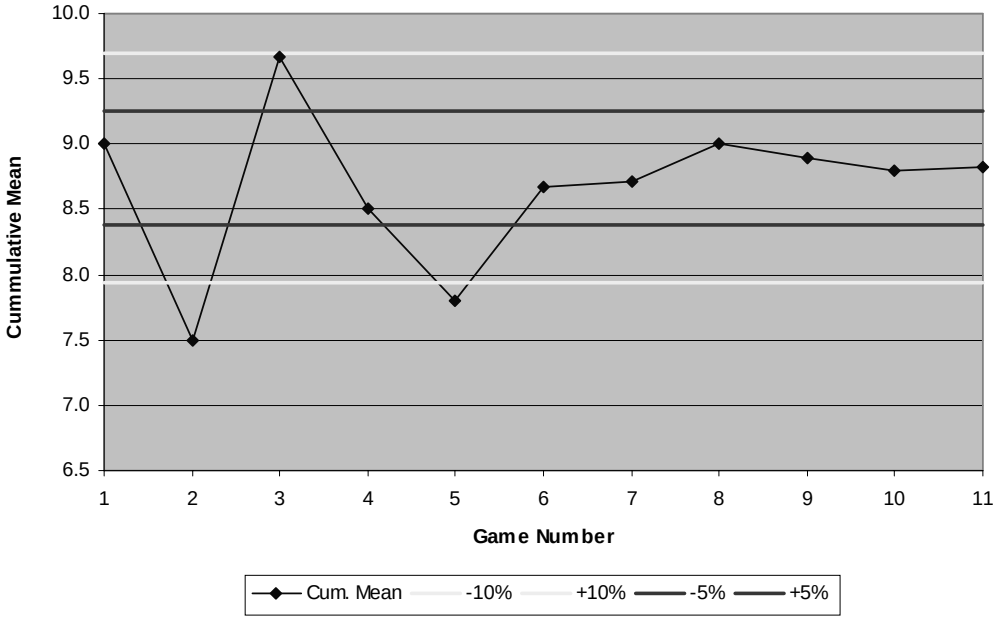

Fig. 9. Cumulative mean number of shots by Arsenal by game in chronological order

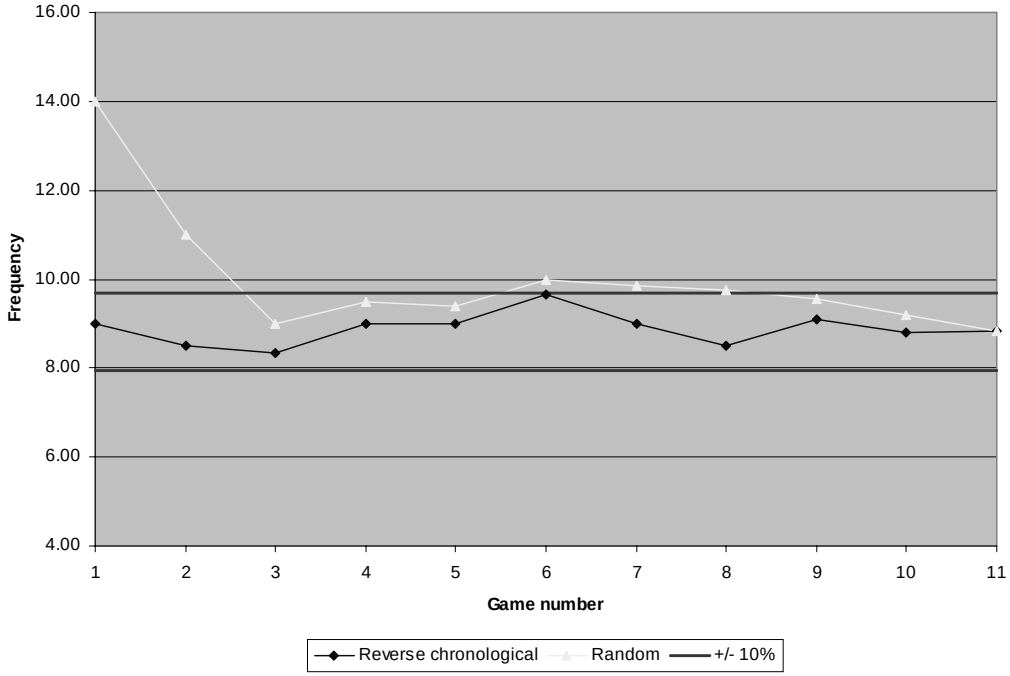

Fig. 10. Cumulative mean frequency of opposition shots in reverse chronological and random order

Similar graphs showing reverse and random distributions display differing analyses; reverse chronological ordering showed excellent stability, but poor for random (figure 10). Although little research supported the quicker stabilisation of opposition shots over that of individual teams, previous studies (Hughes et al., 2001a) failed to differentiate between the opposition and attacking variables. However, Hook and Hughes (2001) confirmed that less successful teams exhibit a more stable, predictable approach to attack; consequently these data are perhaps best explained by the opposition demonstrating a poorer standard of play than that of Arsenal. Alternatively the stable nature of the data could indicate Arsenal's skill and strength in defence, preventing the opposition creating shots on goal using a wide range of attacking methods, although a combination of these factors seems the most probable.

Table 12. Perturbation cumulative means by game.

Perturbation	Cumulative means by game											Mean (11)	+10%	-10%
	1	2	3	4	5	6	7	8	9	10	11			
Run	0.0	0.5	0.3	0.3	0.4	0.3	0.4	0.4	0.3	0.3	0.4	0.4	0.44	0.36
Dribble	0.0	0.0	1.0	0.8	0.6	0.5	0.6	0.5	0.4	0.4	0.4	0.4	0.44	0.36
Pass	1.0	2.0	2.0	2.0	2.0	2.3	2.3	2.5	2.4	2.4	2.5	2.5	2.75	2.25
Skill	0.0	0.0	0.3	0.3	0.2	0.3	0.3	0.4	0.3	0.3	0.4	0.4	0.44	0.36
Tackle	1.0	0.5	0.3	0.5	0.4	0.5	0.4	0.4	0.4	0.5	0.5	0.5	0.55	0.45
CoP	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0.00
Miss Tackle	2.0	1.0	0.7	1.0	0.8	0.7	0.9	1.0	1.0	1.0	1.0	1.0	1.10	0.90
Foul	2.0	1.5	2.0	1.5	1.2	1.2	1.3	1.1	1.0	0.9	0.8	0.8	0.88	0.72
Deflection	1.0	0.5	0.7	0.5	0.4	0.5	0.4	0.4	0.3	0.3	0.4	0.4	0.44	0.36
Positioning	1.0	1.0	1.3	1.0	1.0	1.0	1.0	0.9	1.2	1.5	1.5	1.5	1.65	1.35
Lost Control	0.0	0.0	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.2	0.2	0.22	0.18
Bad Pass	1.0	0.5	0.7	0.5	0.6	1.2	1.0	1.4	1.2	1.1	1.0	1.0	1.10	0.90

CoP – Change of Pace

Table 12 shows the variation between perturbations; although all skills stabilised within 10% of the overall mean by games 10 and 11, the dribble and bad pass variables showed prolonged variation, stabilising by the final two games. These data compare to the pass and miss tackle perturbations which stabilised to within 10% after 7 matches. Figures 11 and 12 represent the miss tackle and dribble perturbation skills graphically. Due to the relatively small frequency of some variables, calculations of cumulative mean showed large differences; for instance the lost control variable needed to stabilise to within +/-0.02 of the overall mean to be considered stable whereas other perturbations had greater tolerances.

Figure 11 demonstrates the analysis of shots and goals over each period of play; from a total of 97 shots on goal, 41% occurred during the first half of matches. The highest frequency of goals occurred between minutes 0-15 and 75-90, although when the data was contextualised, the most efficient goal scoring period was first 15 minutes of the game when, on average every 3.5 shots resulted in a goal (table 4.13). In an interesting contrast to attacking shots, where the highest ratio was observed, Arsenal appear to show vulnerability at the start of the match; perhaps resulting from a lack of confidence/ concentration or, as Gray and Drewett (1999) suggested, the high motivation of the opposition players in the first 15 minutes.

Although 20 shots occurred during the first 15 minutes of the second half, only 2 of those resulted in a goal, perhaps these data could be the result of higher concentration from the Arsenal goalkeeper and defenders at the start of the second half. A total of 58.8% of all opposition shots occurred in the second half of the matches analysed, these data suggest that Arsenal placed less urgency on attack during these periods, perhaps having established a lead whilst the opposition are forced to chase the game.

These data serve to highlight Arsenal strengths and weaknesses rather than suggest future strategies; (for example) just because a team concede from every 4 shots during a period of the game does not mean the opposition should attempt to shoot (and expect to score) from unrealistic positions during that time. Instead these data should be used to compliment other analysis before presentation is made to the coaching staff.

Table 13 describes the distribution of all shots by nature; the highest frequency of shots occurred when Arsenal's opposition were losing. Further analysis to contextualise the data revealed the average time between shots varied by nature, with shot frequency when losing 2.5 times that when winning. An average of 91 minutes per goal (with a shot:goal ratio of 7:1) when losing, contrasts with an average of 44.7 minutes per goal when drawing (shot:goal ratio of 4:1), therefore suggesting Arsenal dominate possession when losing, preventing the opposition opportunity to extend their lead.

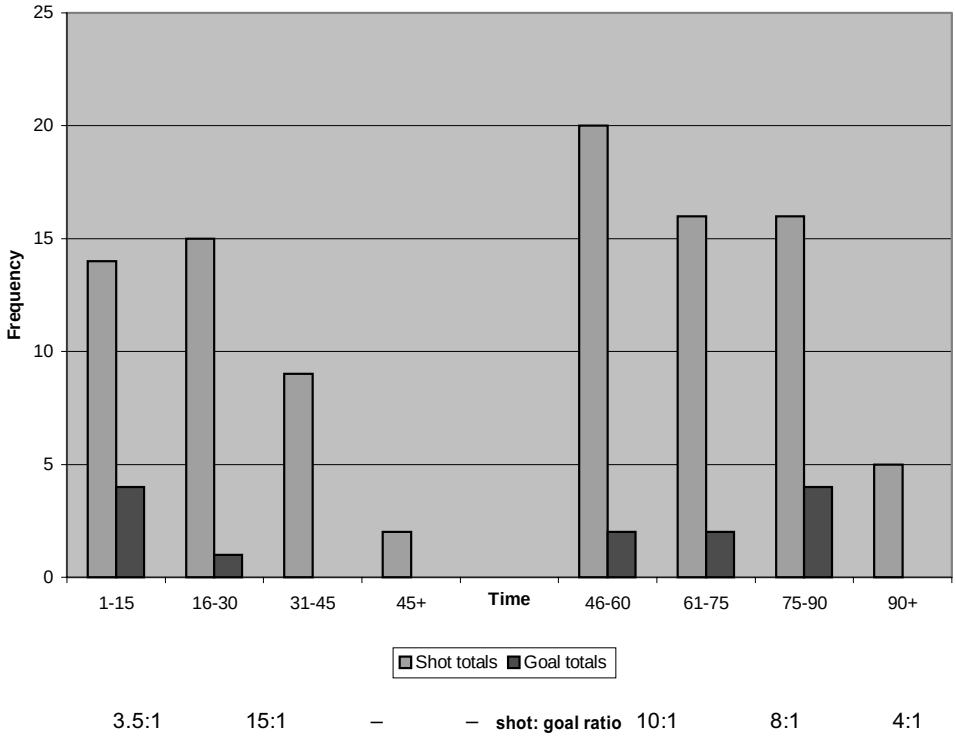

Fig. 11. Shot and goal distribution over time

Table 13. Distribution of shots of the opposition by nature.

Game Nature	Time	Shots	Goals	Average mins p/shot	Average mins p/goal	Shot: goal ratio
Winning	168	9	0	18.7	-	-
Drawing	402	33	9	12.2	44.7	4:1
Behind	364	49	4	7.4	91	13:1
Overall	**990**	**97**	**13**	**10.2**	**71.9**	**7:1**

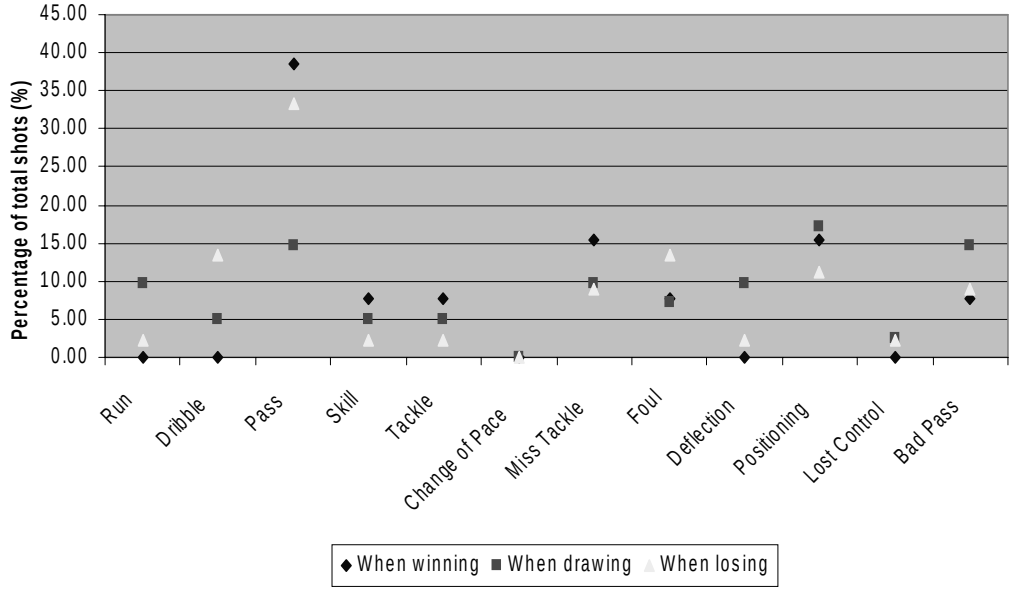

Fig. 12. Distribution of opposition perturbations by nature

Figure 12 details the distribution of perturbations by nature; when winning 38.5% of all shots are created by the pass perturbation compared 15% of shots when drawing. The attacking strategy of Arsenal's opposition show less variation by nature (figure 11) than Arsenal had exhibited (figures 5 and 6), suggesting the tactical awareness described by Hughes et al. (1997) is lacked by the opposition teams. Because this study analysed a multitude of teams, differentiation between the contrasting styles of opposition is impossible, the data represent a general trend of the opposition play. A chi-square test (Table 14) revealed significant differences between the patterns of play for all game states, with the greatest statistical variation occurring between drawing and losing.

When trailing, the opposition used dribbling (14%) perturbations more frequently, and relied less upon skill and tackle. Whilst these data provide little team-specific accuracy, it is interesting to contrast Arsenals reluctance to dribble with the opposition enthusiasm to when losing.

Table 14. Chi-square results for comparison of game states.

Comparison	χ^2
Winning and Drawing	75.60
Winning and Losing	56.66
Drawing and Losing	83.02

Note. The change of pace perturbation was excluded from the calculations because of insufficient frequency. (For df = 10, chi-square must exceed 18.31 to reach the 95% level of confidence.)

Performance profiling with perturbations

From the eleven matches notated performance profiles were generated for Arsenals perturbations. An additional five matches allowed opportunities to test the power and accuracy of the data and each profile. Two different ways of profiling using the 11 sets of data were explored.

The General Prediction Theory (GPT) used the stabilised attacking means for all matches previously presented in section 3.2. The mean values for each perturbation skill were compared to the actual values for four additional games in a method similar to that of Hughes et al. (1997). It was considered necessary to round the figures for perturbations to the nearest whole number, because it is impossible to have a fraction of a shot or perturbation. Four matches were compared to the predicted values, with the previous match always added to the database; consequently for the final match, 14 matches formed the GPT database.

The Nature Specific Theory (NST) used the average minutes per shot (table 8) and normative distribution of shots by nature to predict the proportion of shots in each game. When the actual time is divided by the predicted shot ratio for each nature, a perturbation profile is developed. An example of the formula for calculation is shown below.

*Run Perturbations when winning = (Average percentage of run perturbations when winning / 90) x actual minutes winning = **A***

*(Actual minutes when winning / average minutes per shot when winning) = **B***

*(**A** / 100) x **B** = NST predicted run perturbations when winning*

Run perturbations over whole game = predicted shots when winning + drawing + losing

As for the GPT, it was considered necessary to round the figures for perturbations to the nearest whole number. Four matches were compared to the predicted values, with the previous match always added to the database before the next prediction.

Profile one: the General Prediction Theory (GPT)

Table 15. Predicted and actual frequencies using the GPT model.

	Newcastle		Southampton		Leeds		Chelsea	
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual
Run	2	0	2	2	2	1	2	0
Dribble	1	2	1	3	2	1	2	2
Pass	2	0	2	1	2	2	2	3
Skill	0	1	0	0	0	0	0	0
Tackle	1	0	1	1	1	0	1	1
CofP	0	0	0	1	0	0	0	0
Miss Tackle	1	2	1	1	1	0	1	1
Foul	1	2	1	1	1	1	1	0
Deflection	1	0	1	0	1	1	1	1
Positioning	1	1	1	3	1	3	1	2
Lost Control	1	0	1	1	1	0	1	0
Bad Pass	1	2	1	1	1	1	1	0
Total	**10**	**10**	**11**	**14**	**10**	**9**	**10**	**10**

CofP – Change of Pace

Table 15 shows all predicted and actual frequencies for the four matches. Although the total shot frequency appears to be reasonably accurate, individual perturbations show little accuracy for many of the games. The GPT model predicted 7 of the 12 individual perturbations correctly (58.33%) for the Southampton match and six of the 12 for the Leeds fixture, however the levels of accuracy were poorer for the Newcastle (16.66%) and Chelsea matches (41.66%).

The disappointing levels of accuracy for the Chelsea and Newcastle games highlight the erratic nature of Arsenals play. Against Newcastle, 7 of Arsenal's 10 shots arose from defensive mistakes; un-characteristic for Arsenal, but indicative their opponents frailty in defence. In contrast, against Chelsea a moment of individual brilliance from one Arsenal player changed the game, as Arsenal scored twice in 4 minutes.

Figure 13 shows the combined frequencies for the attacking perturbations; data for four games were merged. Although preventing analysis on a game-by-game basis, this approach allowed statistical tests to be conducted and the study of individual perturbations across a number of games. Of the attacking perturbations, dribble, pass and tackle show encouraging accuracy compared to the others, which were limited in frequency and therefore prone to higher variation. The accuracy of the pass skill could be explained by its generic nature; it provides the highest proportion of shots during each nature, with the exception of losing and could therefore expected to show accuracy when no differentiation is made between natures.

Chi-Square tests revealed significant differences (χ^2=17.57) between the predicted and actual distribution of attacking perturbations, with change-of-pace excluded because of insufficient frequency (chi-square must exceed 9.49 to reach the 95% confidence level ($p<0.05$)).

Of the defensive perturbations shown in figure 14, all bar positioning and lost control show encouraging accuracy, it should be noted that several variables (including lost control) are limited in frequency and therefore prone to have high

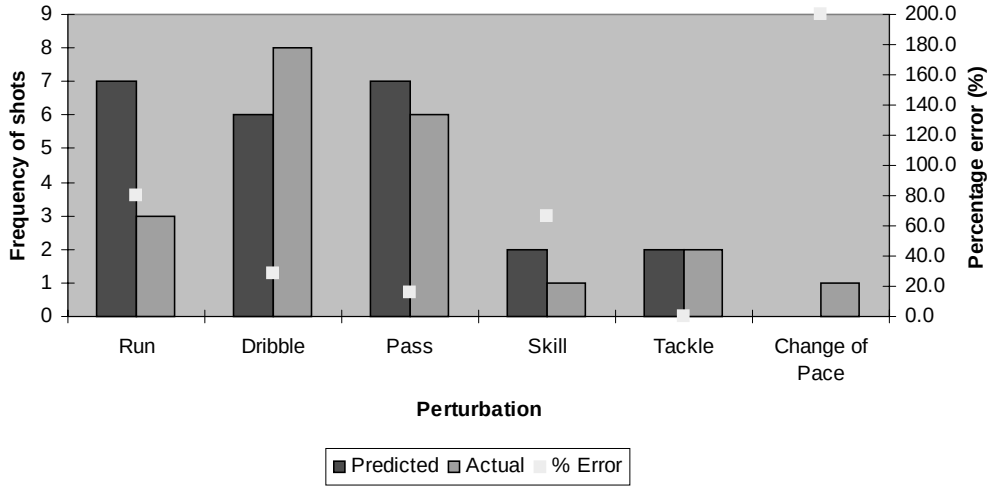

Fig. 13. Combined frequency data for attacking perturbations and percentage error, using the GPT

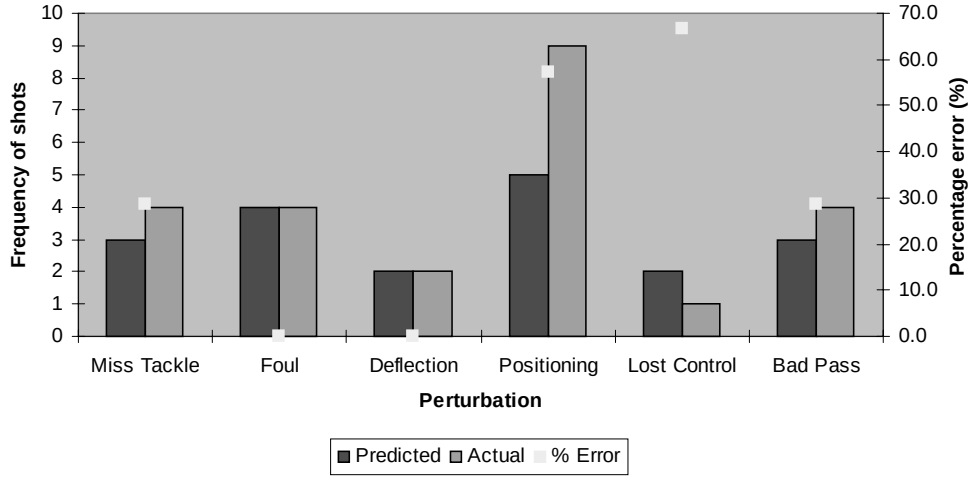

Fig. 14. Combined frequency data for defensive perturbations and percentage error, using the GPT

error when comparisons are made with predictions. A Chi-Square test revealed no significant differences (χ^2=10.06) between the predicted and actual distribution of defensive perturbations (chi-square must exceed 11.07 to reach the 95% confidence level ($p<0.05$)).

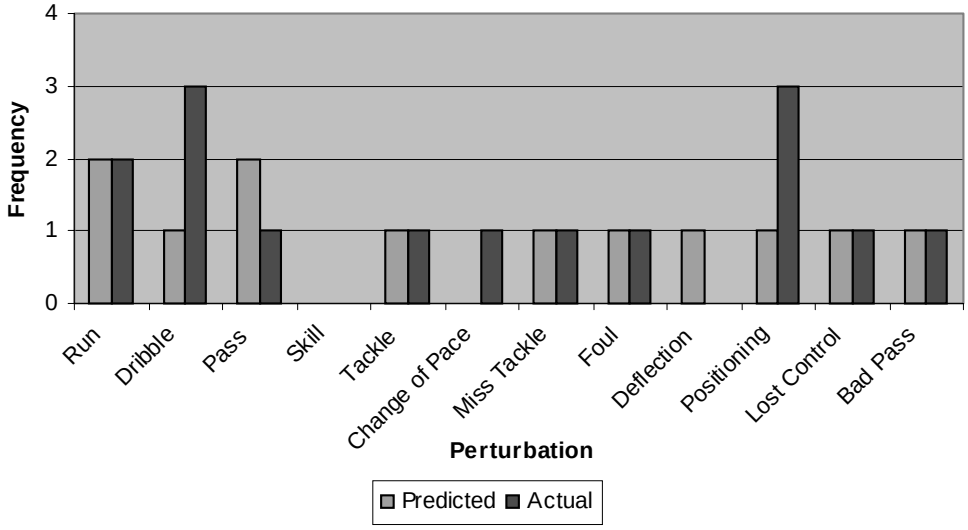

Fig. 15. A graphic comparison of GPT predicted and actual frequencies of shots for each perturbation for the Southampton match.

Figure 15 shows the comparison between predicted and actual values for the Southampton match. As already discussed, this match provided the greatest correlation between predicted and actual perturbation frequencies. The relative accuracy of the profile is perhaps explained by the fact Arsenal spent the majority of the game winning (55mins); the score line and performance could be described as a typical game involving one of the Premierships top teams (i.e. a comfortable win). The large frequency of positioning perturbations is indicative of Southampton's poor defensive skill, and as Gray and Drewett (1999) suggest the team chasing the game leave themselves exposed in defence.

The level of accuracy shown by the GPT was considered disappointing; it was apparent that the GPT had failed to account and adapt for the differences in score-line-dependant tactics, which had been identified. Consequently a new method of profiling which accounted for the variations in style and nature of the game was developed. It was felt that this approach would produce a higher level of accuracy when predicting individual variable frequency than that observed for the GPT.

Profile two: the Nature Specific Theory (NST)

As for the GPT, it was considered necessary to round the figures for perturbations to the nearest whole number. Four matches were compared to the predicted values, with the previous match always added to the database before the next prediction.

Table 16 shows all predicted and actual frequencies for the four matches. Although the total shot frequency appears to be slightly less accurate than the GPT model (table 15), comparison between individual perturbations showed an increased consistency in accuracy. The NST model predicted 6 of the 12 individual perturbations correctly for the Southampton and Leeds matches, 5 of the 12 for the Chelsea fixture (41.66%) although just 3 of the 12 perturbations matched the actual values for the Newcastle match.

The failure of the model to show great accuracy should be viewed as indicative of the erratic nature of Premiership football, as previously discussed. Figure 16 shows the combined frequencies for the attacking perturbations when data for all four games were merged. Of the attacking perturbations, dribble and pass showed excellent accuracy compared to the others, which are limited in frequency and therefore prone to higher errors.

Chi-Square tests revealed significant differences (χ^2=27.58) between the predicted and actual distributions of the attacking perturbations which fulfilled the criteria for chi-square (chi-square must exceed 7.81 to reach the 95% confidence level ($p<0.05$)).

Table 16. Predicted and actual frequencies using the NST model.

	Newcastle		Southampton		Leeds		Chelsea	
	Predicted	**Actual**	**Predicted**	**Actual**	**Predicted**	**Actual**	**Predicted**	**Actual**
Run	2	0	2	2	2	1	2	0
Dribble	1	2	2	3	2	1	1	2
Pass	2	0	2	1	2	2	1	3
Skill	0	1	0	0	0	0	0	0
Tackle	0	0	0	1	0	0	1	1
CofP	0	0	0	1	0	0	0	0
Miss Tackle	1	2	1	1	1	0	1	1
Foul	1	2	1	1	1	1	1	0
Deflection	1	0	0	0	0	1	1	1
Positioning	1	1	1	3	1	3	1	2
Lost Control	1	0	0	1	1	0	1	0
Bad Pass	1	2	1	1	1	1	1	0
Total	10	10	9	14	10	9	10	10

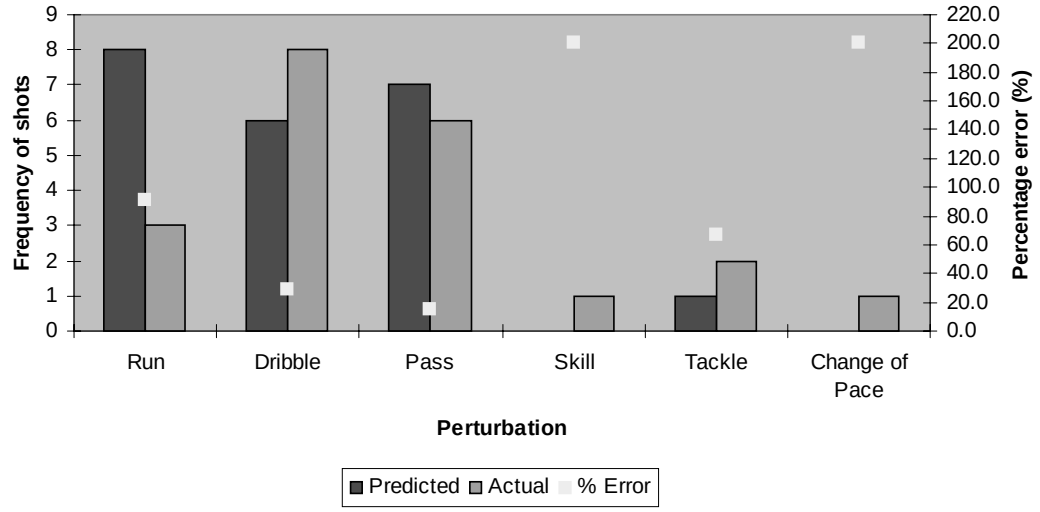

Fig. 16. Combined frequency data for attacking perturbations and percentage error, using the NST

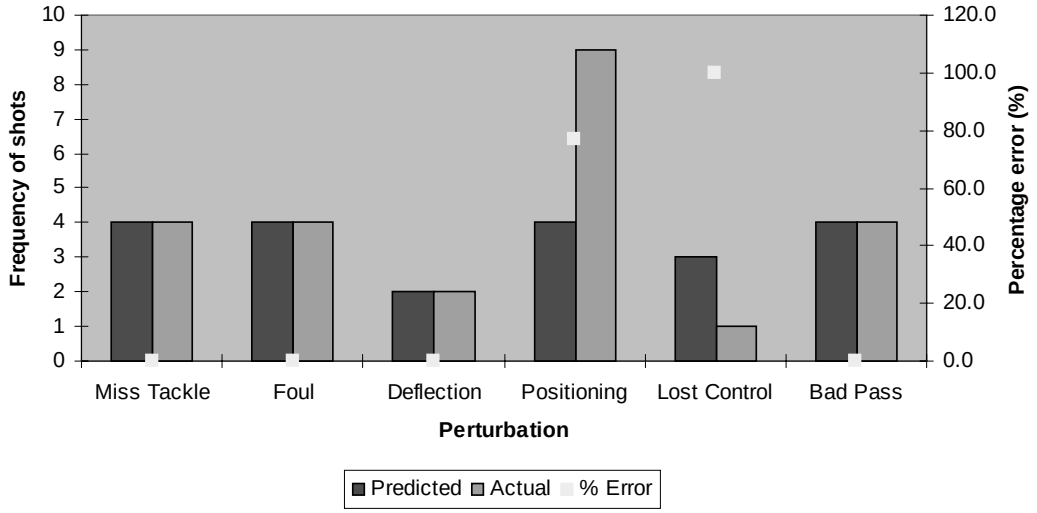

Fig. 17. Combined frequency data for defensive perturbations and percentage error, using the NST

Of the defensive perturbations shown in figure 17, all bar positioning and lost control show perfect accuracy. Further analysis revealed that greater numbers of predictions matched the actual values for attacking perturbations (41.66%) than defensive variables (33.33%); therefore suggesting that by combining the four games, errors have been hidden.

Chi-Square tests revealed significant differences (χ^2=26.09) between the predicted and actual distributions of defensive perturbations (chi-square must exceed 11.07 to reach the 95% confidence level ($p<0.05$)).

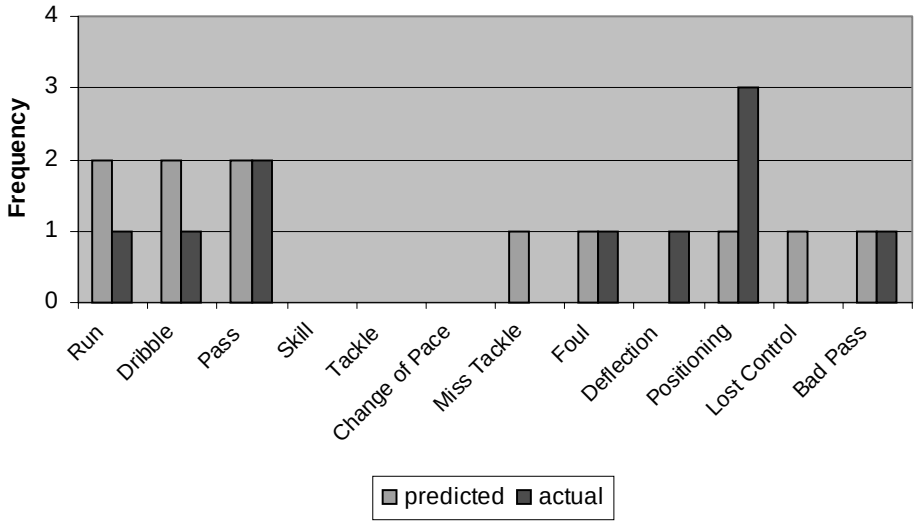

Fig. 18. A graphic comparison of NST predicted and actual frequencies of shots for each perturbation for the Leeds match

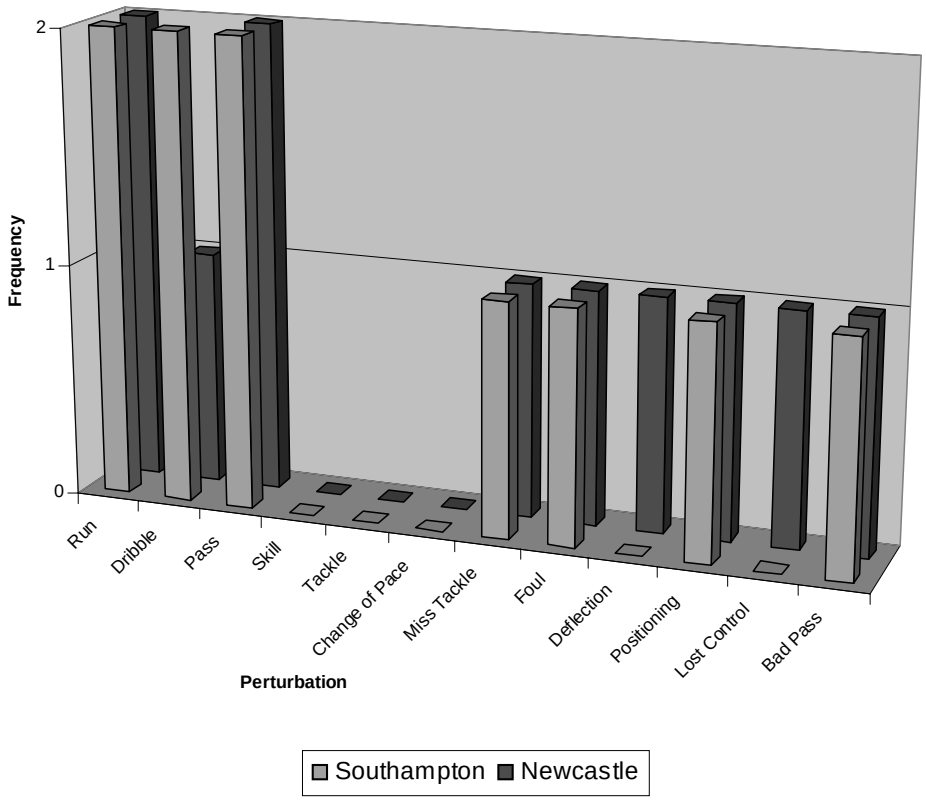

Fig. 19. A graphic comparison of the NST predicted values for the Southampton and Newcastle matches

Although the NST failed to show dramatic improvements upon the GPT, the ability to account for the state of the game when predicting future performance more accurately replicates the demands of matches and may go someway towards improving the accuracy of performance profiles.

Performance profiling – an evaluation

The state or nature of the game may affect the frequency of shots and perturbations; however attempts at profiling and therefore predicting perturbations in any given match have produced mixed results. Table 17 shows that the two models proposed by this paper displayed almost identical levels of success; both performed poorly for the Newcastle match, although the NST appears to allow a more consistent prediction than the GPT.

Table 17. Percentage of exact matches between predicted and actual perturbation frequencies.

	Newcastle	Southampton	Leeds	Chelsea	Average
GPT	16.7	58.3	50.0	41.7	**41.7**
NST	25.0	50.0	50.0	41.7	**41.7**

Work in this paper and that by previous researchers (Hughes et al., 1997; Murray and Hughes, 2001) suggest that predictions using perturbations may only ever to be able to achieve a consistent success level of around 60% for individual perturbation frequencies. Such is the nature of football (and particularly the English Premiership) that teams do not perform in a consistent manner; many of the top teams possess 'flair' players who can randomly produce moments of extreme skill which turn the course of matches. These conclusions support earlier work by Hook and Hughes (2001) which demonstrated the wide ranging, inconsistent methods of attack demonstrated by successful teams.

In contrast to individual sports (Sanderson, 1983), this study demonstrated that Arsenal use significantly different tactics when winning, losing or drawing. Utilising this knowledge, the NST appeared to be a more consistent method of profiling than that previously introduced by Hughes et al. (1997).

Additional obstructions to the modelling process have already been discussed in section 1.2, but the rarity of television coverage is crucial; analysis of every consecutive match could go someway to improving the success of perturbation profiling. When large numbers of matches are collated for profiling, it is reasonable, as Potter and Hughes (1996) suggested that an optimum database size exists. If grading systems such as that proposed by Mosteller (1979) are to be employed in profiling, then it is necessary to know the precise amount of data which creates an accurate profile; data presented in this paper suggested that a minimum of eight games are required for the construction of a representative database. However this study used matches across a long period of time; it is recommended therefore, that eight matches are required for profiling an elite football team when matches are collected intermittently over an extended period of time.

Systems that exhibit dynamical tendencies are held to do so regardless of the level and time-scale at which the system is analysed (Kelso, 1995). This research has attempted in a practical way, to focus on the kinematic relations between players of a particular team (level of analysis) within a sports contest (timescale – a series of matches in one season). Thus, the fortunes of a player or team over a series of contests might itself be considered as a dynamical system on a different level of analysis and time-scale from that considered hitherto, as suggested by McGarry et al. (2002). Further, from a developmental perspective, changes within the players that comprise a series of sports contests would be considered agents for change within a dynamical system. In the course of a season, there were variations in, for example, the injury status, fitness and skill of players and, the availability and selection of players. Thus, the attractor landscape that underpins the intrinsic dynamics of any given sports contest will itself inevitably change over the course of a season, as a result of change in these and other variables. The impact of developmental variables on the intrinsic dynamics of a sports contest is an important issue that future research should address.

Conclusions

It was concluded that the identification and analysis of perturbations and their location was consistent and reliable. Arsenal's characteristic patterns of play were identified enabling the prediction of future match outcomes and highlighting important coaching information such as strengths and weaknesses in attack and defence. A goal was scored, on average from every 5 Arsenal shots with lost control the most efficient attacking perturbation (42.9% shots resulted in goals) and foul the least (10%). In defence Arsenal conceded, on average from every 7.5 shots but appeared to show vulnerability to attacking runs, with 75% of those perturbations resulting in goals.

It was concluded that total shot frequency stabilised after 8 matches, however the varying tactical strategies employed within games caused the data to show high variability. Further attempts to integrate these tactical variations into profiling provided more consistent results than the method introduced by Hughes et al. (1997).

Because elite teams aim for unpredictability and the multitude of factors influencing match situations, prediction of individual perturbations may be very difficult to achieve with higher degrees of success than witnessed in this study. Nevertheless this dissertation demonstrated the potential benefits of nature-specific modelling in soccer which could form the basis for future research using perturbations in soccer.

Recommendations for future research

Because elite soccer may provide limited levels of success, future work should concentrate on the analysis of consecutive, non-elite matches. Further attempts at profiling should discriminate between the game states, defining the changes in strategy and examining the implications for coaching.

To reduce the confusion surrounding the optimum database size for specific teams, future work could analyse the effects of graded models upon performance profiling.

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THE NEW SPORT AND HEALTH PARADIGM – A SOCIO-ECONOMIC ANALYSIS

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Abstract

Health economists, sports physicians and sociologists have worked together on an interdisciplinary basis to develop a welfare-economic cost-benefit model of mass and leisure sports in Austria. With the aid of this model the cost to the economy of a country caused by sports injuries and accidents on the one hand, and on the other the benefits of sport to health economy were calculated for Austria and the year 1998. The aim was to objectivize the question as to the positive and negative effects of sport on health.

It is clearly to be seen that *more economic costs are incurred not from doing sports but from not doing sports.* As immaterial values in sport such as mental, physical and social well-being cannot be quantified, these remain as an additional benefit.

The results of the study can be summed up as follows: Promotion of sport and exercise as a significant facet of lifestyle in a modern health and social system not only helps to improve general well-being but it also contributes towards saving economic costs.

Key words: *Multi-, trans- and interdisziplinarity, cost-benefit survey of active sport*

Introduction

In the first part of this paper it will be shown that the investigation of human behaviour in sport can be carried out only in its entirety. Instead of monocausal explanations multicausal explanations are needed. To achieve this goal multi-, trans- and interdisciplinary paradigms of sport science are a precondition and also a programme – a programme of cooperation between sport scientists of different disciplines in order to combine and develop knowledge and methods from these various sources.

In Vienna we conducted an inter- and indeed also transdisciplinary study concerning the cost / benefit balance of sport participation in Austria. A study of this sort entails cooperation between health economists, sport sociologists and sport physiologists, which seems to be a good example of such a paradigm. This project is an economic analysis of the costs of sportaccidents on the one hand and the benefits of sport participation on the other.

The second part is an abridged version of the report on this study by Weiss, O. et al (2001) which was commissioned by the Federal Ministry for Social Security and the Generations (Bundesministerium für soziale Sicherheit und Generationen) and undertaken by the Austrian Federal Sports Organization (Österreichische Bundes-Sportorganisation) in collaboration with the Institute of Sport Science, University of Vienna (Institut für Sportwissenschaft der Universität Wien) and the Institute Safe Living (Institut Sicher Leben).

Paradigms of Sports Science

If we look into the history of sport science the starting point was more or less physical education and the analysis of sport at school. With the development of sport outside schools (leisure sport, top level sport etc.), sport medicine, kinesiology, psychology of sport, sociology of sport and other disciplines of sport science were established and have investigated sport from many different perspectives.

However, if we look into the future development of sport science we have to take into consideration that sport has become a social phenomenon of great magnitude and complexity. This can be seen and demonstrated most clearly by looking at the example of the economic significance of sport, which is increasing world-wide. A shorter working week, an increase in the value we place on leisure, and the growth of the television industry have helped sport to become a commodity to be produced, marketed, and sold to the public.

As a result sport has become a huge industry. In order to explore this relationship (symbiosis) between sport and economy not only the scientific discipline "economics of sport" is necessary, but disciplines such as psychology of sport, sociology of sport and many others are also needed.

In the same way analysis in sport and health require sociological, psychological, anthropological etc. knowledge and methods. The field of health and sport is very heterogeneous and complex; its investigation does not by any means take

one particular research paradigm as the law but rather prefers pluralism in theory and methodology. As an integrative discipline sport science needs integrative concepts and research designs.

The development of sport science in the past century was characterised by the genesis of and differentiation of various disciplines which developed independent of one another into kinesiology, sociology of sport, economics of sport and so on. Cooperation and integration of these disciplines could be the programme of sport science for this young century.

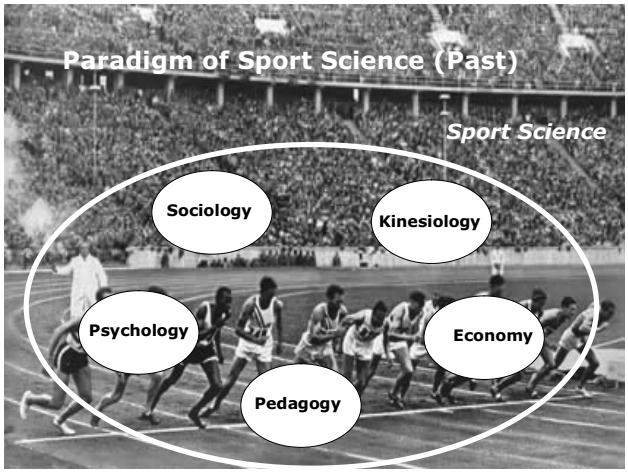

Figure 1. Paradigm of Sport Science (Past)

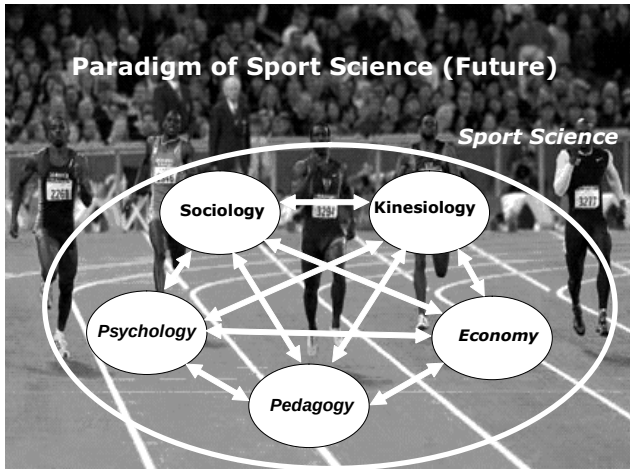

Figure 2. Paradigm of Sport Science (Future)

This shows that *multi-, trans-* and *interdisciplinarity* could be the most important paradigms of sport science in the future.

Multidisciplinary research means the cooperation between different and appropriate disciplines.

Transdisciplinary research means the introduction of foreign elements into an established science.

Interdisciplinary research means the development of comprehensive theoretical concepts through integration of knowledge and methods from different disciplines.

Sports and Health – A Socio-economic Analysis

The Cost of Sports Injuries and Accidents

During 1998 98,626 sports accidents were registered in Austria. The direct costs (for medical treatment and rehabilitation) and the follow-up costs (for sick leave, invalidity pay or death) amounted to € 302 million. Table 1 shows the division of these costs.

Table 1. Cost of Sports Accidents according to Type of Expense (in Austria in 1998)

Type of Expense	No. of Injured and Dead	Cost	% Share	Average Cost per Case
Occupational Production Loss	18.832	141 mio. €	47 %	74.900 €
Sick Leave	98.504	94 mio. €	31 %	940 €
Medical Treatment and Rehabilitation	98.626	67 mio. €	22 %	650 €
Total	98.626	302 mio. €	100 %	3.050 €

- In 1998 the average total cost per sports accident was approximately € 3.050.
- Of this sum, per case approximately € 650 were spent on medical treatment.

Three quarters of the medical costs were for in-patient treatment in hospital, one fifth for out-patient treatment, and only a small fraction was for treatment at doctors' surgeries (Table 2).

Table 2. Cost of Medical Treatment and Rehabilitation (in Austria in 1998)

Type of Treatment	No. of Cases	Cost	% Share	Average Cost per Case
In-patient	18.710	48 mio. €	72 %	2.543 €
Rehabilitation	198	3 mio. €	4 %	13.244 €
Out-patient	74.943	14 mio. €	21 %	189 €
Treatment in Doctors' Practices	23.561	2 mio. €	3 %	87 €
Total	98.504	67 mio. €	100 %	673 €

30% of the cost of occupational production loss due to sports accidents are incurred by deaths, and 70% by invalidity (Table 3).

Table 3. Cost of Occupational Production Loss due to Sports Accidents of Economically Active Persons (in Austria in 1998)

Occupational Production Loss	No. of Cases	Cost	% Share	Average Cost per Case
Death	71	43 mio. €	30 %	0,60 mio. €
Invalidity	244	98 mio. €	70 %	0,40 mio. €
Total	315	141 mio. €	100 %	0,44 mio. €

If the total cost of sports accidents is broken down according to the seriousness of injuries the result is as can be seen in Table 4:

Table 4. Cost of Sports Accidents according to Seriousness (in Austria in 1998)

Cause of Cost	No. of Cases	Total Cost	% Share	Average Cost per Case
Death	122	43 mio. €	14 %	348.320 €
Serious Injury	18.710	180 mio. €	60 %	9.670 €
Minor Injury	79.794	79 mio. €	26 %	1.020 €
Total	98.626	302 mio. €	100 %	3.050 €

A serious injury requires in-patient treatment. A minor injury requires treatment either as an out-patient or in a doctor's practice.

Table 5. Cost of Treatment for Non-fatal Sports Accidents according to Type of Sport (in Austria in 1998)

Type of Sport	No. of Injured	Cost of Treatment in millions €	% Share
Alpine Skiing	21,155	22,45 mio. €	34
Football (Soccer)	22,477	9,93 mio. €	15
Cycling (as a sport)	10,611	8,41 mio. €	13
Other Sports (detailed)	8,198	4,83 mio. €	7
Hiking, Mountaineering	3,934	4,69 mio. €	7
Snowboarding, Tobogganning, Cross-Country Skiing	6,776	3,67 mio. €	6
Inline Skating	5,289	2,30 mio. €	3
Handball, Volleyball, Basketball	7,636	2,25 mio. €	3
Cycling (in normal traffic)	1,785	1,74 mio. €	3
Tennis, Squash, Badminton, Table Tennis	2,611	1,50 mio. €	2
Ice Skating, Ice Hockey	2,578	0,97 mio. €	1
Swimming, Diving, Scuba Diving	231	0,80 mio. €	1
Paragliding, Parachuting	231	0,75 mio. €	1
Gymnastics	1,851	0,59 mio. €	1
Running, Jogging	1,554	0,55 mio. €	1
Climbing	397	0,48 mio. €	1
Skateboarding, Roller Skating	1,058	0,44 mio. €	1
Windsurfing, Rafting, Water Skiing	66	0,03 mio. €	0
Other Sports (not detailed)	66	0,13 mio. €	0
Total	98,504	66,51 mio. €	100

- Thus it can be seen that 60% of total costs are incurred as the result of serious injuries (cost per case € 9.670), 26% stem from minor injuries (cost per case € 1.020), and 14% from fatal injuries (cost per case € 348.320).
- Three sports – in order of accident frequency: alpine skiing, football (soccer) and cycling – answer for over 60% of the costs of medical treatment (Table 5). But to deduce that these are therefore the most dangerous sports would not be correct; the large number of people injured is due to the large number of people doing these sports. Cycling is the most popular Austrian sport, skiing takes third place, and football (soccer) seventh (Weiss 2000).

Table 6 shows the total cost of sports accidents, i.e. the cost of medical treatment and rehabilitation, and occupational production loss, in the case of the economically active through sick leave, invalidity or fatal accident.

Table 6. Cost to the Economy of Sports Accidents in terms of Type of Cost and of Sports with the Most Accidents (in Austria in 1998)

Type of Sport	No. of Injured+ Dead	Medical Treatment + Rehab. (mio. €)	Sick Leave (mio. €)	Invalidity (mio. €)	Fatality (mio. €)	Total (mio. €)
Alpine Skiing	21.183	22,46 mio. € 34 %	35,76 mio. € 38 %	34,66 mio. € 35 %	8,94 mio. € 21 %	101,82 mio. € 34 %
Cycling (as a sport)	12.426	8,43 mio. € 13 %	15,48 mio. € 16 %	11,92 mio. € 12 %	8,36 mio. € 20 %	44,19 mio. € 15 %
Hiking, Mountaineering	3.977	4,72 mio. € 7 %	8,07 mio. € 9 %	–	17,37 mio. € 41 %	30,16 mio. € 10 %
Football (soccer)	22.477	9,96 mio. € 15 %	12,06 mio. € 13 %	5,45 mio. € 6 %	–	27,47 mio. € 9 %
Swimming, Diving, Scuba Diving	237	0,80 mio. € 1 %	0,44 mio. €	20,78 mio. € 21 %	1,82 mio. € 4 %	23,84 mio. € 8 %
Paragliding, Parachuting	242	0,73 mio. € 1 %	0,87 mio. € 1 %	9,45 mio. € 10 %	4,8 mio. € 11 %	15,85 mio. € 5 %
Other Sports	38.083	19,41 mio. € 29 %	21,50 mio. € 23 %	15,84 mio. € 16 %	1,36 mio. € 3 %	58,11 mio. € 19 %
Total	98.626	66,51 mio. € 100 %	94,18 mio. € 100 %	98,10 mio. € 100 %	42,65 mio. € 100 %	301,55 mio. € 100 %

- The most serious, and therefore most expensive accidents occur in swimming (predominantly in diving and scuba diving) and in paragliding and similar extreme sports.
- Some 80% of the costs following sports accidents are incurred from injuries to men.
- The cost of treatment is most expensive in women aged 10 to 14, and in men in the age group 20 to 24.

The Benefit of Sport to Health Economy

The methodological basis used to calculate the benefit of active sport is a welfare economic approach which takes into account not only the given but also the potential level of sports activity. The social expenditure (health system, social security etc.) which could be avoided by an increase in sports activity is also calculated.

There are two stages in the approach to this benefit.

1. Determining the economic cost of diseases which can be considered to be caused by a lack of physical activity:
   - Loss of part of life income due to death whilst still of earning age ("death before the time has come"). This also includes the costs accruing from payments to dependents (widows and orphans) in accordance with insurance principles.
   - In-patient hospital costs
   - Cost of out-patient treatment
   - Loss of contribution towards production and of income due to sick leave, inability to work or a reduction in earning capacity.
2. Calculating how much (given or potential) physical activity can contribute towards minimizing the costs which these so-called "lack of activity" diseases incur.

Risk Group Model (PAR Model)

The risk group or PAR model (Population Adjusted Relative Risk Calculation) links the given spread of behaviour with latent risk (smoking, overeating or just physical inactivity) within a population with a scale of the relative risk for exposed (inactive), little (moderately active) or practically not at all exposed (active – extremely active) groups.

The Relative Risk scale (RR distribution) indicates the higher risk factor (multiple of 1) more exposed control groups have of contracting or dying of a particular disease.

Figure 1 shows the relative risk range of all the groups of diseases taken into consideration for inactive, moderately active and highly active groups of the population. Using the relative risk factor the difference in risk (depending on the relevant level of activity) of falling ill or dying has been identified for the following diseases: coronary heart diseases

(morbidity and mortality) (Ball 1997, Blair 1994, Blair 1994, Colditz 1999, Ekelund 1988, Kushi 1997, Leon 1987, Morris 1953, Morris 1980, Morris 1990, Pfaffenbarger 1986, Pfaffenbarger 1994, Powell 1987, Sandvik 1993, Slattery 1988, Slattery 1989), stroke (Ball 1997, Kiely 1994), discopathies and dorsopathies (morbidity) (Weineck 1997), diabetes II and vascular diseases due to diabetes (morbidity) (Ball 1997, Colditz 1999), diabetes II (mortality) (Colditz 1999), gall bladder disorders (mortality) (Colditz 1999), cancer of the intestine (morbidity + mortality (Brownson 1989, Colditz 1999, Lee 1994, Lee 1995, Powell 1987, Severson 1990, Thune 1996, Vena 1987), breast cancer (morbidity) (Colditz 1999), depression syndromes (Pfaffenbarger 1994), osteoporosis (morbidity) (Ball 1997) and brittle-bone fractures (morbidity) (Colditz 1999).

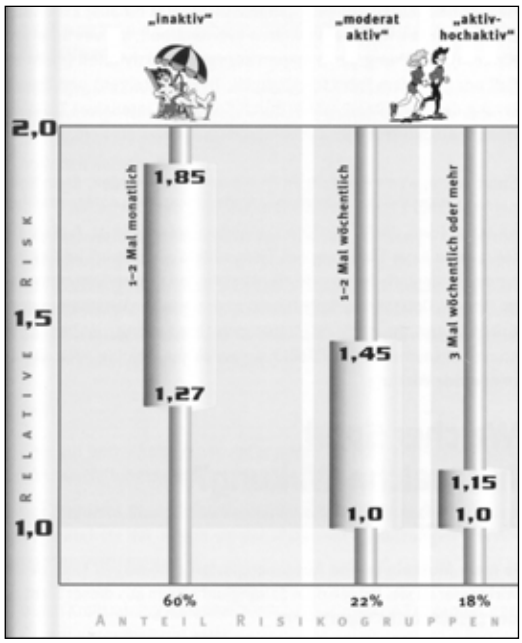

Figure 1[3]. Risk Groups resulting from the Practice of Sports in Austria (1998) (Footnotes)

Translation

"inaktiv" means
inactive
(1-2 times per month)

"moderat aktiv" means
moderately active
(1-2 times per week)

"aktiv hochaktiv" means
active / extremely active
(3 times per week or more)

Anteil Risikogruppen means
Proportion per Risk Group

Figure 1 should be interpreted as follows: the risk of falling ill or dying of any of the diseases and disorders under scrutiny was least for the (extremely) active (RR factor between 1 and 1,15), followed by the moderately active (with RR factor between 1 and 1,45). The group of inactive or marginally active were most at risk with RR factor ranging from 1,27 to 1,85.

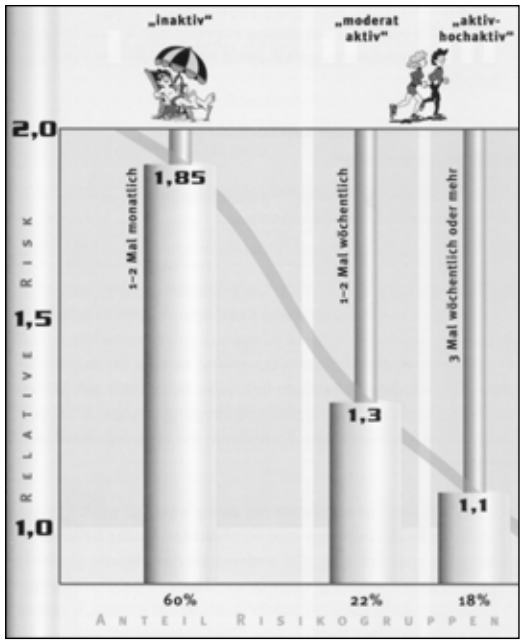

Figure 2. Relative Risk Distribution taking Coronary Heart Diseases (Morbidity) as an Example

Translation

"inaktiv" means
inactive
(1-2 times per month)

"moderat aktiv" means
moderately active
(1-2 times per week)

"aktiv hochaktiv" means
active / extremely active
(3 times per week or more)

Anteil Risikogruppen means
Proportion per Risk Group

Figure 2 shows that the risk of coronary heart diseases is less in the (extremely) active than in the moderately active (RR factor of 1,1 in the active as opposed to an RR of 1,3 in the moderately active). The highest risk of contracting a coronary heart disease is to be seen in the inactive and marginally active group (RR 1,85).

Figure 2 shows an example of the relative risk value with reference to coronary heart diseases.

Using a special formula (Colditz 1999), a population adjusted risk factor (PAR factor) for each group is calculated from the size

of the relevant risk group and its average "relative risk" factors (morbidity and mortality). The reduction of risk achieved by doing sports can be given as a percentage, using these PAR factors. With the aid of the PAR factor saving in costs to the economy can be determined.

Avoidance of diseases and lower mortality rates are the benefits and saving effects of active sport. On the basis of the present levels of physical activity the saving in public expenditure is calculated in terms of the type of disease (Figure 3) and the type of cost item (Figure 4).

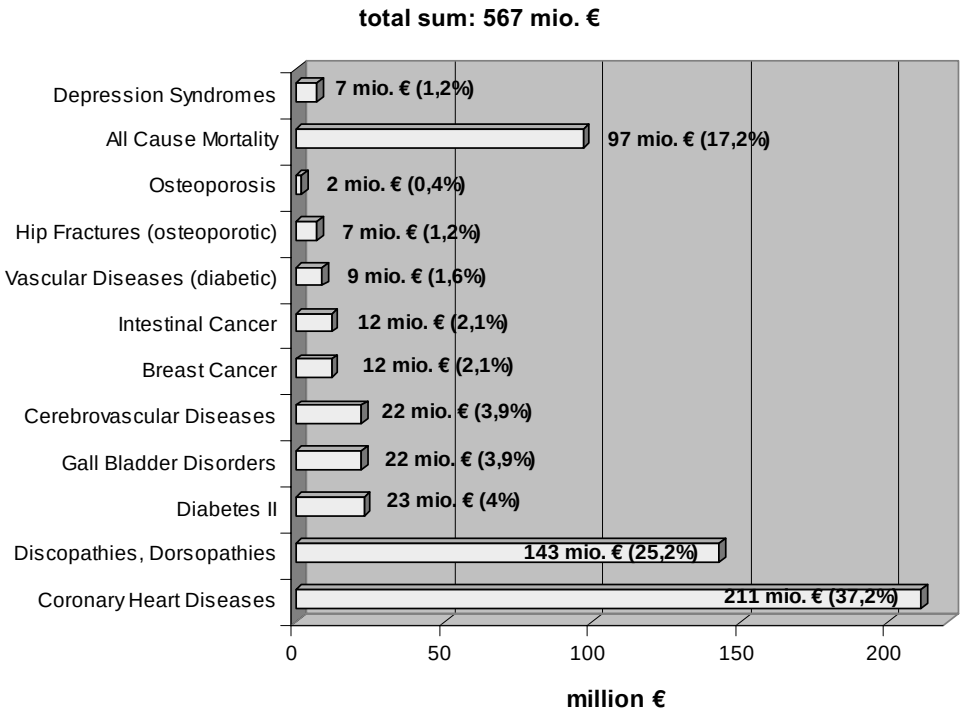

Figure 3. Benefits of Active Sport Saving in Cost according to Type of Disease (in Austria in 1998)

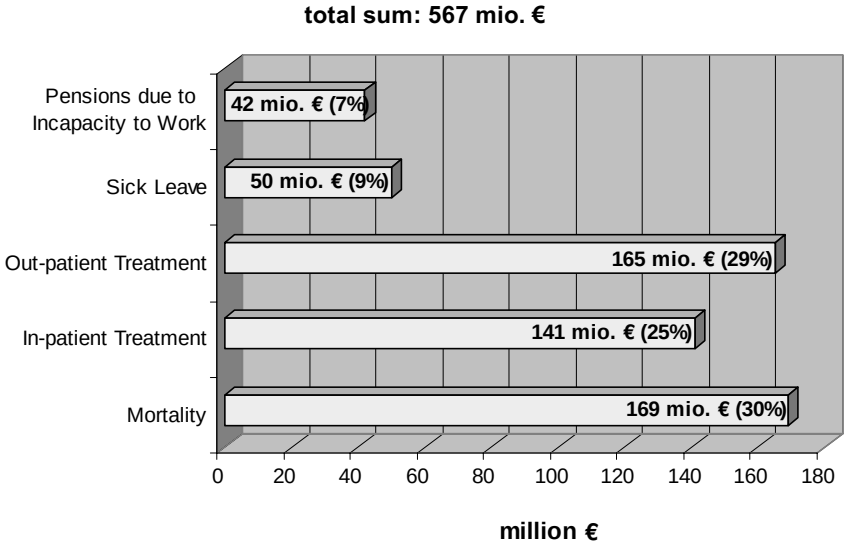

Figure 4. Benefits of Active Sport Saving in Expenditure according to Type of Cost (in Austria in 1998)

Cost-Benefit Survey of Active Sport in Austria with regard to Health Economy

A comparison of the economic costs and benefits of active sport gives the following picture for 1998:

Table 7. Cost-Benefit of Active Sport (in Austria in 1998)

	Cost in Consequence of Accidents (in million €)	in %	Benefit from Avoidance of Costs in consequence of Illness (in million €)	in %
Occupational Production Loss due to				
Death	43	14	169	30
Invalidity	98	33	42	7
Sick Leave	94	31	50	9
Cost of Medical Treatment				
In-patient	51	17	141	25
Out-patient	16	5	165	29
Total	302	100	567	100

- The cost incurred by sports accidents (n = 98,626) come to a total of approx. € 302 million per year, mainly for "Occupational Loss of Production in the case of the Economically Active through Invalidity" and "Sick Leave".
- The benefit (= saving) due to the present level of physical activity in Austria is some € 567 million per year, which means there is a credit balance of approx. € 265 million.
- This benefit is mainly for savings in costs for "Loss of Production due to Death" and for "Medical Treatment".

Benefit of Active Sport (avoidance of costs in consequence of illness)	€ 567 million
Cost of Active Sport (Consequences of sports accidents)	€ 302 million
Balance	€ 265 million

This credit balance can be explained first and foremost by the fact that sports injuries on the whole require less lengthy and cheaper treatment than do diseases caused by lack of exercise. The types of complaint on the credit side take a far more severe course (including fatalities), whereas there are very few cases of invalidity for life, these being the result of typical diseases caused by a lack of exercise (i.e. without injuries or the aftermath of injuries).

The expenditure caused by the relative inactivity of the population group which does little or no sport amounts to some € 840 million. In other words: if half the "inactive" risk group were transferred to the "moderately active" group and the other half to the "active – extremely active" group this would result in an additional benefit or saving effect of € 840 million.

In order to obtain a net potential effect as target variable this potential sum (€ 840 million) must be set against the relevant cost of sports injuries and accidents at each particular level of activity. However, this balance could be improved by introducing effective measures for avoiding injury.

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APA AND SPORT FOR PERSONS WITH A DISABILITY – CURRENT ISSUES AND CHALLENGES

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Abstract

Within physical education, sport and sport science, a new specialisation area has merged during the past few decades: adapted physical activity and sport for persons with a disability. Past and current developments are presented and reviewed, pointing out specific issues of improved participation, professional training and research. The importance of international/ European networking and cooperation is highlighted.

Key words: *disability, inclusion, international cooperation, professional training*

Introduction

During the past four decades, societal changes have occurred which emphasise equity and equality issues related to the role of persons with a disability. These changes have also clearly impacted the area of physical activity and sport in various settings. These impacts include rehabilitation/therapy, education, recreation and high-performance sport. New approaches in physical education and sport have been developed and during the 1970's a new term was introduced "Adapted Physical Activity" (see Doll-Tepper/Dahms/Doll/Von Selzam 1990; DePauw/Sherrill 1997). Currently efforts are being made to offer access to physical education and sport to all, in particular to those with a disability, in segregated environments and increasingly in integrated settings. In this context, it is important to highlight initiatives within the Sport-for-All movement and current developments in the area of high-performance sport, such as in Paralympic sport. Important changes with regard to professional training in adapted physical activity and sport have occurred recently, very often based on the creation of thematic networks amongst experts from different European countries.

European and international cooperation and alliances have significantly contributed to better recognition of adapted physical activity and sport for persons with a disability, increased opportunities for participation and improved teaching and research.

Terminology and definition

As early as in 1952, the term "adapted physical education" was used to describe a specialisation area with a strong focus on children and youth with a disability participating in physical education in special schools. Since the 1970's many professionals in physical education and sport science have preferred the term "Adapted Physical Activity" due to the fact that it covers a much broader spectrum of physical activity and sport for persons with a disability.

In 1996, Sherrill presented the following definition: "Adapted Physical Activity is a cross-disciplinary theory and practice related to lifespan activity of individuals, whose function, structure or appearance requires expertise in (a) assessing and adapting ecosystems and (b) facilitating societal changes for:

- equal access
- integration/inclusion
- lifespan wellness
- movement success
- empowerment/self-actualization"

(Sherrill 1996, 389).

The area of "Adapted Physical Activity" has gained growing recognition as a sub-discipline of sport science and is currently understood as an integral part of research and teaching in the field of sport and physical education (see Massengale/Swanson 1997; ICSSPE 2003).

Current developments in physical education and sport

Although children and youth with a disability in some countries are still educated in segregated settings, such as special schools, more inclusive education is increasingly practised. This is reflected in new educational approaches based on revised legal requirements in many countries around the world. World-wide efforts are currently underway to raise the

status and state of physical education with a particular focus on introducing inclusive physical education in which children and youth with a disability are taught alongside their non-disabled counterparts (see Doll-Tepper/Scoretz 2001).

Equally important in this context are efforts towards improved professional training for teaching staff and addressing research issues in this specific area of expertise.

The Sport-for-All movement has recently addressed issues of inclusion as well, focusing on participation in physical activities and sport for all.

Sport as an adventure and as a high-risk activity has become highly attractive to persons with a disability, offering them opportunities to face new challenges in their lives. Parallel to these developments physical activity and sport are still practised – as in the earlier years – as part of therapy and rehabilitation (see Guttmann 1976).

There is a growing interest of persons with a disability in high-performance sport participation up to and including the pursuit of a career as a Paralympic athlete (see Doll-Tepper/Kröner/Sonnenschein 2001). Until the late 1980's, competitions for athletes with physical, intellectual and sensory disability took place without being noticed by the broader public and the media. This has clearly changed since the 1988 Paralympic Games in Seoul, South Korea, and since the creation of the International Paralympic Committee (IPC) in 1989.

An ever growing number of nations is participating in international sport competitions, such as the Paralympic Summer and Winter Games.

The Paralympic Movement

Over the past years, Paralympic sport and competition has received increasing recognition in the world of sport. This can be shown by the growing level of sporting excellence and an ever increasing number of nations and athletes participating in sporting events, such as the Summer and Winter Paralympics:

Table 1. Summer Paralympic Games

Year	Venue	NPC's	Participants
1960	Rome, Italy	23	400
1964	Tokyo, Japan	22	390
1968	Tel Aviv, Israel	29	1100
1972	Heidelberg, Germany	44	1400
1976	Toronto, Canada	42	2700
1980	Arnhem, the Netherlands	42	2550
1984	New York, USA Aylesbury, GB	45 41	2500 1430
1988	Seoul, South Korea	65	4300
1992	Barcelona, Spain	94	4000
1996	Atlanta, USA	103	3200
2000	Sydney, Australia	123	3824
2004	Athens, Greece	130	4000
NPC = National Paralympic Committee			

Table 2. Winter Paralympic Games

Year	Venue	NPC's	Participants
1976	Örnskoldsvik, Sweden	15	250
1980	Geilo, Norway	18	350
1984	Innsbruck, Austria	22	500
1988	Innsbruck, Austria	22	700
1992	Tignes-Albertville, France	24	600
1994	Lillehammer, Norway	31	950
1998	Nagano, Japan	32	1000
2002	Salt Lake City, USA	40	1100
NPC = National Paralympic Committee			

Issues related to Paralympic sport that are currently addressed by professionals around the world include:

Classification

Integration

Applicability of existing principles underlying performance (exercise physiology, biomechanics, etc.)

Enhancing sport performance

Barriers to sport participation

Attitudes

Empowerment

Retirement from sport

Inclusion – integration (intellectually disabled, deaf, able bodied, IOC)

Spectatorship

Media

Equity issues – gender, ethnicity, etc.

Measurement of performance

Process of educating and disseminating information

Sport injury – aetiology, prevention, treatment

Youth sport (developmental issues),

Performance enhancement

Initial and continuing participation – motivation, adherence

(see Doll-Tepper et al. 1994; 1995).

International conferences have offered a forum for an exchange of experiences and research findings, in particular the so-called VISTA Conferences in 1993, 1999 and 2003.

Close cooperation between the IPC and the IOC is based on formal contracts. Bidding for Olympic Games today includes the bidding for Paralympic Games, a clear indication of the stronger connections between the Olympic and the Paralympic movements.

Special Olympics

Special Olympics has hosted summer and winter sport events for persons with an intellectual disability since 1968. In addition, regular opportunities for participation in recreational activities are offered to these individuals, increasingly in integrated settings.

Table 3. Special Olympics Summer Games

Year	Venue	Country	Participants	Participating countries
1968	Chicago/Soldiers Field	USA	1000	2 (26 states from the USA)
1970	Chicago/Illinois	USA	2000	3 (50 states from the USA)
1972	Los Angeles/California	USA	2500	no data provided
1974	Mt. Pleasant/Michigan	USA	3200	10
1979	New York	USA	3500	more than 20
1983	Baton Rouge/Louisiana	USA	4000	more than 250
1987	South Bend/Indiana	USA	4700	70
1991	Minneapolis/Minnesota	USA	6000	more than 100
1995	New Haven/Connecticut	USA	7000	143
1999	Raleigh, Durham/North Carolina	USA	7000	150
2003	Dublin	Ireland	6500	150

Table 4. Special Olympics Winter Games

Year	Venue	Country	Participants	Participating countries
1977	Steamboat Springs/Colorado	USA	500	2
1981	Smugglers' Notch/Vermont	USA	600	5
1985	Park City/Utah	USA	no data provided	14
1989	Reno/Nevada	USA	1000	18
1993	Salzburg	Austria	1600	50
1997	Toronto/Ontario	Canada	2000	73
2001	Anchorage, Alaska	USA	1900	80
2005	Nagano	Japan	2000	80

Since 1999, important initiatives have been underway in which Special Olympics partners with universities in Eastern Europe and Central Asia to focus on children with special needs and the professional preparation of students and teachers.

New developments in professional training

The "European Master's Degree in Adapted Physical Activity", a European graduate degree programme has been available to students since 1991. This programme is co-ordinated by the KU Leuven, Belgium (see Van Coppenolle et al. 1993; Van Coppenolle et al. 2004). This one-year programme addresses various aspects of adapted physical activity, providing an insight into physical activity and sport related issues, as well as disability related topics. Theoretical approaches are linked to practical applications covering the whole spectrum of adapted physical activity, including rehabilitation, therapy, education, recreation and high performance sport. Starting in 2005, this European initiative will be extended to an ERASMUS MUNDUS programme and will allow students from non-European countries to participate.

In 1997, another programme was initiated, the "European University Diploma in Adapted Physical Activity", co-ordinated by the University of Paris, France. A 7-weeks-intensive course offers students the opportunity to become acquainted with the most recent developments in adapted physical activity taught by teachers from different European countries.

Moreover, the University of Rome, Italy, has been co-ordinating the "European Master's Degree in Preventive and Adapted Physical Activity" since 2002. This programme brings together teachers and students with different academic backgrounds with a strong focus on medical aspects of adapted physical activity. These developments in professional training in Europe are accompanied by the creation of new networks, such as the "Thematic Network Educational and Social Integration of Persons with a Disability through Adapted Physical Activity" (see Van Coppenolle et al. 2004; De

Potter et al. 2004). Information and educational material are being made available and contribute to the introduction of joint programmes at the national level, e.g. courses and classes in "Adapted Physical Activity" in universities and institutions of higher education. An example of a national initiative is the "Information Centre for Sport for Persons with a Disability" in Berlin, Germany. This institution collects and disseminates information about physical activity and sport opportunities for persons with disabilities and health-related problems. In addition, the Information Centre organises conferences which bring together different institutions and organisations in the area of disability and sport. Currently a new European Thematic Network has been initiated that is focusing on Adapted Physical Activity, disability and ageing.

This is an important field of "Adapted Physical Activity" as the ageing population has not yet been the focus of research and initiatives.

Physical activity and physical education are part of lifelong education and more efforts are needed to bring together scientific expertise, initiate new programmes and share information about the benefits of physical activity across the lifespan.

International cooperation and networking

During the 1970's an umbrella organisation for adapted physical activity was established, the International Federation of Adapted Physical Activity (IFAPA). Biannual international symposia offered an opportunity for researchers and practitioners with different professional backgrounds to meet and exchange their most recent research findings and practical experiences. During the past three decades regional branches have developed, such as the "European Association for Research into Adapted Physical Activity (EARAPA)", the "Asian Society for Adapted Physical Education and Exercise (ASAPE)" and the "North American Federation of Adapted Physical Activity (NAFAPA)". Since 1984, a scientific journal, the "Adapted Physical Activity Quarterly (APAQ)" has served as a forum for the dissemination of research findings and for the exchange of information concerning different approaches and developments world-wide. In addition, the journal "Palaestra" also published in the US, offers a broad spectrum of information related to disability and sport.

Sport for persons with a disability – from an organisational perspective – has received increased attention and new structures have been introduced. As early as 1924, the "Comité International des Sports des Sourds (CISS)" was established in Paris, France, bringing together athletes, coaches and administrators of deaf sport. Ever since that time CISS has been organising world events both in the summer and winter, now called "Deaflympics".

After World War II, several international sport organisations for persons with a disability came into being, such as the "International Stoke Mandeville Wheelchair Sports Federation (ISMWSF)", the "International Sports Organisation for the Disabled (ISOD)", the "International Blind Sports Association (IBSA)", "Cerebral Palsy-International Sport and Recreation Association (CP-ISRA)" and the "International Association for Sport for Persons with an Intellectual Disability (INAS-FID)". In order to join forces in developing international sport events, such as the Paralympic Games, an "International Coordinating Committee (ICC)" was established in 1982, which later led to the creation of the "International Paralympic Committee (IPC)" in 1989.

Since the early 1990's the IPC has taken the responsibility of organising international sport events, in particular, the Winter and Summer Paralympic Games, which follow the Olympic Winter and Summer Games. Currently, the IPC represents a global network of disability sport, bringing together the above mentioned international sport organisations and over 160 National Paralympic Committees. In 2004, ISMWSF and ISOD merged into a new organisation, called "International Wheelchair and Amputee Sports Federation (IWAS)".

Close relations have been established with a number of international organisations of sport and sport science, in particular with the "International Olympic Committee (IOC)", the "International Council of Sport Science and Physical Education (ICSSPE)" the "International Federation of Adapted Physical Activity (IFAPA)", the "International Paralympic Committee (IPC)" and "Special Olympics International". It is important to intensify these alliances and networks in order to provide full inclusion of persons with a disability into physical education and sport.

Challenges

A review of the developments of adapted physical activity and sport for persons with a disability clearly indicates two important trends: a new specialisation area with many facets has evolved, both with regard to research and to teaching. These developments are clearly reflected in the practice of physical activity and sport, where people with a disability benefit increasingly from participation and take up leadership positions. In addition, an inclusive approach is preferred by many experts and professionals around the world, which means, that adapted physical activity is not only seen as a separate area of expertise but also as an integral part of lifelong education, of sport participation with a variety of choices for the individual and as part of a complex research agenda.

On an organisational level, synergies are emerging, bringing together organisations of physical education and sport with those who just a few years ago where only focusing on people with disabilities. These trends will continue, supported

by new laws and legal requirements at the national levels and by innovative efforts on the international level, led by the World Health Organization (WHO), United Nations Educational and Scientific Organization (UNESCO), the International Olympic Committee (IOC) and International Council of Sport Science and Physical Education (ICSSPE).

This process does not proceed with the same speed in all parts of the world. Cultural differences, as well as economic and social challenges and less positive attitudes towards individuals with a disability on a personal level, present obstacles and barriers towards their full inclusion and acceptance (see DePauw/Doll-Tepper 2000). The "European Year of Persons with a Disability" in 2003 drew attention to the need for change, highlighting equality, active participation and self-determination of individuals with a disability. 2004, the "European Year of Education Through Sport" has emphasised the important role of sport as part of lifelong learning and in educational processes.

The year 2005 has been proclaimed by the United Nations as the International Year of Sport and Physical Education. The resolution 58/5 entitled "sport as a means to promote Education, Health, Development and Peace" refers to the potential and power of sport and physical education in all facets of society.

"Giving young people with disabilities the opportunity to participate in physical education programmes at school and through community clubs is crucial given the additional benefits, among others, for social inclusion and self-esteem they receive from sport and physical activity" (UN Concept IYSPE 2005; 2004, 4).

It is crucial to use this momentum in all areas of society to offer equal opportunities and to secure equality for all.

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MUSCLE AND TENDON INTERACTION DURING HUMAN MOVEMENTS

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Abstract

Real-time ultrasonography enabled in vivo MTC scanning and promised a realistic determination of the interactions between muscle and tendon during human movements. The tendinous tissues were quite compliant, and the elastic property was different among muscles. Internal shortening of fascicle was caused by the tendon elasticity. During human movements such as jumping, walking and ankle extension-flexion exercise the muscle fiber contracted with nearly constant length, while the tendon performed stretch-shortening cycle. It is suggested that human MTC are designed to match muscle force generation and tendon elasticity for efficient movement performance.

Key words: *ultrasonography, fascicle, tendinous tissue, elasticity*

Introduction

Human movement is performed by contractions of muscle fibers that are connected to tendons to comprise muscle-tendon complex (MTC). Muscle fibers not only transmit force to tendons, but also interact with them due to tendon compliance. Therefore, to know functional characteristics of muscle fiber and tendon during human movements, we need to measure *in vivo* directly and successively the geometric arrangements of muscle and tendon. This paper aims to review our recent approaches to estimate the interaction of the behavior between muscle fiber and tendinous tissues during human movements using ultrasonography.

Estimation of elastic property in tendinous tissues

Visualizing of muscle and tendon on real-time ultrasonic images made it possible to estimate the elastic properties of tendon *in vivo* in human (5,9,12). On the longitudinal ultrasonic image we could define the cross point (P) of the echo from one fascicle and aponeurosis. The point P moved proximally during muscle action at the fixed joint (i.e. "isometric" action). The distance traveled by the P was considered as the length change of tendinous tissues (i.e. elongation of tendinous tissues). Strain of tendinous tissues was estimated from the tendon elongation and the initial length of the distal tendon, which was estimated over the skin. The strain increased curvilinear in form with increasing joint torque, and the maximal strain was observed at maximal joint torque. The maximal strain was higher in VL and MG than in TA.

When the TA activates isometrically at fixed ankle joint, the curvilinear relation in form was observed between lengthening of tendinous tissues and tendon force. The linear region, with an approximately constant modulus of elasticity following the toe region, was used for the determination of stiffness. To calculate tendon stress cross-sectional image of the distal tendon of TA was taken by using ultrasonography (5). The force-length relation for tendinous tissues converted to stress-strain relation, and Young's modulus was calculated. The Young's modulus increased with increasing the tendon force.

The maximal strain was the highest in VL followed by MG, and TA demonstrated the lowest strain, suggesting that the functional properties of MTC differ significantly among muscles. The elasticity of tendon is advantageous when the tendon acts as a spring. In daily human movement such as locomotion, VL and MG activate as main agonist muscles to propel the body, and the quite compliant tendinous tissues in VL and MG (i.e. lower Young's modulus and higher strain) can efficiently store and reuse the elastic energy. TA, on the contrary, does not exert propulsive force but controls ankle positions during locomotion. Considering that large compliance of the tendinous tissues could impede the control of fine movement (14), lower strain and higher Young's modulus for TA seem theoretically reasonable.

Estimation of internal shortening of fascicle

When the joint torque increased at fixed joint (i.e. isometric action), the shortening of fascicles (i.e. internal shortening) was observed in each muscle. The fascicle internal-shortening decreased and tendon strain increased with increasing %MVC in each muscle. Smaller internal-shortening and higher tendon strain was observed in TA compared to MG and VL. It is considered that the magnitude of internal shortening of fascicle is caused by such architectural factors as the tendon-length to fiber- length ratio and the elastic property of tendinous tissues. More internal fiber shortening has been observed in isolated muscles with higher tendon length to fiber length ratio (16). However, significant lower internal

shortening was found in TA than in VL although tendon-length to fiber-length ratios were almost identical. The smaller internal shortening of TA, therefore, may be caused by significantly higher Young's modulus of TA tendon, compared to other muscles. On the contrary, the internal shortening of MG was larger, which would have been caused by significantly higher tendon-length to fascicle-length ratio and lower Young's modulus of MG tendon.

Behavior of muscle fiber and tendon during pedaling, walking and jumping

Changes in the length of fascicle and tendinous tissues were estimated during ankle-bending exercise, jumping, walking and bicycle pedaling.

Vertical jumping

To estimate behavior of fascicle and tendinous tissues during squat jump the sequence ultrasonic images were taken from MG. In the first half of push-off phase the shortening of fascicle (26%) and lengthening of tendinous tissues (6%) was observed while MTC length was constant. On the contrary, before take-off the fascicle contracted near isometrically, accompanying with abrupt shortening of both tendinous tissues and MTC (5%). It is indicated that in the early push-off phase the mechanical energy generated by the muscle contraction was stored predominantly in the tendinous tissues as elastic energy (5 J) and 88% of the stored energy (4.4 J) was reused before take-off (10).

Walking

We investigated length changes in the fascicles and tendinous tissues of MG during walking. In the stance phase the MG muscle was active and the fascicles maintained constant length (nearly 50 mm), while the tendinous tissues was stretched by 7 mm. In push-off phase both MTC and tendinous tissues shortened rapidly. These results show that MG fascicle is activated near isometrically during walking, while the tendinous tissues execute a stretch-recoil cycle (2).

Bicycle pedaling

Ultrasonic images obtained from VL were taken during bicycle pedaling at 98 Watt with 40 revolutions per min of pedaling rate. The fascicle length of VL shortened from 127 to 91 mm during knee extension phase, while the tendinous tissues were elongated by 10 mm. The average shortening velocity of fascicle increased by 50% in early knee-extension phase and decreased by 29% in latter half of that phase, compared with that of MTC. The maximal shortening velocity of fascicle was less than that of MTC by 22%. It was suggested that the elasticity of tendinous tissues enabled the VL fascicles to develop force with lower contraction velocity than MTC (11).

Length-force characteristics of muscle fiber during human movements

It is well known that the length of sarcomeres in muscle influences the force generated by muscle fiber. The sarcomere length can be estimated by dividing the fascicle length by the average number of sarcomers in series in fascicles (1). The average sarcomere length during human movements was estimated and superimposed on a sarcomere length-force relationship for human muscle derived from the data of Waker and Schrodt (15). The results indicate that the working ranges of sarcomere length are over the plateau and the upper part of both descending and ascending limbs, where a relatively larger force can be generated.

In conclusion, in such stretch-shortening cycle (SSC) exercises as ankle bending, jumping and walking the muscle fiber can contract with near constant fiber length, which is around plateau region of sarcomere force-length curve. This quasi-isometric contraction of muscle fiber was caused by lengthening-shortening behavior of tendinous tissues (catapult action) (4). While in no SSC exercise such as bicycle pedaling the muscle fiber can contract relatively lower velocity than the shortening velocity of MTC, which is also advantageous for the force production in muscle fiber because muscle can produce higher force at lower velocity region due to force-velocity characteristics of muscle.

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THE NECESSITY OF QUALITY, QUALITY ASSESMENT AND QUALITY CONTROL IN PHYSICAL EDUCATION

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Abstract

This paper presents the results of a social and consumers quality evaluation within the school physical education subject. The presented data are based on questionnaires with representatives from different social sectors (n=122) and secondary school pupils (n=1730). It was concluded that the current course specific objectives of school physical education, as determined by the Flemish Educational Government, contain the expectations of the research population. On the other hand, many respondents stated that the school physical education objectives are still too seldom being attained. As a consequence, this paper ends with a plea for a course specific quality care system to further improve the effective and efficient realisation of today's school physical education objectives. It also refers to the creation of a course specific quality evaluation instrument for school physical education.

Key words: *school physical education, quality evaluation, quality care, Flanders*

Introduction

During the last decade the concept of quality has become very popular in different sectors of society both profit as well as non-profit (De Knop, 1998; De Knop & De Martelaer, 2000). Consequently, the call for more qualitative criteria became more pronounced within the field of education (Trompedeller, 2000). Also in Flanders, the northern Dutch-speaking part of Belgium, quality care has captured a central position within the recent educational policy of its government (Verhaeghe et al., 1998; Michielssens, 2002). De Knop (1999) states that the development of structured, course specific, quality care and control systems and the stimulation of quality awareness are of utmost importance to ensure the future of physical education in the school curriculum. Before an analysis of the current situation of the quality of school physical education in Flanders can be done, specific standards are to be postulated as the term "quality education" can be defined in many different ways (Louwet, 2002). The theoretical quality model presented by van Bottenburg and Schuyt (1996) and van Bottenburg, Van 't Hof, and Oldenboom (1997) offers a framework within which quality features for school physical education can be organised. Four types of quality are distinguished: (i) social quality, (ii) consumers quality, (iii) product quality, and (iv) process quality. In accordance with this theoretical model one can state that school physical education is of "total" quality when it fulfils (i) the (justifiable) expectations of society, (ii) the potential wishes and expectations of the pupils and their parents, (iii) the criteria laid down by experts, and (iv) when school physical education is organised effectively and efficiently.

A first step to evaluate the quality of school physical education is to find out if pupils and contemporary society do agree with the current operationalisation of quality school physical education in Flanders, or in other words, the course specific objectives (Gombeir, 1993). Bearing this in mind, this paper will focus on four main research questions: (i) What expectations do the consumers and the contemporary society have towards quality school physical education? (ii) Do the expectations of the consumers and the contemporary society match the current course specific final attainment levels of school physical education? (iii) How well do the expectations and experiences of the consumers and the contemporary society correspond to the main objectives of school physical education? (iv) What are the minimal and/or ideal conditions to be able to fulfil the current course specific objectives of school physical education?

Methods

The evaluation of the social quality of school physical education was to a large extent qualitative in nature. Data were collected through the use of a questionnaire which consisted of open (n = 5) as well as closed (n = 4) questions. The questions addressed to the participants (i) expectations, (ii) present experiences and (iii) former experiences towards school physical education. One hundred seventeen organisations from the social midfield and five aldermen with a combined office of sport and education agreed to participate. The social midfield can be defined as a unity of organisations, institutions and movements that fulfil an intermediary function between the individuals on the one hand and the society on the other hand (Siongers, 2000). As a consequence, a varied group of organisations, representing different social sectors, was selected. An overview of the different participating sectors, the total number of questionnaires send, the number of returns and the degree of response are reported in table 1.

Table 1. Overview of the total number of questionnaires send, the number of questionnaires returned and the degree of responses (%) for each participating social sector.

Sector	Total number	Return	Degree of Response (%)
1. Education	24	21	87.5%
2. Sport	32	26	81.2%
3. Youth	28	16	57.1%
4. Media	21	12	57.1%
5. Health	17	11	64.7%
6. Social services	11	7	63.6%
7. Economics	15	8	53.3%
8. Culture	10	7	70.0%
9. Other	11	6	54.5%
10. Politics	10	5	50.0%
11. Association of parents	3	3	100%
Total	182	122	67.0%

The degree of response exceeded the 50.0% barrier within all the social sectors. 57.3% of the respondents were male and 42.7% female. The age differed from 18 to 63, with an average of 37.6. 28.2% of the respondents have got a secondary school teacher's or master's degree in physical education and 48.3% is a parent.

For the evaluation of the consumers quality of school physical education a representative sample from the Flemish secondary school population was selected ad random and stratified by school-system (e.g., catholic or community school), grade level and type of education (e.g., technical, vocational or general education). The selection resulted in a total research population of 1,730 pupils, originating from ninety different schools. At the time of the study, the participants ranged in age from 13 to 22 years (M_{age}=16.5 years) and were in the last year of the first (N=477, 27.6% of total sample), second (N=692, 40.0% of total sample) or third (N=561, 32.4% of total sample) school grade. 886 were boys (51.2%) and 844 were girls (48.8%). Each of the participants completed a written questionnaire which was grouped into three sections. The first section was used to collect demographic information. In the second section two Likert-type scales were used to respectively assess pupils' perceptions and experiences regarding physical education objectives. In the third and final section of the questionnaire, all participants were asked to identify the most pronounced reasons they had encountered for not achieving certain physical education objectives.

Results

A first major purpose of this study was to examine the extent to which the physical education objectives, as formulated in the Flemish physical education curriculum, were accepted by contemporary society and secondary school pupils.

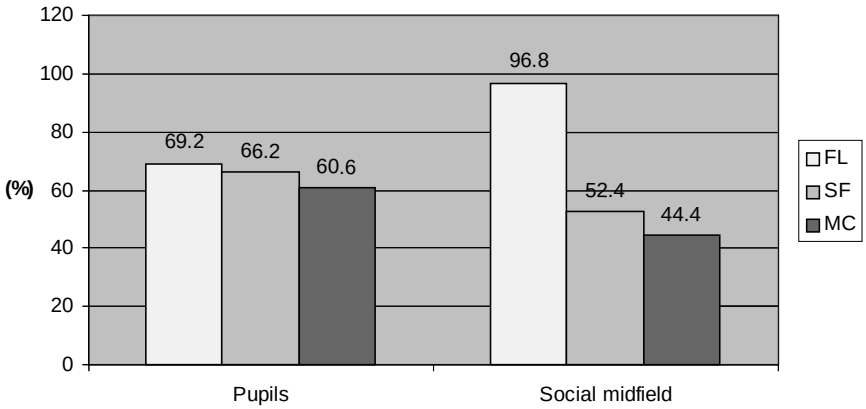

Figure 1. Importance of domains of physical education objectives according to the pupils and the respondents from different social, educational, and workforce agencies and organisations (FL: physically fit and healthy lifestyle, SF: self-image and social functioning, MC: motor competencies)

As reported in Figure 1, the most prominent domain of physical education objectives occurred to be the development of a physically fit and healthy lifestyle, with 69.2% of the pupils and 96.8% of the respondents from the social midfield mentioning its importance in class. In this area, recurring objectives that were considered as important by the research population were among others: (i) stimulating a positive attitude and promoting the life-time practice of sports, (ii) improving the general physical fitness of youngsters and (iii) guarantee the complete physical development of pupils in light of "a sound mind in a sound body". According to the respondents, the school physical education subject should also pay attention to the development of the self-image and social skills of pupils by learning them to (i) operate in group activities, (b) accept and assess personal possibilities and restraints and (iii) show effort, persistence and perseverance during physical activity. The development of this domain of objectives was identified as important by respectively, 66.2% of the pupils and 52.4% of the respondents from the social midfield, making it the second most important domain of objectives. The importance of developing motor competencies during school physical education classes was underlined by 60.6% of the pupils and 44.4% of the respondents from the social midfield. The development of motor competencies should, according to most of the respondents, best focus on widening and deepening the basic motor competencies of pupils by teaching them some basic sport technical and movement skills. Finally, 73.5% of the pupils and 21.7% of the respondents from the social midfield stated that school physical education should offer variation and relaxation for the compulsory daily routine of sitting still behind a school desk. In other words, the school physical education subject should, according to these respondents, provide physical relaxation to compensate for the daily strenuous mental activities during the other more theoretical oriented school subjects.

More than half of all respondents from the social midfield were convinced that the school physical education objectives are too seldom being met (55.6% sometimes and 1.6% never to sometimes). Nearly half of the pupils in this study endorsed the former opinion with regard to the development of a physically fit and healthy lifestyle (48.1%), the development of self-image and social functioning (45.1%) and the development of motor competencies (43.1%). Both the pupils (62.5%) and the respondents from the social midfield (49.3%) agreed on the most pronounced reason for not reaching the expectations, namely the lack of curricular time allocation. Other reasons that the respondents in this study had encountered for not achieving their expectations and/or current physical education objectives are presented in Table 2.

Table 2. Overview of the reasons for not achieving the expectations/school physical education objectives according to the respondents of the social midfield and the pupils (%).

Reason	Pupils	Society
- a onesided and unappealing activity offer	42.2%	39.4%
- the lack of a qualified and/or motivated physical education teacher	28.3%	38.0%
- the undervaluation and underestimation of physical education by school management, other subject teachers, government and parents	24.9%	32.4%
- the inadequate and/or insufficient sport infrastructure at school	33.6%	25.3%
- the restricted motivation of pupils with regard to physical activity	40.4%	29.6%
- the large differences between pupils within the same class (lack of differentiation and individual attention)	51.7%	12.6%
- physical education is often taught in too large classes	26.5%	/

Discussion

Based on this study, it was concluded that the social and consumers quality of school physical education in Flanders is at present only partly successful. Although the current final attainment levels of school physical education are a surplus value as they incorporate well the expectations of the social midfield and the pupils, their effective and efficient implementation and realisation seems to be susceptible to many different factors. Many of the respondents in this study underlined that the pronounced expectations (and as a consequence also the course specific final attainment levels) are still too seldom being met. As a result, questions do arise about the feasibility of the current final attainment levels of school physical education. Maybe too many objectives are being purchased in too little time and/or maybe the pronounced objectives are not being met as a consequence of organisational hindering. In this matter the implementation of a course specific quality care system may contribute to a more effective and more efficient realisation of today's school physical education objectives. To support the secondary schools with their internal quality assurance task, researchers at the Vrije Universiteit Brussel are currently developing an instrument to analyse the process quality of school physical education. The instrument will originate from an extensive literature study and depth-interviews with members of the Schools Inspectorate (2), the Pedagogical Counselling Office (13), physical education teachers (19), school principals (4) and school physical education experts (8). The instrument considers objective preconditions that prove to be minimal and/or essential to achieve the current school physical education objectives. Finally, the instrument not only attributes a school physical education quality score, but it also provides the school with specific information on which topics should be improved, to further enhance the school physical education quality. In the next phase of the project the latter instrument will be further tested on a larger population of different schools.

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KINESIOLOGY SCIENCE AND PROFESSION IN FUNCTION OF QUALITY SCHOOL

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Abstract

The authors discuss some of issues related to the role of kinesiology in function of quality school. Modern era requires schools which can be quickly and easily transformed to all life circumstances and which teach our youngsters to adapt to these ever changing circumstances. Education should support and foster growth and development, so we should be always aware of the actual fitness level and anthropometry status of children. Initial, transitional and final assessment is prerequisite not just for defining teaching goals but also for the diagnosis, prognosis and programming of teaching. It is also important for students self-evaluation and understanding of his own ability and skills level.

Transformation of existing school, from kinesiology point of view, should relies on three main criteria - differences between the children, on monitoring and proper evaluation along with direction toward quality and third - on skilled professionals which are willing and ready to accept a new system of values.

Key words: *teaching, children, evaluation*

Introduction

The expansion of scientific and technology discoveries and innovations, communication and information technology and accelerated globalization demand for a continously changing education. For this reason, reorganizations of education and fundamental changes of the position of education in society are becoming one of the priority tasks worldwide.

Dynamical and complex reality requires schools which can be quickly and easily transformed to all life circumstances and which teach our youngsters to adapt to these ever changing circumstances. In another words, modern society imposes high standards on schools. To be more precise, schools must be places where the students will come willingly and happily, where they can develop their characteristics and abilities, acquire knowledge and skills, and improve their motor skills. In addition, the schools must help them to become aware of the value of creativity, altruism, ethics and work responsibilities. The schools must help to teach them human values and send them forth with positive experiences.

Hence, in answering the question: "What are the characteristics of a quality school?" from kinesiological point of view – we could probably agree that it should be (1) a school where each child can achieve success in accordance with his or her individual abilities, (2) a school where each child could make progress, and (3) a school where each child can develop a positive self-image. If these conditions are met, then it is very likely that no child in such a school would suffer from the fear of school that affects so many children today.

That leaves one question left to be answered: How do we achieve the above characteristics and ensure that each child's needs are met?

Kinesiology Paradigm Of Quality School

If we want to each student, including the disabled, to attend the school and make progress in order to succeed in accordance with his or her capabilities, some prerequisites must be met.

The most important task is to make the initial fitness and anthropometry assessment. This is not prerequisite just for defining teaching goals but also for the diagnosis, prognosis and programming of teaching. At the same time this is most certain way to confront so called "teaching to the average student" and to meet real students, to see them how they really are, with all of their virtues and vices, with better or poorer abilities and skills, with better or lower motor achievements levels and with more or less appropriate moral properties.

In accordance with the above, it is not enough just to be a knowledgeable professional but it is also necessary to be well-informed on the subjects of physical development and actual fitness and anthropometry characteristics. Education should support and foster growth and development, so we should be always aware of the actual fitness level and anthropometry status of children.

Therefore, an understanding of the population with which we work should enable us to provide to each teacher program contents which can have positive influence on the development of skills and abilities and on improvements of motor achievements and social behavior with respect to developmental characteristics and students' authentic needs. From a kinesiology point of view, regarding authentic needs, every PE teacher should recognize in which area each student

is best and then provide him the opportunities for development of this ability for the whole period of education. At the same time they should provide each child an opportunity to develop other abilities, as much as possible. In this way we are enabling to each student to progress and to be especially successful in that in which he is most talented. Enabling children to succeed is certainly one of the basic conditions of a quality school. In addition to insight into the initial fitness and anthropometry status of students, which should be provided at the beginning of the school year, for successful work and for quality school functioning we must also consider feedback of teaching. We must consider the results of our work and the progress of each and every student during the school year and during the students' whole education. Without controlling and monitoring the transitional states of physical fitness and anthropometry we cannot get either feedback information about current physical fitness and performance measures nor can we evaluate the effects of the program and make corrections and changes in the program as needed. At the same time, we should educate the student in self-analysis and self-evaluation. This is very important because self-evaluation provides not only insight into one's own ability and skills level, but also the understanding of one's actual ability state. On the basis of self-evaluation and understanding every child can ask him/herself: 1. How am I doing in PE? 2. How do I know that? 3. What can I do to be even better?

Having a good self-evaluation technique gives each child the opportunity to avoid an idealistic self-image, but rather to have realistic information on which to proceed. This way each child can learn by his own experience that only through personal effort and making an investment in himself can he accomplish success both now in this specific subject and in the future in real life, which is a very important ethic quality.

Except transitional monitoring and evaluation we should conduct a final assessment and evaluation. We need final assessment not only for the evaluation of students' progress from initial states onward, but also for estimation of overall exercise and training effects. More then that, on the basis of this evaluation we can direct students in various form of individual work through school year and school holidays'. All of this allows students and teachers to work in conditions that are adequate to real students' needs and concrete teaching conditions. That also creates sound student-teacher relationships which are very important for attaining mutual success. Authors deem that if the above conditions are met, it will contribute to individualization of work through individual teaching, so that teachers will no longer speak to the so called "average" student rather than to the real ones. Also, that will allow each student to optimally develop his characteristics and abilities, to be successful and pleased with himself and, finally, it should help children to prepare themselves for life beginning in early childhood.

At the end of every school year and cumulatively at the end of every educational period, for example, at the end of primary or high school, every child and his or her parents could be given a progress report with regard to the child's established level of knowledge, skills, and abilities. The report could recommend a future course of education or training that would be beneficial to the child based upon the in-depth knowledge we would have of the child. Without a doubt, this is not only one of the fundamental tasks of the school, but also insures that students receive from school what they expect, a good education that will allow them to succeed in life. Happy and successful students are the basic criteria for the evaluation of a quality school.

Conclusion

Presented kinesiology point of view on quality school, mainly from aspect of potential and needful contribution of kinesiology science and profession in creating and functioning of quality school is one of the attempts to accelerate process of transformation of existing school. Further transformation of school (which is imminent), relies on three main criteria. First, it should take into consideration differences between the children, such as gifted children, children with underdeveloped abilities, disabled children, etc. Second, it should provide monitoring, evaluation, and direction toward quality. Third, it should provide skilled professionals that are ready to accept a new system of values. All that is even more necessary if we can agree that modern school is not only in function of teaching, or more precisely the school is not only in function of solving problems, the school should teach how to solve the problems. Accordingly, there is no place in new school for dilemma – of whether to learn for school or to learn for life, because the school is life, quality school should be life, respectively!

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WHAT KIND OF A NATIONAL CURRICULUM FOR PHYSICAL EDUCATION WOULD WE LIKE IN CROATIAN PRIMARY SCHOOLS?

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Abstract

Physical education is a process of learning, the context being mainly physical. The purpose of this process is to develop specific skills, knowledge and understanding and to promote physical competence. During compulsory physical education pupils need a broad and balanced curriculum to meet their needs. In September 2003 the Ministry of Science, Education and Sports of the Republic of Croatia defined the Project named The National Education Standards for primary schools in Croatia. One part of this Project is the National Curriculum for Physical Education. This article describes the strategy of physical education in Croatia and the main aims, criteria and results of the Project of the National Curriculum for Physical education for primary school.

Key words: *Croatian National Education Standards*, *National Curriculum for Physical Education, primary schools*

Introduction

Regular participation in physical activity is recognized as essential to the development of children and the promotion of physical activity in both, children and adults, and has become a national health goal. (Ishee, 2004). School physical education is the only system to which all children, whatever their background and circumstances, have a statutory right. The period of childhood and youth is a decisive time for the formation of an adult personality, and a part of this personality can be created only with the elements of physical activity.

Students′ experience in physical education classes can influence their attitude towards physical activity, so that is the reason why it is very important for physical education classes to be attractive, fun and most appropriate for their abilities and interests.

The public health community is becoming increasingly interested in the role of schools in health promotion. Allensworth, Lawson, Nicholson & Wyche, 1997 identified school physical education and related physical activity programmes as having a major role in supporting public health objectives. Additionally, there is growing evidence to suggest that physical activity behaviour may be established early in life (Malina, 1996). The author found out that children spent nearly 7 hours a day, 36 weeks a year in schools for 12 years. Quality programmes in school environment could provide the early start they need to become lifelong movers.

Council of Europe and EU surveys suggest that in a large majority of countries physical education seems to have attained the same or a similar legal status as other subjects. (Hardman, 2002) In Croatian education system physical education contains numerous elements for future directions that can be interesting for the European Union. The quality of physical education and sports for pupils depend on various conditions; quality of national education standard for physical education, curriculum status and implementation, resources for physical education (such as finance, facilities and equipment, qualified teaching personnel) and future directions to improve the status of physical education and sport for pupils and students.

The situation in Croatia is everything but satisfactory for some parts of physical education. Pre-school children have compulsory physical education, but the analysis confirms that mainly children do not have physical education regularly. This inappropriate situation depends on the motivation of nursery-school teachers and facilities, because about 30% of kindergartens in Croatia do not have sports gyms or some adequate places for exercise. In addition, we do not have inspection authorities.

The majority of children in the first to the third grade have three physical education lessons a week. More than 20% of primary schools do not have their own sports facilities, whereas secondary schools do not have about 30% of the necessary sports facilities. We would not be satisfied with the implementation of curricula for physical education the first to the fourth grade. The same situation exists in kindergartens. The every day physical activity is of the main importance for the harmonious development of children. Professors of physical education and sports experts should provide a part of everyday physical education curriculum.

Primary school pupils in the fourth to eight grade have two physical education lessons per week. In some well-organized primary schools with quality conditions, pupils have optional sports activities depending on their interest, teacher's qualification, equipment and some other very important conditions. The Republic of Croatia has the organized system of school sports competitions. Every primary school has school sports clubs with different sports activities. We have very well-organized sports competition system for 12 different sports activities on high level.

Kosinac, Kučić (2003, unpublished) found out that in some Croatian regions, pupils avoid physical education. The most frequent reasons are teacher sensitivity to the students′ needs and abilities for designing the most appropriate learning environment.

The Croatian's government decided to change, design and improve the most useful and appropriate national curriculum for pupils in primary schools.

Methods

In September 2003 the Ministry of Science, Education and Sports of the Republic of Croatia defined the Project named The National Education Standards. The first step in this Project is to define the National Curriculum for primary schools in Croatia. One part of the Project is the National Curriculum for Physical Education. The Faculty of Kinesiology of the University of Zagreb, Teacher Education Academy of the University of Zagreb and the Institute for Education of the Republic of Croatia were the main partners of this Project.

The Republic of Croatia has had detailed curricula for physical education since the first school system. The main part of teaching is motor skills which are modified by didactic means to serve the scholastic purpose and thus they become teaching units. It is very important to stress that since the beginning the curricula of physical education have been prepared according to sex and age. Neljak (2002) conducted the first research in the Republic of Croatia in order to determine hierarchical values of the content of physical education for pupils since the first grade of primary schools until the fourth grade of secondary schools regarding transformation in features, abilities and utilities. The results have shown that the participation in Physical Education has different individual influence according to the change of features, abilities and utilities.

The obtained results have significantly contributed in making the National Curriculum for Physical Education in the process of programming of teaching for primary schools. The author found out the different influence of each teaching unit on potential changes of anthropological status of children and youth during their education. At the same time, the author stressed the importance of the obtained results from the point of view of estimating higher precision in the choice of teaching content responsible for the purpose of the educational process.

The main aim of the National curriculum for physical education is to establish the basic knowledge and abilities for pupils in order to facilitate the existing curriculum as well as to encourage students to pass on the acquired knowledge. Fundamental requirements for developing a successful physical education programme are to interest and motivate students to learn the intended objectives. The motivation is defined as „the collection of causes that engage someone in an activity". (Wakefield 1966.)

The working group of the Ministry defined the main criteria for making the National Curriculum for Physical Education:

1. To ensure the development of pupils general health abilities
2. To ensure usefulness (everyday living, urgent situations, basic quality for improvement in different sports activities)
3. To ensure objective feasibility in current material conditions of the Republic of Croatia
4. To ensure the development of anthropological features of pupils (areas of sensibility)
5. To satisfy interests or needs of pupils
6. To ensure attractiveness of the new curriculum
7. To avoid the old-fashioned, dangerous and out of date elements
8. To suggest new sports activities which students want to introduce
9. To design lessons that students will find meaningful
10. To allow students to assess their own progress
11. To design activities with specific goals
12. To allow students to make choice
13. To design activities that will challenge all students

In addition to these criteria, the working group of the Ministry tried to answer a very important question: should physical education classes return to teaching males and females separately?

If our goals are for students to achieve the highest possible level of skill and fitness, then it may be appropriate to organize classes according to gender. The sexes are motivated differently, and succeed with different approaches. Croatian National Curriculum for physical education for pupils in the fifth to eight grade of primary school is separate and depends on school′ s conditions, such as the number of pupils, the balance in terms of gender, the number of professors of physical education, the schedule and dimension and the equipment of sports gyms. Female students experience physical education differently than male students; they require more complex strategies from simply making physical education co-educational. (Gabbei, 2004).

According to Chambers (1988), single-gender grouping is important for the following reasons: participation in instructional units considered "contact activities", ensuring that female students have wide opportunity to develop skills during instructional units and ensuring that evaluation standards do not have an adverse impact on male and female students.

The new National Curriculum for Physical Education consists of many different plays, sports team games such as: mini-handball, handball, football, mini-basketball, basketball, volleyball, martial arts, gymnastics, dance, track and field athletics and some other activities which depend on interests of pupils and of course conditions of facilities, equipment and teaching personnel and environment. The working group decided that each teaching unit would be mentioned only once in the National Curriculum and that it can be repeated in all grades of primary school.

In process which the Ministry would like to improve and define curricula for physical education for the whole educational system we would like to identify and teach children with disabilities in general physical education. 2005 is proclaimed as International year of physical education and sports. Therefore, the Ministry of Science, Education and Sports paid the special attention to the integration of pupils with disabilities into general physical education. Physical educators must learn to identify and work with children with disabilities and to teach them the same values and skills that other children learn.

Grosshans and Kiger, 2004 pointed out that if learning disabilities go undetected, these children may never reach the physical or social skill levels other children attain. Children with learning disabilities are frequently not accepted on the playing field because of their lack of affective (social and emotional) skills which are essential for teamwork. The working group of the Ministry made the National Curriculum for Physical Education which contain programme for pupils with disabilities. The Curriculum for Physical Education for Pupils with Disabilities is made in relation to pupil's individual abilities and with consultation of specialist of medical science if the pupils are involved in rehabilitation programme. Giving young people with disabilities the opportunity to participate in physical education programmes at school is crucial given the additional benefits, among others, for social inclusion and self-esteem they receive from physical activity.

Conclusion

The Ministry of Science, Education and Sports and the Faculty of Kinesiology of the University of Zagreb in Croatia made the new National Curriculum for Physical Education for primary schools.

They wonted to solve some problems we mentioned in the article. They also know that the physical education teachers have a very important role to develop a new curriculum. If pupils do not enjoy what they are doing, they will simply avoid the activity. Understanding, developing and applying teaching units will help pupils to build the foundation necessary to be successful in many lifetime activities.

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DIFFERENCES IN EFFICIENCY OF TEACHING METHODS IN PE WITH CHILDREN AGED 7-10

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Abstract

The experiment was conducted on a sample of 327 children aged 7-10 (1st to 4th grade primary school) in order to establish the differences in efficiency of teaching forward roll.

Synthetical (integral) and analytical methods were applied. Children who learned integratively were more successful in acquiring new motor skill. It seems that synthetical method of learning is more appropriate for younger children. Properly applied teaching procedures turned away possible difficulties which could arise during skill acquisition.

Key words: *methods of learning, motor skills*

Introduction

According to most recent concepts in kinesiology (Findak i Mraković 2003) selection of teaching methods is a very important factor for successful teaching. Teaching methods could be divided into synthetical (integral) method, analytical (sequential) and combined. Synthetical method seems to be the most appropriate since the movement sequence is taught in its entirety. This research should establish the magnitude and characteristics of influence of specific teaching method on successfulness of teaching motor skills to children of younger school age, divided into 4 sub samples defined according to age. Field of kinesiology is not concerned only with transfer of knowledge - which can be comprised in term - "information transfer" component, as "energy transfer" and methods connected with that method (Findak and Mraković 2003) have a very important contribution. Those two components are negatively interrelated (Mraković, 1997; Prskalo, 2001). PE teachers should be able to provide and transfer the skills acquiring knowledge and technique issues as well as to manage and supervise exercise and training.

Methods in domain of knowledge and skills acquisition ("information transfer") are divided into methods whose prevalent aim is education and methods which deal with personal and social behaviour issues. Both of them have their own existence (Findak and Mraković, 2003).

Learning methods present educational component of teaching methods whereby the methods are most often divided into synthetical, analytical and combined methods of learning (Findak, 1999).

Synthetical method is considered most natural because movement is taught integrally - in its entirety. The advantage of this method is to allow expression and development of student individuality.

Some previous studies have established that synthetic method is especially appropriate for teaching in elementary grades (Prskalo, Findak 2003; Prskalo et al., 2003) .

This is primarily due to the fact that children of this age comprehend all the phenomena integrally and don't have analytical thinking skills fully developed.

Apart from that, programme contents for students up to 4th grade are very simply structured which allows for integrated learning with repetitions and with gradual error correction. This is the benefit and relief for nervous system and it accelerates automation process (Findak, 1999).

Analytical method of teaching implicates learning of movement sequence by parts or step-by-step. Moves are divided and taught part by part until they are learned when again linking of the moves follows. For the purpose of the efficacy of teaching, one should be careful and take care that each move unit makes logical assembly; that child's individuality must not be overlooked and that sequential learning shouldn't be too long in order to avoid the automation and impossibility to combine the moves later in ensemble, respectively. Analytical learning is justified in case of heavy and complex activity with large quantity of elements, structural units, respectively, when performance in entirety provokes fear and when inertial forces, which are uncontrollable for novice, emerge (Milanović, et al., 2003).

Combination of synthetic method and intervention with analytical learning is the basis of combined method of learning.

Methods

The aim of the study is to assess and evaluate the differences in learning efficacy of "Forward Roll" between the use of analytical and synthetical learning method. The authors hypothesized that there is no substantial difference between sub samples in which analytical and synthetical method has been used - before and after application of experimental factor.

The sample consisted of 327 boys and girls attending first to fourth grade primary school in Petrinja, experiment was conducted from March to June in 2003. Children were divided into two groups, the first group was submitted to the experimental factor - learning forward roll by synthetical method and second group to learning by analytical method of learning.

The forward roll lesson was new for both groups. Motor tasks in analytical method were the following: 1) Raising the hips through push-off of the feet with the hands on the ground in front of the body (3 times). 2) Three push-offs in previous position followed by forward roll up to sitting position. 3) After one push-off with the hands still on the ground forward roll to squat position. 4) After one push-off with the hands on the ground forward roll to upright position. 5) Forward roll.

In early stage of the learning synthetical method of learning included downhill forward roll. After three hours of practise children were assessed with the following **test** (Findak, 1992): The performer stands straight with the legs and hands shoulder width apart. From the previous position performer moves to squat position and places her/his hands on the ground in front of the body, pointing forwards. Push-off and start to roll through the neck and the top part of the shoulders, further through the sitting and squat position to upright position. During roll the performer must not lean on his/her head and has to stand up without pushing his/her hands against the floor.

Grading: excellent - if the performer does not lean on his/her head on the ground and if he/she stands up without pushing his/her hands against the floor; very good - if the performer does not lean on his/her head on the ground but stands up with pushing his/her hands against the floor; good - if the performer does not lean on his/her head on the ground but finishes in seating position and stands up with pushing his/her hands against the floor; fair- if the performer leans on his/her head on the ground, finishes in seating position and stands up with pushing his/her hands against the floor; poor unacceptable/insufficient - if the performer can not do a forward roll. Data were analysed using a Statistica 6.0. Descriptive statistics is used to describe the central tendency and variability of data. Normality of distribution was estimated using Kolmogorov-Smirnov procedure whereas significance of differences between sub samples was evaluated using Mann Whitney "U"test.

Results and discussion

Results of pre-and-post experimental evaluation of forward roll were submitted to Kolmogorov-Smirnov test for physical fitness. The distribution of both samples was found to be not normal. For this reason non-parametric statistical significance Mann-Whitney "U" test was employed. Results, listed in Table 1 and 2 show that there were no significance of differences in performance of forward roll before the learning took place.

Table 1. Descriptive data of forward roll grades before and after aplying experimental factor

Analytical method	Valid N	Mean	Std.Dev.	Skewness	Kurtosis	K-S	Sig
OC1	152	2,38	1,02	0,63	0,06	p < ,01	0,71
OC2	152	3,16	0,99	0,53	-0,72	p < ,01	0,00
Difference	152	0,79	1,04	1,47	1,81	p < ,01	0,00
Synthetical method	**Valid N**	**Mean**	**Std.Dev.**	**Skewness**	**Kurtosis**	**K-S**	**Sig**
OC1	175	2,40	1,30	0,43	-1,08	p < ,01	0,71
OC2	175	3,83	1,04	-0,53	-0,62	p < ,01	0,00
Difference	175	1,43	1,24	0,60	-0,73	p < ,01	0,00

Apart from statistically established differences, distribution of grades also appears to be another index of advantage of synthetical method of learning. In general, distribution of grades, after the influence of experimental factor, shows positive asymmetry in the sample where the analytical method was applied (Table 1) indicating grouping of results on the left side of the grade scale, hence in the area of low grades. On the other side, distribution of grades in sample where the synthetical method was applied shows negative asymmetry, i.e. grouping of the grades in the area of higher grades (Viskić-Štalec, 1997).

The results seem to confirm the first part of null hypothesis - there were no substantial differences between subsample in which the analytical method was applied and the one in which the synthetical method was applied - before the influence of experimental factor. At the same time, the obtained results failed to confirm the second part of the null hypothesis - that there are no differences between sub samples after experimental factor was applied.

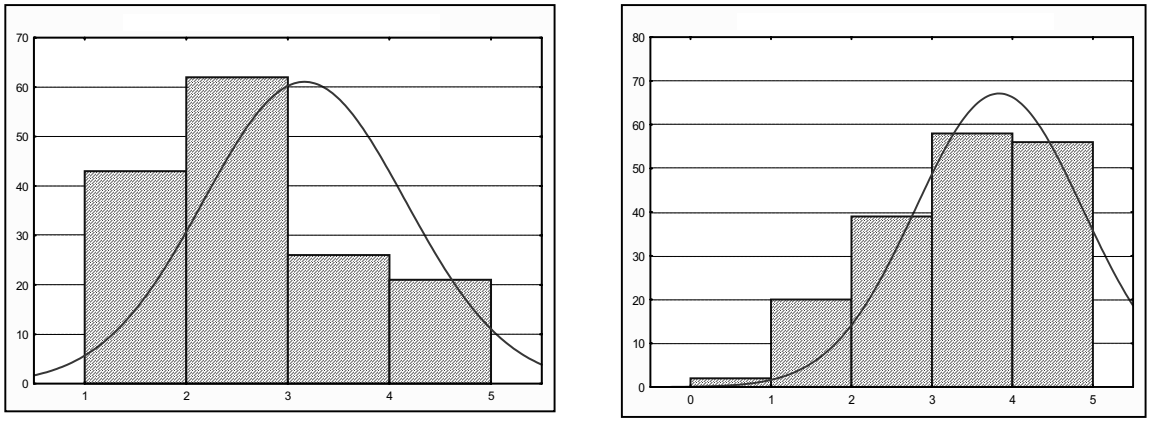

Figure 1. Improvement in acquiring forward roll by analytical and synthetical method, respectively

Findings of the research indicate that synthetical method is more appropriate for teaching in lower grades. The reasons can be found in a well-known fact that children observe and comprehend phenomena integrally and at the same time analytical reasoning is not developed enough. PE syllabus in lower grades is composed of basic motor skills and simple movement forms, therefore, integral learning, repetition and error corrections, is a relief for nervous system and enhancement in skill automation. Properly applied teaching procedures turned away possible difficulties which could arise during acquiring of skill/skill acquisition

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RELATIONS BETWEEN PHYSICAL SELF-CONCEPT AND PHYSICAL ACTIVITY IN BOYS

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Abstract

The aim of the present study was to investigate the relationship between physical self-concept and physical activity of boys. The sample consisted of 251 boys, aged 5.9 to 8.2 years (mean age = 7.2 years ± 0.9 SD). Physical self-concept was assessed using Stein's Children's Physical Self-Concept scale. Physical activity was measured by the Harro's questionnaire. Children were classified to low and high physical activity groups based on their mean scores. One-way ANOVA was used to analyse the data. There were significant difference ($p < .05$) between the low and the high activity group concerning Global Physical Self-Concept Scale and subscale of Physical Performance, where boys from the high activity group scored higher. There were no significant differences in the subscales of Physical Appearance and Weight Control. The most important conclusion of this research suggests the theoretical assumptions that the physical activity and physical self-concept of children are related.

Key words: *physical performance, physical appearance, weight control, self-concept*

Introduction

Regular physical activity is associated with various benefits even in the psychological field (e.g., Pišot & Završnik, 2002; Planinšec, 2003; Sallis, et al., 2000). There has been a substantial increase in research into the psychological correlates of physical activity, including physical self-concept (e.g., Alfermann, et al., 2003; Crocker, et al., 2000; Planinšec, et al., 2004). Not much research has been done concerning the relations between physical self-concept and physical activity in children.

Physical self-concept is one of the dimensions of global self-concept (e.g., Bracken, et al., 2000; Marsh, 1996). Researchers have developed a multidimensional construct of physical self-concept, which comprises of different fields. Fox in Corbin (1989) have developed a Physical Self-Perception model, which includes four specific areas: body attractiveness, sport competence, strength competence and physical condition. Marsh (1996) has analysed the physical self-concept of adolescents according to the following components: appearance, strength, condition/endurance, flexibility, health, coordination, activity, body fat, sport, global physical self-concept and esteem. Children's physical self-concept consists of the following subdomains: physical appearance, physical performance and weight control (Stein, 1996). The perception of a physical self-concept is, especially in children, an important influence on the development of a global self-concept and determines its level (Bracken, 1992; Fox, 1997; Planinšec, 2002).

Physical self-perceptions are related to physical activity in children and adolescents (Morgan, et al., 2003; Crocker et al., 2000). Sonstroem (1997) report a positive relationship between participation in physical activities and self-concept. Children who were more physically active had considerably higher levels of self-esteem (Tremblay, et al., 2000). High-level physical activity is an important component in the development of self-esteem in children (Strauss, et al., 2001). Physical self-perceptions are significant correlates of physical activity in children and adolescents (Raudsepp, et al., 2002). Hagger et al. (1998) have discovered that groups of low and high physical activity children differ in some areas of physical self-perception. The connection between physical activity and some subdomains of physical-self concept (physical conditioning and sport skills) was discovered by Crocker et al. (2000).

Most of the above conclusions relate to older children and adolescents, but very little has been established about the relation between physical self-concept and physical activity in young children. This sparsity of our knowledge is probably the result of problems that occur when we try to measure physical self-concept (Stein et al., 1998) and physical activity (Planinšec, 2003) for this age group.

The main aim of the present study was to establish the relation between level of physical activity and physical self-concept in young boys. Discovering relationships between physical activity and physical self-concept is important for everyone (parents, teachers and trainers) who is in any way responsible for the physical activity of children.

Method

Participants. The sample consisted of 251 boys, aged 5.9 to 8.2 years (mean age = 7.1 years ± 0.9 SD). Participants were recruited from eleven primary schools in north-eastern Slovenia. During the assessment, the children were healthy and there were no other special conditions that might have impeded their usual physical activity. The parents of all participating children signed an informed-consent form.

Assessment of physical activity. A questionnaire for the assessment of physical activity in children (Harro, 1997) was used. The questionnaire is divided into two parts; one is intended for parents, the other one for teachers. The duration of activity was monitored and assessed for a whole week. On the basis of data from the questionnaire, an average of daily moderate to vigorous physical activity was calculated. A mean split was used to divide children into two groups by activity level - low physical activity group and high physical activity group. The validity of the questionnaire was satisfactory (Harro, 1997).

Physical self-concept. The children's Physical Self-Concept Scale (CPSS; Stein et al., 1998) was used to assess global physical self-concept and the subdomains of physical performance, physical appearance and weight control behavior in children. The test consists of 27 items, 9 for each subscale. Four statements are given for each item, and the child chooses the one he/she finds most accurate. Each statement is worth from 1 to 4 points, and by adding the points we get a total for every subscale and a global score. Pilot testing with 6-7 year-old children has shown that, when provided with appropriate instructions and guidance through the scale, the children encountered no problems.

Procedures. Measurement was carried out in autumn. Parents and teachers were well acquainted with the filling in of the questionnaire and with the criteria for defining moderate to vigorous physical activity. One teacher was monitoring a maximum of seven children. The students received all necessary information from two experts who were present during the filling out of the CPSS questionnaires.

Statistical analyses. SPSS was used for data processing. Analysis of variance (ANOVA) was used to examine differences in physical self-concept. Statistical significance was set at an α level of 0.05.

Results

Results show (Table 1) that there is a significant difference ($p < .05$) between the low activity group and the high activity group concerning Global Scale and Physical Performance, where boys from the high activity group achieve better results. There are no significant differences in the subscales of Physical Appearance and Weight Control.

Table 1. Physical Activity of Non-overweight, Overweight and Obese Boys

Variables	*Non-overweight (n = 142)*	*Overweight (n = 24)*	*Obese (n = 13)*	*p*
	Mean ± SD	Mean ± SD	Mean ± SD	
MVPA – weekdays (min/day)	80.7 ± 36.9	79.7 ± 38.1	78.1 ± 35.6	NS
MVPA – weekend (min/day)	107.4 ± 42.8	104.9 ± 43.3	83.9 ± 39.5	<.05
MVPA – total (min/day)	88.3 ± 38.6	86.9 ± 39.6	79.7 ± 36.7	<.05

NS (not significant)

The average daily physical activity (Table 1) in the low physical activity group is 73.21 minutes per day (± 37.56 SD), and in the high physical activity group 111.78 minutes per day (± 43.86 SD); the difference between these two groups is significant ($p < .05$).

Discussion

The results of this research confirm conclusions about the relations between physical self-concept and level of physical activity (e.g., Crocker et al., 2000). High activity group children scored higher results on the Global Physical Self-Concept and subscale of Physical Performance. Such results could be expected, since the characteristics which fundamentally influence Global Physical Self-Concept and Physical Performance are related with physical activity. Motor skills and abilities (catching a ball, balance, high jump, fast climb, fast run, throwing a ball), which represent items in the subscale Physical Performance, will be more developed in children that are more physically active. The physical self-perception subdomain, especially condition, strength and sport, differentiate low- and high-active children very well (Hagger, et al., 1998). There were no differences between the low and high activity groups in Physical Appearance and Weight Control. Hagger et al. (1998) also state that the low and high activity groups differ least in perceptions of bodily attractiveness. This was expected, since Physical Appearance and Weight Control are far less dependent on the level of physical activity than characteristics in the Physical Performance subdomain.

The most important conclusion of this research confirms the theoretical assumptions that the level of physical activity and perceived physical self-concept are related. The question remains, though, whether a higher physical self-concept is the result of a higher level of physical activity, or whether children with a higher physical self-concept are simply more physically active. The causal link between physical activity and physical self-concept should certainly be investigated with a sample group of children.

Conclusions about the connection between physical activity and physical self-concept can be used by anyone who deals with the physical activity of children, especially physical educators and trainers in order to (a) create a positive motivation climate, (b) design effective intervention programs and (c) choose a learning strategy which will encourage children to take part in physical activity and their physical self-concept. Since physical self-concept is an important part of global self-concept we have to consider it very carefully. We also should encourage children to increase their levels of physical activity, which has a number of benefits in the psychological field as well.

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PERCEPTION OF MOTIVATIONAL CLIMATE IN PHYSICAL EDUCATION CLASSES

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Abstract

Motivational climate is an important variable in the educational setting since it determines a situational goal structure. The aim was to study how pupils' gender and age influence their perception of PE classes' climate. 171 pupils (39% boys, 61% girls) from two age groups (7th grade of primary and 2nd grade of secondary schools) took part in the study. Learning and performance orientations in physical education classes questionnaire (LAPOPECQ; Papaioannou, 1994) was used to study the motivational climate. Results of present study show that gender and age separately influence how adolescents perceive the motivational climate in PE classes. Teachers' directions and leadership behavior toward the effective learning process therefore may not be universal but as much as possible adapted to the developmental characteristics of pupils.

Key words: *motivational climate, physical education, gender, age*

Introduction

Motivational climate determines a situational goal structure that can be comprehended as a joint goal orientation of individuals in a certain learning environment or situation (Barić, 2004). Motivational climate is a contextual variable (Duda, 1992), determined by characteristics of a concrete environment. According to Duda (1992) there are two basic patterns of motivational climate: mastery climate and competitive climate.

Mastery climate represents an environment where teachers highly emphasize pupils' learning progress, effort and skill improvement (Duda, 1992). Such motivational climate is prevailed by cooperation and pupils are oriented toward personal progress. Success or failure is dependent upon the subjective assessment whether one achieved mastery, earned or improved on a task. Perceptions of ability are self-referenced and dependent upon learning and improvement (Roberts, 2001). Teachers that co-create such climate are usually democratic, instructive and interested in pupils as individuals. Second type of motivational climate is performance climate (Duda, 1992) and is characteristic for environments where teachers emphasize failure, punish mistakes and give less positive feedback and social support to pupils (Roberts, 2001). Pupils are motivated by using the normative criteria (comparison to the others) of performance evaluation, and by believing that success is a result of the superior abilities. They perceive that teacher and classmates are constantly evaluating them and their performance, while great emphasize is given on the superior accomplishments of sport skills and goal achievements. Teachers who influence such pattern of climate are usually autocratic and dictatorial (Barić, 2004).

Since several age and gender differences were reported in previous studies (see Duda, 1992; Smoll & Schutz, 1980), the study was aimed at investigating these characteristics of motivational climate in PE classes in Slovenian primary and secondary schools.

Method

Participants

A total of 171 pupils (n_{boys} = 66; n_{girls} = 105) from different primary and secondary schools from all Slovenian regions participated in the study. Participants attended 7th grade of primary school (n = 76; M_{age} = 13.08 yrs; SD_{age} = 0.42 yrs) and 2nd grade of secondary school (n = 95; M_{age} = 16.02 yrs; SD_{age} = 0.36 yrs).

Assessment and procedure

Motivational climate in physical education classes was assessed by *Learning and Performance Orientations in Physical Education Classes Questionnaire* (LAPOPECQ; Papaioannou, 1994). The questionnaire was translated and adapted to the characteristics of Slovenian sample by authors of this contribution. The 27 items Slovenian version of

LAPOPECQ was employed to assess the motivational climate in PE classes on a 5-point Lykert-type scale (1=strongly disagree; 5=strongly agree).

The factor analysis showed that LAPOPECQ consists of five orthogonal factors (Cecić Erpič, Boben, Škof, Zabukovec, & Barić, 2004; Papaioannou, 1994). The first two scales refer to a learning-oriented climate namely created by teachers' behavior (α=0.77) and pupils' satisfaction with learning (α=0.78). The third scale (α=0.71) imply competition prevailing climate, where a success is defined by clear normative-based criteria (e.g., being better than others). Items of the fourth scale describe a learning climate where a success is defined through criteria, related to pupils' abilities (e.g., achieving success without effort). The last scale (α=0.78) describes a climate defined by pupils' fear and worries about mistakes.

After the written consent from their parents was obtained, participants were tested in groups in classroom settings. Instruction was given that the items refer to PE classes on general and not to the specific class. A 2x2 MANOVA was conducted to evaluate the influence of gender and age on the characteristics of perceived motivational climate in PE classes.

Results

The means and SD for the LAPOPECQ scales are presented in Table 1. 2x2 MANOVA was conducted to determine whether there were gender and age differences in the perception of motivational climate. There were no interacting effect between age and gender.

Table 1: Descriptive statistics LAPOPECQ scales regarding gender and age

	boys			girls			primary school			secondary school		
	n	M	SD	n	M	SD	n	M	SD	n	M	SD
L1	61	25.02	5.14	98	26.74	4.59	67	26.30	5.06	93	25.86	4.75
L2	60	15.80	4.06	100	16.56	4.71	66	17.15	4.40	95	15.70	4.45
L3	62	16.31	3.48	98	12.81	3.96	68	15.81	4.27	93	12.92	3.59
L4	60	12.12	3.81	101	11.07	2.78	68	12.16	3.66	94	10.95	2.76
L5	59	14.42	3.44	98	14.38	2.98	64	15.25	2.92	94	13.79	3.17

Legend. L1 = teachers' behavior; L2 = pupils' satisfaction with learning; L3 = success, defined by normative-based criteria; L4 = success, defined by ability-based criteria; L5 = pupils' worries about mistakes

Discussion

Results of 2x2 MANOVA showed that gender and age significantly influence some components of motivational climate in PE classes. While there were no interacting effects between gender and age, results show that girls evaluate components related to teachers' behavior more positively than boys meaning that girls perceive teachers as more satisfied with their progress in the learning process ($F = 4.86$, $p < .05$). There are significant gender differences in perception of how success in PE classes is defined. Boys perceive success as more defined by clear-normative based criteria ($F = 32.46$, $p < .00$) than girls do. As competitiveness is characteristic for such motivational climate, this means that boys perceive PE classes as more competitive than girls do which was shown in other studies as well (e.g., Smoll & Schutz, 1980; Zabukovec, Cecić Erpič, Boben, & Škof, 2002). On the other hand, boys also perceive to a greater extent that success in PE is defined by ability-based criteria ($F = 4.04$, $p < .05$).

The perception of motivational climate is significantly influenced also by pupils' age. The results show that age doesn't influence only one of measured motivational climate components, i.e. teachers' behavior. According to their assessments, other four components are more characteristic for motivational climate of younger pupils. 7th grade pupils evaluate the climate in PE classes as more competitive (i.e., success defined by clear-normative based criteria, $F = 21.53$, $p < .00$) and at the same time as more oriented towards the development of abilities (i.e., success defined by clear-ability based criteria, $F = 5.79$, $p < .05$) than older pupils. Interestingly, results show that younger pupils are more satisfied with a learning process ($F = 4.15$, $p < .05$), while at the same time motivated by worrying about the mistakes ($F = 8.64$, $p < .05$). Younger pupils therefore perceive motivational climate in PE classes on general as oriented toward learning of new skills, where also information and knowledge on health related issues are being thought. Results are not surprising as they represent the developmental characteristics of early and middle adolescence (Smoll & Schutz, 1980).

Results of present study show that gender and age separately influence how adolescents perceive the motivational climate in PE classes. Teachers' directions and leadership behavior toward the effective learning process therefore may not be universal but as much as possible adapted to the developmental characteristics of pupils. Since teachers' behavior is one of significant components of motivational climate, these results imply some information about development of an effective motivational climate.

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EFFECTS OF MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES ON SPRINT SPEED IN BOYS OF 11-12 YEARS

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Abstract

The system of 20 variables were applied on the sample of 102 5th-form elementary school pupils, 1 of which 20 m-running speed (as criterion variable), 9 morphological characteristics and 10 motor abilities (as specific system of predictor variables). The purpose was to determine the effect of the predictor system of morphological variables and the predictor system of motor variables on the criterion variable of 20 m-running speed in order to establish the most rational procedures on planning and programming the training contents, as well as an efficient development of the motor abilities relevant to the development of sprint speed with boys aged 11-12. Data were processed by application of the regression analysis.

The results indicated that the applied system of predictor variables of morphological characteristics had statistically significant effect on the criterion variable of 20 m-running speed at the level of .00 (p=.00), that the coefficient of multiple correlation was .71 (Ro=.71), whereas the common variability (square of the multiple correlation) was about 51% (Ro^2=.51). This particularly means that morphological characteristics may account for 47% of positive effect on the sprint running. Statistically significant effects on the criterion running variable at 20 m were those of individual variables of body mass and skin folds of upper arms.

The applied system of predictor motor variables on the 20 m-running speed variable had statistically significant effect at the level of .00 (p=.00), coefficient of multiple correlation was .75 (Ro^2=.75), whereas the common variability (square multiple correlation) was about 57% (Ro^2=.57). This means in particular that motor abilities account for 57% of positive effect on sprint running. Individual statistically significant effect on the 20 m-running criterion variable was that of the repetitive strength of the trunk and shoulders (lean backward in lying position and pull-ups on horisontal bar), explosive strenth of arms and shoulders (medecine ball throw from lying position), and coordination (passing throught and jumping).

The results based on the claculated matrices of effects of the predictor systems of morphological and motor variables on the 20 m running variable point to the fact that boys of 11-12 years achieve sprint results mostly owing to integral biological growth and development (body mass) and motor abilities, especially repetitive strength of the trunk and shoulders, explosive strenth of arms and shoulders, as well as legs coordination.

Key words: *effects, morphological characteristics, motor abilities, sprint speed, boys aged 11-12.*

Introduction

Research of various effects of processes of the body exercising and/or training on the development of particular anthropological characteristics of children represents one of the most important orientations in physical education and sport. It includes defining the goals and tasks of the exercising process; condition of exercisers and limiting factors, within which it also implies diagnosis, planning, programming and control of the exercising process and/or training (Findak, 1999, Pejčić, 2002).

In order to make the development of relevant skills and characteristics possible, it is necessary to apply different exercises (means, contents, instructors), stressing the fact that they must result from well conceived activities, selection and application, i.e. that they meet the goals and tasks of the exercising process.

As the effects of exercising also depend on the application of the loading method, for each exercising structure it is necessary to know in advance which means (exercise, contents) should be used for a particular purpose, as well as how to apply it. Obviously, the means, methods and workloads cannot be treated, analyzed and applied separately, but they should be regarded as mutually dependent and conditioned elements while conceiving, composing, programming, putting in operation and controlling of the exercising process in order to envisage and analyze the desired effects.

Depending on the orientation of particular sports, one can differentiate between the means aimed at adopting specific motion forms (usually applied when training technical elements) and means aimed at development of the relevant anthropological characteristics of children. As is already known, the above orientations imply mutual relations

and effects, as for the development of the relevant anthropological ability or characteristic, it is necessary to adopt the relevant motion (technical) structure in a rational, economical and optimum manner, by means of which effects must be produced on goal-oriented development of the desired anthropological abilities and characteristics (Kurelić, Momirović, Stojanović, Šturm, Radojević & Viskić-Štalec, N. 1975).

The exercising means and/or training aimed at learning and improving the desired and goal-oriented motion structures (sports-technical elements, motor information) must be conducted in an extremely selective manner, based on a previous choice or a new plan of specific (situational) motion structures (preliminary exercises, intermediate exercises, actual exercises) which are the closest to the situational motion structure according to their form, character and structure. In doing so, the final goal should be to achieve the fastest and highest exercise effects while performing them and adopting the relevant motion structures, by means of which optimum development of the relevant anthropological abilities and characteristics being in function of the desired goals could be achieved with the least possible structural motion elements.

The development of the particular relevant anthropological abilities and characteristics, whose success primarily depends on the selection of proper means, their application and workload, should not be oriented to the aimless exercising, which means that it is useless to develop particular skills and characteristics of children without the particular requirement. Thus, the training means aimed at the development of the relevant anthropological abilities and characteristics must be conceived and/or selected with an aim that their modification is performed under the effect of the previously adopted (skilled, automated) motion structures (exercises and contents). In doing this, there is a well-known rule that regardless of what the selection of the program contents (means) is based on, priority will be given to the contents of higher complexity, i.e. to those which enable the achievement of higher number of goals.

Having in mind the fact that the goal of physical education and training in elementary school is optimum anthropological integrity of children, it is desirable to conduct occasional research in order to control the influence of complexity of the achieved effects on individual relevant anthropological abilities and characteristics (Malacko & Popović, 2001).

This was the essential reason to check through this research the influence of particular relevant anthropological abilities and characteristics, and, indirectly, of the applied contents of the exercising or training process on the sprint speed in children.

In accordance with the above approach, the purpose of this research was to determine the effects of morphological characteristics and motor abilities on the sprint speed of boys at this age, in order to get an insight of the effects of application of the teaching and training program contents and to take adequate measures for further application of goal-oriented exercises, methods and workloads.

Methods

The sample of 102 elementary school pupils of the 5th form were subjected to testing 20 variables, of which 1 was variable of 20 m dash speed (criterion variable), 9 were variables of morphological characteristics, and 10 were variables of motor abilities (specific system of predictor variables).

Within the field of morphological characteristics, the following system of predictor variables was applied: (1.) body height, (2.) shoulder width, (3.) biiliocristal width, (4.) body weight, (5.) upper arm circumference, (6.) thigh circumference, (7.) triceps skinfold, (8.) subscapular skinfold, and (9.) abdominal skinfold.

Within the motor abilities, the following system of predictor variables was applied: (1.) dragging and jumping over, (2.) agility in the air, (3.) obstacle course backwards, (4.) plate tapping, (5.) one foot tapping, (6.) two feet tapping, (7.) standing broad jump, (8.) medicine ball put - lying, (9.) sit-ups, and (10.) reverse sit-ups.

For evaluation of the sprint speed (criterion variable), the variable of 20 m dash from high start was applied.

The effects of the systems of morphological and motor variables (system of predictor variables) on the variable of 20 m dash were calculated by means of regression analysis.

For calculation and analysis of the obtained results, the following univariant statistical parameters were applied: standardized regression coefficient (β) was applied for individual effects of each predictor variable on the criterion variable, t-test (t) was applied for testing the significance of effects of each predictor variable on the criterion variable, statistical significance of effects of standardized regression coefficients of each predictor variable on the criterion variable at the level of .5 up to .00 ($p<.05$).

Multivariant values were calculated by means of the following statistical parameters: square of multiple correlation or total variance of the system of predictor variables on the criterion variable (R_0^2), square of multiple correlation or the total variance of the system against predictor variables and the criterion variable (R_0), coefficient of the average square for regression of residual (F), and statistical significance of effects of the whole system of predictor variables on the criterion variable at the level from .05 up to .00 ($p<.05$).

Results

Analysis of Table 1 points clearly to the fact that the applied system of predictor morphological variables on the criterion variable of sprint speed (20 m dash from high start) has multivariant and statistically significant effect at the level of .00 (p=.00), as well as that the coefficient of multiple correlation amounts to .71 (R_0=.71), which explains the mutual variability of about 51% (R_0^2=.51).

Table 1: Effects of predictor system of morphological variables of the criterion variable of 20 m dash from high start

Varijables	β	t	p
1	-.09	-.67	.50
2	-.23	-1.73	.08
3	.06	.38	.70
4	.74	2.16	.03*
5	-.46	-1.96	.05*
6	.39	1.60	.11
7	.58	2.71	.00*
8	-.18	-.88	.37
9	-.19	-.78	.43

Ro^2 =.51 **Ro =**.71 **F =**10.84 **p =**.00*

Table 2: Effects of the predictor system of motor variables on the criterion variable of 20 m dash from high start

Variables	β	t	p
1	.28	2.29	.02*
2	.10	1.35	.17
3	.10	.84	.39
4	.12	1.37	.17
5	-.15	-1.47	.14
6	-.09	-.93	.35
7	-.02	-.18	.85
8	.17	2.07	.04*
9	.07	.61	.54
10	-.42	-3.46	.00*

Ro^2 =.57 **Ro =**.75 **F =**12.35 **p =**.00*

By means of the univariant analysis of the applied system of predictor variables, a conclusion can be drawn that the statistically significant effects on the criterion variable of 20 m dash from high start are produced by: body weight (4), thigh circumference (5) and skin fold of the upper arm (7).

The analysis of the Table 2 points clearly to the fact that the applied system of predictor motor variables on the criterion variable of sprint speed (20 m dash from high start) produce multivariant and statistically significant effects at the level of .00 (p=.00), as well as that the coefficient of multiple correlation amounts to .75 (R_0=.75), which explains the mutual variability of about 57 % (R_0^2=.57).

By means of the univariant analysis of the applied system of predictor variables, it may be concluded that the statistically significant effect on the criterion variable of 20 m dash from high start is produced by the following variables: dragging and jumping over (1), medicine ball put - lying (8), and reverse sit-ups (10).

Discussion

The results of regression analysis in 11-12 years old boys point to the fact that the whole system of applied morphological variables and the whole system of motor variables have statistically significant effects on the sprint speed at the level of .00 (p=.00). It was found out that the boys with increased body weight, upper arm circumference and adipose tissue of upper arm, as well as with increased coordination of the whole body, explosive strength of arms and shouler girth, and repetitive strength of back muscles achieve better results in sprint running.

The obtained and analysed results indicate that the boys at this age may achieve better results in sprint running usually at the cost of the increased total body weight, upper arm circumference, explosive strength of arms and shoukler girth and repetitive strength of the back. This means that they achieve better results in dash at the cost of the upper extremities, muscles of the back, and coordination of the whole body, and not that of the explosive strength of the lower extremities and speed of alternative movememnts, as was expected.

This indicates further that in the teaching process and/or training, there was insufficient application of the program contents aimed at the development of explosive strength of legs and sprint running, which is highly important for the children at this age, as the sprint speed is involved in most of the relevant sports activities.

The results achieved in boys at the age of 11-12, indicated that motor abilities and morphological characteristics, formed at the integral base, account for the manifestation of sprint speed, provided that the body weight, explosive strength of arms and shoulder girth, repetitive strength of back muscles and coordination of the body represent the predominant characteristics, abilities or traits in manifesting speed of sprint running at this age.

Based on the obtained results, a conclusion can be drawn that the boys at this age have not developed sufficiently the explosive strength and speed of alternative movements of lower extremities. This means that, in the future work with boys, more attention should be paid to the application of exercises aimed at the development of relevant motor abilities for achieving better results in sprint running. This means in particular that the program contents must be conceived and/or selected in such a manner that their application is performed under the influence of already adopted (instructed, automated) motion structures (exercises, contents).

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RELATIONS BETWEEN ANTHROPOLOGICAL CHARACTERISTICS AND PERFORMANCE IN SCHOOL ATHLETICS OF GIRLS INVOLVED IN EXTRACURRICULAR SPORTING ACTIVITIES

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Abstract

The goal was to determine relations of anthropological variables and performance in certain school athletic disciplines in 56 girls (10-11 yrs of age) which participated in various programmes of extracurricular activities (school athletics, team sport games, other sporting activities) two times a week besides the regular physical education classes. The anthropological status was assessed by three anthropometric, six motor and one functional variable. Performance variables consisted of results accomplished in 300m running, long jump, high jump and throwing the ball. The findings confirmed that early engagement of girls in athletic programmes, focused on natural forms of movement, is not only recommendable, but also indispensable for their optimal physical development.

Key words: *anthropometry, team sport games, school sport, school year*

Introduction

Insufficient physical activity is a main feature of modern way of living of all age groups. Two physical education (PE) classes per week, or 90 minutes of organized physical activity is a too small stimulus for children's normal development. Therefore, it is of a vital importance to include as many children in other forms of organized sport and exercise for children and the young. Various forms of school sport, extracurricular and extramural sporting activities, most of which are verified by the Croatian Ministry of Science, Education and Sport, may help to incite the children to exercise regularly. Unfortunately, no programme of athletics has been offered so far. It is somewhat surprising, because athletics is a basic sport and requires no extra facilities or equipment, in other words, it may be accessible to everyone. It is even more important if we know that natural forms of movement are hardly surviving nowadays, especially in urban population. Therefore, children should first learn to walk, run, jump and throw properly. And athletic programmes offer all of these.

The aim was to determine if there were any differences among three groups of girls involved in various extracurricular activities on the basis of anthropological variables and variables of performance in school athletics at the beginning and at the end of the school year

Methods

Sample of subjects. The study was performed on the convenience sample of 56 girls, fourt- and fifth-graders, that is 10-11 years of age, from elementary schools of Čakovec. Besides participating regularly in PE education classes twice a week (2 x 45 min), each one of them was engaged in one of extracurricular programmes. In the athletic group there were 22 girls, in team sport games 17, and 17 girls were in the group named "other sports".

Extracurricular programmes. Extracurricular programmes were performed two times a week (2 x 45 minutes). The athletic programme was composed of the following teaching units: running (all kinds of), walking, jumping, throwing and elementary games. The main determinants of the team sport games' programme were learning of technical and tactical fundamentals of a particular sport and development of other necessary motor skills and abilities. In the group of "other sports" programmes accentuated learning of sport specific technical fundamentals and only the elements of the gymnastics programme were similar to those in the athletics programme.

Sample of variables. The sample of ten anthropological variables (3 anthropometric, 1 functional, 6 motor) is identical to the test regularly used for the initial and final anthropometric, motor and functional measurement in Croatian elementry schools, as described in the handbook "Norme – primijenjena kineziologija", by Findak and associates (1996).

Anthropometric variables: body height (height; cm), body mass (mass; dag) and forearm circumference (forearm circ.; mm). *Motor variables:* hand tapping (tapping; reps.), standing broad jump (broad jump; cm), straddle sit-and-reach (sit-and-reach; cm), polygon backwards (polygon; s), pull-up hang (pull-up; s), sit-ups in 60 s (sit-up; reps.), 3-minute running (4th formers; F-3; points) or 6-minute running (5th formers; F-6; points).

Athletic performance variables: 300-metre running (300 m; s), long jump (cm), high jump (cm) and throwing the 200 g ball (ball, m).

The selected variables are highly reliable and have good metric characteristics. The anthropological variables are regularly used in the Croatian elementary schools for the initial and final assessment of motor and functional status of pupils. The school athletic disciplines used are components of the physical education curriculum for the 4th and 5th form of the elementary school.

Data processing methods. The datra were processed using the software STATISTICA 5.0 at the Faculty of Kinesiology University of Zagreb. Descriptive statistics of all the groups of variables were calculated for each subsample separately. Discriminant analysis was used to determine statistical significance of differences among the groups obtained in the initial and the final measurement and canonical correlation analysis was used to determine relations among the anthropological and athletic performance variables.

Results and discussion

The results of discriminat analysis indicate that the significant changes have occurred in the period between the initial and final measurement. Namely, in the initial measurement significant statistical differences between the three groups of girls were obtained on both disciriminant functions (Table 1).

Table 1. Chi – Square Test (initial)

Roots removed	Chi – Square Test with Successive Roots Removed					
	Eigenvaule	CanonicalR	Wilks' Lambda	Chi-Sqr.	df	p-level
0	1.513	0.776	0.241	66.128	28	**0.000**
1	0.650	0.628	0.606	23.279	13	

Table 2. Factor structure matrix (correlation of variables – canonical roots; initial)

Variables	Factor structure matrix	
	Root 1	Root 2
height	0.197	-0.544
mass	-0.012	-0.698
forearm circ.	-0.063	-0.541
tapping	0.115	-0.095
broad jump	0.355	-0.062
sit-and-reach	0.156	-0.196
polygon	-0.369	-0.059
sit-up	0.258	0.051
pull-up	0.324	0.045
F3, F6	0.427	0.119
300 m	-0.486	0.043
high jump	0.812	0.166
long jump	0.511	-0.137
ball- 200 g	0.204	-0.382

Table 3. Means of canonical variables (initial)

Group	Means of canonical variables	
	Root 1	Root 2
ATHLETICS	1.449	-0.220
TEAM SPORTS	-1.284	-0.838
OTHER SPORTS	-0.592	1.123

It is obvious (Table 4) that groups differ significantly among themselves (p=0.001) on the first discriminant function, whereas on the second function there were no differences among them.

Values of the orthogonal projections (correlations) of the variables with discriminant functions (Table 5) reveal that the groups differ from each other in the variables *long jump*, *high jump*, *300 m running*, *F3 & F6* and *standing broad jump.* The position of the centroids of the groups in relation to the discriminant function make it obvious (Table 6) that the athletic group is on the negative pole, whereas the other two are on the positive pole of the discriminant function. The mentioned differences in the values of orthogonal projections of the variables on the discriminant function speak in favour of the better results of the athletic group.

Table 4. Chi-Square Test (final)

Roots removed	Chi-Square Test with Successive Roots Removed					
	Eigenvalue	Canonical R	Wilks' Lambda	Chi-Sqr	df	p-level
0	2.245	0.832	0.205	73.771	28	**0.000**
1	0.506	0.580	0.664	19.034	13	0.122

Table 5. Factor structure matrix (correlations of variables - canonical roots; final)

Variables	Factor Structure Matrix	
	Root 1	Root 2
height-2	-0.184	**0.612**
mass-2	0.025	**0.825**
forearm circ.-2	0.084	**0.822**
tapping-2	-0.233	0.123
broad jump-2	**-0.414**	0.209
sit-and-reach-2	-0.114	0.298
polygon-2	0.380	-0.085
sit-up-2	-0.263	-0.043
pull-up-2	-0.242	-0.148
F3, F6-2	**-0.548**	-0.160
300m-2	**0.559**	0.054
high jump-2	**-0.739**	0.201
long jump-2	**-0.589**	0.428
ball-2	-0.288	0.387

Table 6. Means of canonical variables

Group	Means of Canonical Variables	
	Root 1	Root 2
ATHLETICS	**-1.758**	0.209
TEAM SPORTS	1.592	0.726
OTHER SPORTS	0.682	-0.997

Correlations among morphological variables displayed significant correlations between body *height* and *body mass* (0.707), and between *body mass* and *forearm circumference* (0.907). The significant negative correlation is obvious between *body mass* and *polygon backwards* (- 0.751)*. Because results are turned upside down.The variable *hand tapping* established a single correlation with the variable *standing broad jump* (0.517). The variable *standing broad jump* is highly correlated with all the motor variables, most with the *polygon backwards* (-0.751).

The variable *F3, F6* established the positive correlation with the *standing broad jump* (0.516) and the negative correlation with the polygon backwards (-0.523). Mutual correlations among morphological variables are as expected, whereas their correlation with the variables of the motor and functional space is somewhat lower.

Table 7. Correlation among anthropological variables (the final measurement)

	height	mass	forearm circ.	tapping	broad jump	sit-and-reach	polygon	sit-up	pull-up	F3,F6
height	1.000	**0.707**	**0.563**	0.277	0.341	0.401	-0.149	0.179	-0.106	-0.009
mass		1.000	**0.907**	0.061	0.036	0.338	0.112	-0.048	-0.437	-0.119
forearm circ.			1.000	-0.023	0.001	0.288	0.033	-0.033	-0.414	-0.175
tapping				1.000	**0.517**	0.284	-0.460	0.467	0.302	0.362
broad jump					1.000	0.489	**-0.751***	**0.549**	0.493	**0.516**
sit-and-reach						1.000	-0.405	0.259	0.102	0.096
polygon							1.000	**-0.668**	**-0.614**	**-0.523**
sit-up								1.000	0.440	0.482
pull-up									1.000	0.416
F3,F6										1.000

Results of the applied canonical correlation analysis displayed relatively low correlations among anthropological and performance variables (Table 8). The variable *long jump* established the most positive correlations with anthropological variables. The variable *long jump* established the negative correlation with the variable *polygon backwards* (-0.700) and *300 metre running* (-0.738), whereas it established the highest positive correlation with the variable *standing broad jump* (0.824). The variable *high jump* established the most significant correlation with the variable *standing broad jump* (0.751) and positive correlation with the morphological variable *body height* (0.504). The variable *throwing the 200g ball* is positively correlated with the *standing broad jump* (0.611). The variable *300 metre running* is positively correlated with the *polygon backwards* (0.695), whereas it established the highest negative correlation with the variable of functional abilities *F3, F6* (-0.688).

Tablica 8. Canonical correlations among anthropological and performance variables (final measurement)

Variables	300 m	high jump	long jump	ball
height	-0.096	**0.504**	0.425	0.499
mass	0.225	0.131	0.122	0.342
forearm circ.	0.262	-0.022	0.093	0.305
tapping	**-0.571**	**0.568**	0.480	0.410
broad jump	**-0.685**	**0.751**	**0.824**	**0.611**
sit-and-reach	-0.114	0.320	0.358	0.383
polygon	**0.695**	**-0.551**	**-0.700**	-0.469
sit-up	**-0.617**	0.465	**0.526**	0.494
pull-up	**-0.560**	0.404	**0.529**	0.171
F3,F6	**-0.688**	**0.550**	**0.557**	0.236

The obtained results demonstrate statistically significant differences among groups of girls in anthropological and athletic performance variables both in the initial and final measurements. The differences obtained in the final measurement may be attributed to the influence of the applied extracurricular programmes. Statistically the best scores were registered for the group engaged in the

programme of athletic disciplines. Canonical correlation analysis showed that the motor abilities have greater influence on performance in athletic disciplines than the anthropometric characteristics. The findings may be useful in improving the physical education curriculum and syllabus, as well as in extracurricular sporting and exercise activities' planning and programming in elementary school.

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ANALYSIS OF THREE DIFFERENT WAYS OF ASSESSING MOTOR ABILITIES WITH THE TESTING ASSIGNMENT OF LONG JUMP WITH APPROACH

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Abstract

In the paper we study the measurement characteristics of the test assignment 'long jump with approach' (step and a half technique) and analysed differences between the evaluations of three independent evaluators who made assessments using holistic, ponderation (weight) and analytical methods. The study was carried out on a sample of 193 13-year-old students who in September 2003 had finished six years of school. The acquired data was elaborated with the basic procedures of descriptive statistics, correlational analysis and variance analysis. We identified adequate measurement characteristics of an assessment. There are differences in the three methods of making assessments but they are not significant. The analysis shows that the best way of making an assessment in schools is the holistic assessment method.

Key words: *assessment, motor abilities/skills, long jump with approach, measurement characteristics*

Introduction

The new physical education curriculum defines the standards of knowledge expected at the end of each trimester. Physical education teachers usually introduce the task of 'long jump with approach' to assess the standards acquired in the second and third trimesters of primary school. This assessment usually involves measuring the length of the jump (Kovač, Jurak and Strel, 2003). For the external assessment and testing of knowledge at the end of primary school the so-called analytical method of assessment is used to test the task long jump with approach by implementing accurate measures and descriptives since the assessment is expected to be as objective as possible. In this study we also tried out some other methods of assessing and compared them with the different marks obtained using the holistic, ponderation (weight) and analytical methods.

Differences between holistic, ponderation (weight) and analytical assessment methods

According to Jurman (1989) when applying the analytical method a teacher initially examines the existing knowledge and later the absence of knowledge, and only then decides on the respective mark considering the standards and evaluation scales; whereas with the holistic method the entire demonstration of a student's knowledge is first assessed »intuitively« on the basis of personal standards for marks. When speaking about defining the criteria and descriptives for the analytical and holistic methods, Rutar Ilc (2003) says that each area of assessment needs its own criteria also according to different levels; and when applying the holistic method of assessment we use for each particular assessment level or marks several criteria at the same time. The ponderation (weight) method of assessment is a combined way which includes both the characteristics of the holistic method and the analytical method of assessment. We have so far not encountered in physical education any similar study that compares different assessment methods. However, the differences between the holistic, ponderation (weight) and the analytical methods of assessment have already been evaluated in other school subjects. In general, they have discovered certain advantages and weaknesses specific to the evaluated materials with the result that some authors (Marentič Požarnik, 2000; Tacol, 2000; Zrimšek, 2000) state it is necessary to use different assessment methods.

Measurement characteristics of test assignments for assessing motor skills

The theory of assessment first of all emphasises the validity, reliability, objectiveness, sensitivity and economic aspects of assessment (Jurman, 1989; Sagadin 1993; Bucik, 2000). An evaluation is **valid** when it is in line with the contents and objectives of the subject (Bucik, 2000; Marentič Požarnik, 2000). Here we also implement the adaptation of different taxonomic goals. In physical education what is mostly implemented is the determination of basic and general (declarative) knowledge and specific (procedural) knowledge (Kovač, 2000; Rutar Ilc, 2003). An assessment is **reliable** when the same teachers give after a new assessment the same mark for the same displayed knowledge (Zorman, 1974; Bucik 2000; Marentič Požarnik, 2000). The reliability of assessment can be increased through good assessment measures (Marentič Požarnik, 2000). An assessment is **objective** when different evaluators give the same mark for the same displayed knowledge. The objectivity of the assessment is mostly enabled by standard knowledge tests (Zorman, 1974; Sagadin, 1993).

Authors (Dežman and Kovač, **2002;** Kovač et al., 2002; Lorenci et al., 2002; Premlč, 2002; Zadražnik, 2002; Majerič, 2004) who have recently studied the measurement characteristics of testing assignments used in assessing motor skills have found they are appropriate for use in the evaluation of physical education.

Methods

Sample of tested and assessed individuals

The sample of tested individuals covered 193 male school children who had finished six years of school and who were 13 years old by 1 October 2003. The sample of tested individuals is representative for Slovenia. The data was collected in the research of Strel et al. (2003). School children performed a test exercise under the same conditions. The school children's performances were videotaped. They were assessed by three independent evaluators who are official evaluators from the National Examination Centre. Knowledge was assessed with a unique protocol.

Exercise testing and measures for assessing three different evaluation methods

Demonstration 1: Description of the movement technique

1) Approach	2) Take off	3) Flight	4) Landing
			
The student is positioned on the runway for long jump on the spot of the measured line. The length of the approach is ten to fourteen running steps. Running starts so that the rhythm is accelerated gradually, equally and the maximum speed is attained. Preparations for take off are achieved without any big change in the rhythm, the penultimate step before landing for the take off is quite longer and the last one is a little shorter and faster.	The student starts his take off with an active position of the feet for take off on the most flexible (highest) part of the board; a short phase of amortisation follows and a quick and energetic take off with total extension in the jumping joint, knee and hip joint of the take off leg. The view is directed to the front and the trunk is erect during take off. An effective forward swing of the swinging leg follows with a slight move up and an effective swing of the arms. The entire take off is directed forward and up.	The student is in the air and keeps the position he had at the moment of take off (stable balanced position). After take off the legs are kept wide apart, the trunk is erect, the view is directed forwards. The arm which is opposite the swinging leg remains in a forward position, and the second arm makes a round movement in an upwards and forwards direction. The preparation of landing starts while pulling the take off leg towards the swinging leg so that both legs are extended forwards; the swing of the arms is directed backwards and down, the trunk is slightly bent forward.	When landing the student pushes his legs to the most forward position as possible so that the contact of the feet with the mattress moves closest to the parabolic of the flight. When touching the mattress the feet have to be in a parallel position.

Description of movement technique according to Lorenci (2003); Kinogramme: Čuk (2003); Drawing from Hausmann (1983).

Table 1. Instruction for assessment – the holistic method

Assessment Instructions – The Holistic Method	
Assessment method:	The evaluator assesses both performances in points from 0 to 5 according to the measures used for assessment (Table 1). After each performance he scores the motion according to deviation from the correct performance using scales from 0 to 5. A correct performance earns the highest number of points, and zero is awarded when the student does not do the exercise at all or the exercise is well out of line with the instructions. Performances deviating from the correct one are assessed by the evaluator using scales from 4 to 1 depending on expert knowledge and experiences. The number of points is then transferred to the mark as shown in Table 2.

		Points	**Descriptive**	
Measures for assessment (Table 1):		5	Correct performance.	
		4	Performance deviating from the correct one.	
		3	Performance deviating from the correct one.	
		2	Performance deviating from the correct one.	
		1	Incorrect performance.	
		0	No performance or not in line with the instructions.	

		MARK	**NUMBER OF POINTS**	
Assessment scales (Table 2):		1 insufficient)	0 and 1	
		2 (sufficient)	2	
		3 (good)	3	
		4 (very good)	4	
		5 (excellent)	5	

Notes for Evaluation List:	The evaluator assesses the motion with points (for the first and second performance) and puts the number of points in the table. Then he circles the best points and transforms them into the final mark in the indicated table window.

Evaluation list:	**Name and Surname**	**Performance**	**Comment on mark**	**No. of points**	**Final mark**
		1			
		2			

Table 2. Assessment instructions – ponderation (weight) method

Assessment instructions							
Assessment method	The evaluator assesses both performances using a score from 0 to 10. During each performance the motion is separated into individual phases of movement. According to its importance each phase has a certain number of maximum possible points a student can get. The evaluator assesses the separate phases of the movement according to his expert knowledge in line with the given measures (Table 1), where 0 means an incorrect performance, and the highest value (weight) in a certain phase of the movement means a correct performance. The total number of points for each phase of movement is transformed into a mark according to Table 2.						
Measures for assessing different weights:		**Measure of weight**	**Assessment profile**				
			Incorrect performance		Correct performance		
		1	0		1		
		2	0	1	2		
		3	0	1	2	3	
Assessment scales (according to Tomažin et al. 2001):		**MARK**	**SUM OF WEIGHTS (acquired number of points)**				
		1 (insufficient)	<3				
		2 (sufficient)	3-4				
		3 (good)	5-6				
		4 (very good)	7-8				
		5 (excellent)	9-10				
		FINAL MARK					
Notes for Evaluation List:	The evaluator circles points for each phase of the movement and puts down the total sum and the final number of points for the movement of the first and second repetitions in the evaluations list. The best marks are taken into consideration and used for the final mark.						

Evaluation list:	**Name and Surname:**								
Phase of movement	The highest number of points for the final mark (weight)	Performance 1				Performance 2			
		Incorrect performance		Correct performance		Incorrect performance		Correct performance	
1) Approach was correctly measured, fast and determined	2	0	1	2		0	1	2	
2) The last three strides are performed with an emphasised rhythm	2	0	1	2		0	1	2	
3) Take off is performed with one leg (take off)	3	0	1	2	3	0	1	2	3
4) Flight – before landing legs are kept in line and feet are extended	1	0		1		0		1	
5) Landing – is carried out on both legs	2	0	1	2		0	1	2	
TOTAL NUMBER OF POINTS									
FINAL MARK		1 (insufficient)	2 (sufficient)	3 (good)	4 (very good)	5 (excellent)			
		<3 points	3-4 points	5-6 points	7-8 points	9-10 points			

Evaluation scales are adapted after Mr. Tomažin et al. (2001).

Table 3. Assessment instructions – analytical method

Assessment instructions		
Assessment method	The evaluator assesses both performances using points from 0 to 5 according to the attached descriptives. Each performance is divided into separate phases of movement. Each phase has certain mistakes that are most common (see column »mistakes« in the performance of movement) which can appear during that phase of the performance. The evaluator assesses each phase of the movement according to the given scales.	
Points	Mistakes	Descriptives
5	No mistakes or a small mistake	The student performs the approach and long jump with full reliability, with no mistakes or only with one small mistake.
4	Several small mistakes	The student performs approach and long jump, but the performance is not entirely reliable. He makes several small mistakes.
3	One big mistake	The student has difficulties in the harmonisation of approach and take off; performance is not entirely reliable. During the performance he makes one big mistake.
2	One big and several small	The student has difficulties in harmonisation of the approach and take off. He performs the long jump without reliability. During the performance he makes one big and several small mistakes.
1	Big and small mistakes	The student has difficulties in harmonisation of the approach and take off. He performs the long jump without reliability. During the performance he makes big and small mistakes.
0	Does not perform or not in line with the instructions	The student does not perform the long jump. He runs past the take off board or runs across the take off board; he takes off with two legs.

Mistakes during performance of the movement	
1) Approach	
B	Excessive extending or shortening the last strides before the take off.
S	A too long or too short approach.
S	Incorrect rhythm of the approach (start is too fast, finish of the run is too slow, without adequate rhythm).
S	View is directed to the take off board.
2) Take off	
B	Takes over his heels.
B	Take off is not successful (insufficient stretching in jumping, knee and hip joints).
B	Double take off.
S	At take off the trunk leans excessively forward or backward.
S	View is directed upwards.
S	The swing with the swinging leg is not successful (stretched leg).
N	Student does not take off, but runs across the take off line or runs past it.
3) Flight	
B	Bend backwards is too big (spinning backwards).
B	Bend forwards is too large.
B	Legs are too low.
B	No preparation for landing (legs remain in lunge).
S	Non-synchronised work of hands and legs.
S	Matching of the take off leg with the swinging leg is too quick.
N	Wrong technique.
4) Landing	
B	Single leg landing.
B	Forward or backward fall on landing.
S	Insufficient lifting of legs.
S	Double leg landing into lunge.
B – big mistake; S – small mistake; N – not performed or non-synchronised with instructions.	

Notes for Evaluation List	The evaluator ads up the mistakes and puts them down in the window “total mistakes” for the first and second performances. Any better performance is noted and the points of the better performance are transformed into the final mark.

Evaluation list:					
Student’s number	Student’s mistakes		Mistakes total (write down)		Final mark
			Performance 1	Performance 2	
	B				
	S				
	N				

Measures for assessment are modified according to an assignment prepared by the National Examination Centre: Lorenci (2003).

Methods of elaborating data

The data were elaborated with the basic procedures of descriptive statistics, co-relational analysis (Cronbach's Alfa Coefficients) and the analysis of variance. We ran the SPSS statistics programme for Windows.

Results

Reliability of the assessment

The reliability of the test assignment for assessing motor skills was checked using Cronbach's alfa coefficient by which we examine the internal robustness of marks after several repetitions (Dežman and Kovač, 2002). To find out the reliability of the assessment of motor skills each of the three evaluators assessed the first 10 tested individuals (out of 193) twice within 30 days.

Table4. Reliability of assessment

		Basic Statistics – *first assessment*						**Basic Statistics** – *control assessment*					*Correlation between marks*										
		N	***min***	***max***	***AS***	***SD***		***N***	***min***	***max***	***AS***	***SD***		***O 1***	***KO 1***		***O 2***	***KO 2***		***O 3***	***KO 3***		***O P***	***KO P***
Holistic method	**E 1**	10	3.00	5.00	4.10	0.57	CO 1	10	2.00	4.00	3.60	0.70	**E 1**	1.000		**E 2**	1.000		**E 3**	1.000		**O P**	1.000	
	E 2	10	2.00	5.00	3.60	0.97	CO 2	10	2.00	5.00	3.20	0.92	**CO 1**	0.671	1.000	**CO 2**	0.725	1.000	**KO 3**	0.771	1.000	**CO P**	0.925	1.000
	E 3	10	2.00	5.00	3.60	0.84	CO 3	10	1.00	5.00	2.80	1.23												
	E P	10	2.67	4.67	3.76	0.58	CO P	10	2.00	4.67	3.20	0.81	**alpha**	0.793		**alpha**	0.840		**alpha**	0.837		**alpha**	0.934	
weight method	**E 1**	10	2.00	5.00	3.70	0.67	CO 1	10	2.00	5.00	3.40	0.97	**E 1**	1.000		**E 2**	1.000		**E3**	1.000		**A P**	1.000	
	E 2	10	1.00	4.00	3.40	0.70	CO 2	10	2.00	4.00	3.30	0.67	**E 1**	0.374	1.000	**CO 2**	0.894	1.000	**CO 3**	0.484	1.000	**CO P**	0.783	1.000
	E 3	10	1.00	5.00	3.80	0.92	CO 3	10	3.00	5.00	4.40	0.70												
	E P	10	2.33	4.67	3.63	0.65	CO P	10	2.67	4.33	3.70	0.55	**alpha**	0.520		**alpha**	0.944		**alpha**	0.636		**alpha**	0.871	
analytical method	**E 1**	10	1.00	4.00	2.30	0.95	CO 1	10	1.00	4.00	2.70	0.95	**E 1**	1.000		**E 2**	1.000		**E3**	1.000		**A P**	1.000	
	E 2	10	1.00	5.00	3.40	1.17	CO 2	10	2.00	5.00	3.40	0.84	**CO 1**	0.485	1.000	**CO 2**	0.830	1.000	**CO 3**	0.731	1.000	**CO P**	0.868	1.000
	E 3	10	1.00	4.00	3.10	0.88	CO 3	10	1.00	5.00	3.10	1.20												
	E P	10	1.00	4.00	2.93	0.84	CO P	10	2.00	4.33	3.06	0.78	**alpha**	0.650		**alpha**	0.881		**alpha**	0.821		**alpha**	0.928	

Legend: E 1 - first evaluator; E 2 – second evaluator; E 3 – third evaluator; A P – average of all three evaluators; CO 1 – first evaluator – control second evaluation ; CO 2 – second evaluator - control (second) evaluation; CO 3 – third evaluator - control (second) evaluation; CO A – average of all three evaluators - control (second) evaluation.

The analysis (table 4) shows that the holistic method of assessment is the most reliable since the Cronbach's alfa coefficient was biggest for the average mark of the three evaluators (0.934); the analytical method is less reliable (0.928) while the least reliable way is the ponderation (weight) method (0.871).

Objectivity of assessment

The objectivity of the assessment was examined with Cronbach's alfa coefficient which is used to measure compatibility between the marks of single evaluators and the common object of assessment (the first main component of all three evaluators) (Dežman and Kovač, 2002). The analysis shows that for the objectivity of the assessment of the average mark of the three evaluators Cronbach's alpha coefficients are relatively equal in the holistic (alpha: 0.809) and ponderation (weight) methods (alpha: 0.811). The analytical method, where the alpha coefficient is the biggest (0.836), is partly declining.

Table 5. Objectivity of assessment

		Basic Statistics						**Correlation between evaluators and K1**					**Cumulative**
		min	**Max**	**AS**	**SN**	**SD**			**Mark 1**	**Mark 2**	**Mark 3**	**K 1**	
Holistic method	**E 1**	1.00	5.00	2.93	1.24	8.89		**E 1**	1.000	0.514	0.599	0.819	0.670
	E 2	1.00	5.00	2.36	1.20	8.64		**E 2**	0.514	1.000	0.661	0.851	0.725
	E 3	1.00	5.00	2.46	1.27	9.15		**E 3**	0.599	0.661	1.000	0.889	0.790
	Total	1.00	5.00	2.58	1.26	5.23		**K1**	lambda	cum %		alpha	
								1	2.184	72.814		0.809	
Weight method	**E 1**	1.00	5.00	4.17	0.91	6.52		**E 1**	1.000	0.547	0.550	0.809	0.655
	E 2	1.00	5.00	2.95	0.92	6.64		**E 2**	0.547	1.000	0.678	0.874	0.764
	E 3	1.00	5.00	3.30	1.06	7.61		**E 3**	0.55	0.678	1.000	0.875	0.766
	Total	1.00	5.00	3.47	1.09	4.54		**K1**	lambda	cum %		alpha	
								1	2.397	79.899		0.811	
Analytical method	**E 1**	1.00	5.00	2.47	0.97	7.01		**E 1**	1.000	0.603	0.635	0.853	0.728
	E 2	1.00	5.00	3.13	0.85	6.11		**E 2**	0.603	1.000	0.676	0.873	0.762
	E 3	1.00	5.00	3.43	1.07	7.69		**E 3**	0.635	0.676	1.000	0.887	0.786
	Total	1.00	5.00	3.01	1.05	4.35		**K1**	lambda	cum %		alpha	
								1	2.276	75.877		0.836	

Legend: E 1 – first evaluator; E 2 – second evaluator; E 3 – third evaluator; A P – average of all evaluators

Analysis of differences between holistic, ponderation (weight) and analytical assessment methods

Differences in the average marks of the three evaluators acquired while implementing the holistic, ponderation (weight) and analytical methods of assessing were examined by an analysis of variance.

Table 6. Analysis of variance between holistic, ponderation (weight) and analytical assessment methods

	Method of assessment	Basic Statistics			Test of variance homogeneity			Analysis of variance		
		N	min	max	median	SD	F	Sig.	F	Sig.
holistic/ analytical method	holistic	193	1.00	5.00	3.75	0.79				
	analytical	193	1.00	5.00	3.01	0.84				
	total	386	1.00	5.00	3.38	0.89	0.215	0.643	79.325	0.000
holistic/ weight method	holistic	193	1.00	5.00	3.75	0.79				
	weight	193	1.00	5.00	3.47	0.82				
	total	386	1.00	5.00	3.61	0.82	0.388	0.534	11.494	0.001
weight/ analytical method	weight	193	1.00	5.00	3.47	0.82				
	analytical	193	1.00	5.00	3.01	0.84				
	total	386	1.00	5.00	3.24	0.86	0.017	0.896	29.701	0.000

We found (table 5) statistically significant differences among marks obtained in the holistic, ponderation (weight) and analytical assessment methods. The arithmetic median of marks was highest with the holistic method of assessing (3.75), lower for the ponderation (weight) method (3.47) and the lowest for the analytical method of assessing (3.01). This reveals that the marks were highest with the holistic method of assessing (being the most commonly used in school practice). We can therefore assume that the criteria for assessment were satisfied slightly more easily when a teacher was not concentrated on mistakes. On the contrary, the criteria for the ponderation (weight) and holistic methods were more strict and severe as they are based on identifying the mistakes.

Discussion and conclusion

We found that the testing assignment for the evaluation of a long jump with approach (step and a half technique) from the point of view of measurement characteristics (validity, objectiveness, reliability, efficiency aspect) is adequate for assessing motor skills with all three assessment methods. The analysis proves that due to its more adequate measures, which are enough open and flexible yet still efficient enough and at the same time more reasonable from the efficiency aspect, the holistic method seems more convenient. These findings are in line with those of other scientists (Kovač, Jurak and Strel, 2003; Majerič, 2004). Despite this, the examined measurement characteristics are also adequate for the ponderation (weight) and analytical methods of assessing. This shows that, in conformity with teachers' autonomy, it is mostly up to them to decide on the assessment method they will use – but it is important that they adjust it to the level of the students' knowledge.

The analysis of the arithmetic median values shows that the criteria for assessment were more easily satisfied with the holistic and ponderation (weight) assessment methods and were a lot more severe in the analytical method of assessment. Hence we can assume that the holistic and ponderation (weight) methods of assessment are most appropriate for evaluating knowledge in the phase of training and checking; and the analytical method is most appropriate for testing and evaluating at the end of the entire athletics programme when students have already mastered the long jump and their knowledge has already been tested.

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THE CHANGES IN SOME MOTOR ABILITIES IN 7-YEAR OLD BOYS FOLLOWING JUDO TREATMENT

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Abstract

In here presented paper, author's defined influence of the judo-treatment in the 7-year old boys. The sample of subjects was divided in the experimental (E;N=41), and control group (C;N=57). Both groups participated in regular physical education classes. E group performed additional nine-month-judo treatment. There were no significant differences between E and C in the initial measurement. Discriminant analysis and analysis of the variance revealed significant differences in improvement of the motor abilities between two examined groups. Since E group finally performed significantly better in the agility, repetitive strength and flexibility, authors are of opinion that the judo can be considered as a valuable and highly effective physical activity in 7-year-old boys.

Key words: *children, sport, development*

Introduction

In different science-disciplines a numerous experiments are performed, aimed on precise definition of the complex problems of human organism functioning and development.

In field of kinesiology, a special interest is focused on the interrelations and influence of the different sport-activities on some human abilities and characteristics. It is especially attributed on motor-abilities, because of their unalterable value in motor-learning processes.

In the present paper we analyzed 7-year old boys, the sample which is exceptionally interesting because of the unstable motor-development. If genetic factors are excluded, there are still several effective-elements (like nutrition, socio-economic status and physical activity) that can be effectively used as potential growth and development factory in 7-year old children. From the kinesiological point of view, the physical activity is most interesting, mainly because of the a) there is no doubt that physical activity positively and effectively influence on growth and development, and b) the intensity and type of the physical activity is relatively easy to modified (Malina R. M., C. Bouchard. 1991).

Different authors and experts define judo as sport, (and/or) self-defense, (and/or) physical-activity-type, even as - a life-philosophy, but there is no doubt about it's positive influence on different anthropological dimensions in the active (professional) athletes (all according to Žara 1980). However, there is obvious lack of information concerning possible influence of the judo treatment on the motor-status in the novice judo athletes. Therefore, the aim of the present study was the evaluation of the 9-month judo-treatment on some motor abilities in 7-year-old boys.

Methods

The sample of the subjects was consisted of 98 first-grade-boys (mean age 7.2 ± 0.5 years), divided in the experimental (E: N = 41, all novice judo-athletes), and control group (C: N = 57, all non-athletes). Both groups participated in the physical education classes (3 x 45 min a week), but experimental group performed judo-school-training (3 x 45 min a week) also. The only criteria used in the judo-school-selection were a) interest and b) clinical and motor health.

To establish basic motor dimensions, 12 standard motor-tests were used (Krstulović, S. 2004.) measuring flexibility (S&R – sit and reach; ShD – shoulder dislocation), coordination (SA – steps aside; POL – polygon backwards), frequency of simple movements (HT – hand tapping; FT – foot taping), aerobic endurance (F3′ - 3 minutes dash), explosive strength (BJ – standing broad jump; BT – ball throwing), static strength (HANG – both arm hang), repetitive strength (SIT-UP – situ-ups) and speed (M20 – 20 meters dash).

Judo-training-program was generally divided in two parts. The first part was consisted of simple judo-elements (Postures, grips, movements, falls, throws and pinning techniques). The second part was consisted of official physical-education themes for the first-graders, we considered most relevant for the sampled subjects.

Descriptive statistical parameters (means, standard deviation) were analyzed in both groups (E and C). Discriminative canonical analysis was used for the purpose of establishing differences between E and C group, separately in the initial as well as in the final measurement. Univariate analysis of the variance ($ANOVA_{DIFF}$) was calculated for the variables of the initial-final differences, between the analyzed groups (C and E).

Statstoft's Statistica (ver 5.0) was used in all statistical procedures.

Results

Table 1. Descriptive statistics (M – mean; SD – standard deviation), $ANOVA_{DIFF}$ (M_{DIFF} - differences between final and initial measurement; F test)

	EXPERIMENTAL				CONTROL				$ANOVA_{DIFF}$		
VARS	INITIAL		FINAL		INITIAL		FINAL		M_{DIFF} C	M_{DIFF} E	F-test
	M	SD	M	SD	M	SD	M	SD			
S&R (cm)	34.25	7.35	45.76	8.44	36.18	8.8	41.25	7.37	5.06	11.50	14.42[b]
ShD(cm)[#]	54.68	8.15	49.93	9.38	54.27	8.03	49.34	6.42	-4.93	-4.76	0.02
POL(s)[#]	17.15	3.19	15.67	3.38	18.02	2.86	16.11	3.14	-1.91	-1.48	1.12
S-A(s)[#]	14.11	1.45	12.84	1.19	14.19	1.77	13.94	2.02	-0.25	-1.28	31.97[b]
BJ(cm)	116.95	13.16	133.58	15.71	121.06	17.31	132.24	15.43	11.18	16.63	2.56
BT(m)	9.39	2.46	11.49	3.15	10.35	3.36	12.68	3.56	2.33	2.10	0.15
HT(f)	18.12	2.48	20.46	2.28	18.8	2.08	21.1	1.72	2.30	2.33	0.00
FT(f)	26.28	3.06	29.81	2.61	25.64	1.46	28.58	1.67	2.94	3.53	1.38
SIT-UP(f)	23.59	6.1	30.73	6.31	22.63	7.69	27.07	6.02	4.44	7.15	6.96[b]
HANG(s)	13.62	11.94	23.38	13.78	12.51	7.86	17.87	11.31	5.37	9.76	2.94
M20(s)[#]	4.84	0.36	4.51	0.27	4.89	0.44	4.53	0.29	-0.36	-0.33	0.19
F3(m)	503.15	39.94	523.49	54.11	495.96	65.81	513.4	70.39	17.44	20.34	0.30

[a]$p < 0.05$, [b]$p < 0.01$, [#]reversely scaled variables

Table 2. Discriminant analysis results in the initial and final measurement (DF – structure of the discriminant root; Can R – canonical correlation coefficient

VARS	INITIAL			FINAL		
	C (M ± SD)	E (M ± SD)	DF	C (M ± SD)	E (M ± SD)	DF
S&R (cm)	36.18±8.80	34.25±7.35	0.25	41.25±7.37	45.76±8.44	-0.37
ShD(cm)[#]	54.27±8.03	54.68±8.15	-0.05	49.34±6.42	49.93±9.38	-0.05
POL(s)[#]	18.02±2.86	17.15±3.19	0.31	16.11±3.14	15.67±3.38	0.09
S-A(s)[#]	14.19±1.77	14.11±1.45	0.05	13.94±2.02	12.84±1.19	0.41
BJ(cm)	121.06±17.31	116.95±13.16	0.28	132.24±15.43	133.58±15.71	-0.05
BT(m)	10.35±3.36	9.39±2.46	0.34	12.68±3.56	11.49±3.15	0.22
HT(f)	18.80±2.08	18.12±2.48	0.32	21.10±1.72	20.46±2.28	0.21
FT(f)	25.64±1.46	26.28±3.06	-0.30	28.58±1.67	29.81±2.61	-0.37
SIT-UP(f)	22.63±7.69	23.59±6.10	-0.14	27.07±6.02	30.73±6.31	-0.38
HANG(s)	12.51±7.86	13.62±11.94	-0.12	17.87±11.31	23.38±13.78	-0.28
M20(s)[#]	4.89±0.44	4.84±0.36	-0.14	4.53±0.29	4.51±0.27	-0.10
F3(m)	495.96±65.81	503.15±39.94	0.14	513.40±70.39	523.49±54.11	0.06
Centroid	0.39	-0.54		0.65	-0.91	
CanR			0.42			0.61[b]

[b]$p < 0.01$, [#]reversely scaled variables

In the table 1, in both groups, improvement in all measured variables is observable, bearing in mind that in some variables improvement is obvious as numerical increase in results, and in reversely scaled - as numerical increase (see legend).

Discriminant analysis (table 2) revealed no significant differences between the groups in the initial measurement. However, in the final measurement, discriminant root reached satisfying level of the significance ($CanR = 0.61$; $p < 0.01$). Centroid positioning defines E group as dominant in most of the analyzed variables, mostly in frequency of the simple movements, static and repetitive strength, agility – coordination and speed. $ANOVA_{DIFF}$ calculation defined significant differences between C and E group in flexibility, agility and repetitive strength. From the M_{DIFF} values we can conclude that E group achieved more superior improvement in these variables than C group.

Discussion

From our point of view, there are several possible reasons for the superior motor-improvement in the E group, comparing to the C group. The basis of the changes and improvements can be explained particularly for the motor-abilities:

- Flexibility (Sit and reach test) - it is proven that the flexibility is highly trainable ability (after Krstulović 2004). Furthermore, one of the priorities of the judo treatment performed in the E group was - development of the flexibility.
- Agility / coordination (Steps aside test) – previous researches confirm the predictive value of the coordination in judo-sport, especially in young-athletes. Even more, previous results verified the effectiveness of the judo-treatment in the development of the coordination (all according to Sertić 1994). Therefore, we could expect the results we established in here presented study.
- Repetitive strength (Sit-ups) – Besides already clarified coordination-importance, repetitive strength is considered as one of the most important judo-success-factors (Sertić and Vuleta 1997.). Different games of the combat – character, adequate to age, performed in the ground and/or standing-position in every training-session. Furthermore, various special – exercises (performed individually and/or in pairs), were directly aimed on the improvement in the strength dimensions. Since the repetitive strength is highly trainable (after Krstulović 2004) the established improvement in strength does not surprise us.

Generally, it can be concluded that nine-month judo training process contributed to improvement in motor-abilities in 7-year-old boys. It especially emphasizes in the agility (coordination), repetitive strength and flexibility. Here presented results identify the judo-sport-participation as effective and highly-valuable physical activity for 7-year-old boys.

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INVOLVEMENT OF PRIMARY SCHOOL HIGHER GRADE PUPILS IN EXTRACURRICULAR AND OUT-OF-SCHOOL SPORT ACTIVITIES*

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Summary

In this project the figures got in a survey which was carried out on a selected sample were analyzed. The sample was combined of 181 primary school pupils, from 5th until 8th grade. The main goal was to research the involvement of pupils in extracurricular and out-of-school activities (Table 6), as well as the importance of parents` influence on their activation (Table 4). Using the Analysis of Variance (ANOVA) in Statistica programme, the obtained figures gave us the insight in basic statistic parameters and the importance of difference among active and inactive pupils (Table 3). Data processing showed us that in this sample the number of pupils involved in different sporting activities was almost the same as the number of inactive students. The analysis also showed that the number of active male pupils is higher compared to the number of female pupils. It has also been found (Table 7) that there is significantly smaller number of schoolboys, compared to schoolgirls, who are temporarily excused from physical education. Analysis has also showed the significance of parents` social status, especially mother's education and her personal involment in sports as one of the important factors for higher involvement of children in different sport sections.

Key words: *pupils, sporting activities, extracurricular activities, out-of-school activities, parents.*

Introduction

Modern ways of life, together with technique and technology developments, computer science, communication, have significantly made man's life and work easier, but at the same time they have restricted his basic biotic need connected to personal activation and motion. Consequences are especially shown in the decline of psychophysical abilities, and they are evident in the growth of chronicle illness which is indirectly and directly connected to hypokinesia. Such disorders and decline in psychophysical abilities are even more dramatic if they occur during childhood, when the activity is crucial for growth and development. Negative consequences are especially observable on functional and motoric abilities. Cardio-vascular diseases are number one mortality agents of people in developed countries. Compared to other diseases which cause death their share is over 50%. In our country this figures are almost the same, but with the difference that in developed countries significant funds are invested and different actions are undertaken for health prevention through adequate physical activity programmes. Our researches say that early health prevention through physical activities should start as soon as possible (Mraković, Findak and Metikoš, 1992), and that psycho physiological abilities of today's pupils are drastically declining in comparison to the results of ten years ago. Searching for the causes of this we should emphasize the lack of physical activity in the first place. Causes for this can be found among many factors, and the most observable one is modern technology, which makes children spend large part of their daily activities sitting at computers and TV programmes, and writing homework. On the other hand, children living in towns have limited area for movement in their housings, as well as in the neighborhood where they could play freely, because there is less free area which is now mostly taken by cars. For most of the organized sporting activities, parents should have the time and money, and their finances are on the average low and limited. During regular physical education in school, children's organism is not activated enough and the total number of periods does not satisfy objective needs. All of this and other similar factors cause in children, in the earliest age, health problems, which interfere with natural child's growth until it reaches its optimal level. There are more obese children, children with posture problems, children who have flat feet, and some psychosomatic diseases. (Kosinac, 1998) If we know that a pre-school child in average walks 7 kilometers a week, and that movement radius is significantly declining as the child grows and the increase of his obligations, than it is certain that the strategies for preserving psychosomatic abilities, and by that the child's health itself, should develop in the direction of increasing child's daily physical activities. Sporting and recreational activities must enclose all children, through sport clubs, associations or organizations, since the school programme can not satisfy optimal children's needs for physical activity. The activity programme needs to be adjusted to optimal needs of growing children and it should include all methodological units appropriate for that age, which will encourage regular psycho physiological development and create the habit among children for doing exercise. It can be achieved through mutual cooperation of parents, teachers, and professionals in sport organizations. Child's affirmation does not need to be accomplished through result only, but also through participation, socialization, games and other forms which can get children interested and motivate them to

* *Young researcher award*

stay active. Numerous researches proved that regular sporting activities have the basic role in development and reaching optimal level of the general anthropological child's status, and creating better preconditions for maintaining higher level of basic components of health status.

The aim of this survey was to determine the involvement of school children, from fifth until eighth grades of a primary school in Karlovac, in extracurricular and out-of-school sporting activities. Analyzing the results of a questionnaire, parent's influence on children's involvement in regular sport programmes outside teaching procedure, was researched (Bosnar, 2003.).

Research methods

The research was conducted on a sample of 181 pupils from fifth until eighth grades in "Braća Seljan" primary school in Karlovac. Questionnaires which were filled in by pupils gave us the insight into the structure and number of students according to sex, age and class. The sample was made of: 73 fifth grade pupils, 53 sixth grade pupils, 65 seventh grade pupils and 71 eighth grade pupils. The total sample included 89 schoolgirls and 92 schoolboys.

Variable sample was divided in several groups, and besides the general parameters as age and sex, the results of anthropometric parameters of body weight and height, as well as school success were obtained. A group of questions was connected to pupils' answers on taking part in sporting activities outside the curriculum and on the number of "temporary excused" from physical education in school. I also looked into the connection between parents' attitudes and habits on sporting activities, as well as their education, and their children's involvement in extracurricular sporting activities.

The information gathered through questionnaires was analyzed by ANOVA in Statistica programme. We also got the basic statistic parameters which gave us the insight on frequency, maximal and minimal result, arithmetic average, and the magnitude and importance of deviations.

Results and discussion

Analysis of obtained figures (Table 1) showed that of 181 pupils in total, of which 89 are schoolgirls and 92 schoolboys, 93 pupils (both male and female) take active part in extracurricular sporting activities, weather in sport clubs or in school sport sections. At the same time 88 pupils in total are not taking part in any organized sport activity during the time outside regular classes. In the total sample from fifth until eight grades in group of pupils who are active in extracurricular activities there are 64.1% of schoolboys and 51.4 % active schoolgirls. Already we can notice significant inactivity of schoolboys and it ranges 35.9%, and it is even more expressed among schoolgirls and it ranges 48.6%. It is interesting to follow the trend of activation and giving up sport activities in comparison to age, and the class they are attending. (Table 2) The trend of relinquishing activation is significant between fifth and sixth grades, meaning they give up sport in sixth grade. We can observe that the total number of inactive students in the fifth grade is 38.6% (of which 18.8% inactive schoolboys and 59.1% of inactive schoolgirls), while in the sixth grade

Table 1: Percentage of pupils according to criteria: active - inactive

	M	F	Total
Active	59 64.1%	34 38.2%	93 51.4%
Inactive	33 35.9%	55 61.8%	88 48.6%
Total	**92**	**89**	**181**

Table 2: Percentage of active and inactive pupils according to classes

	M_5	F_5	$Total_5$	M_6	F_6	$Total_6$
Active	18 81.2%	9 40.1%	27 61.4%	13 61.9%	4 16.7%	17 37.8%
Inactive	4 18.8%	13 59.1%	17 38.6%	8 38.1%	20 83.3%	28 62.2%
Total	**22**	**22**	**44**	**21**	**24**	**45**
	M_7	F_7	$Total_7$	M_8	F_8	$Total_8$
Active	12 66.7%	8 50.0%	20 71.4%	16 51.6%	13 48.1%	29 50.0%
Inactive	6 33.3%	8 50.0%	14 50.0%	15 48.4%	14 51.9%	29 50.0%
Total	**14**	**14**	**28**	**31**	**27**	**58**

Table 3: Difference between active and inactive pupils (ANOVA)

	Active children					Inactive children						
Variables	n	AS	Min	Max	SD	n	AS	Min	Max	SD	F	p
SUCESS	91	4.38	2	5	.68	86	4.44	2	5	.70	.31	.581
CLASS	93	6.55	5	8	1.21	88	6.63	5	8	1.14	.19	.662
ROD_M_6	91	100.14	100	101	.35	78	100.01	100	101	.11	9.78	.002
ROD_T_6	89	100.30	100	102	.49	75	100.11	100	101	.31	9.13	.003
SP_M_8	92	3.48	2	5	1.02	87	3.26	1	5	.80	2.42	.122
SP_T_8	86	3.80	2	5	1.00	84	3.44	2	5	.91	606	.015
TV_11	93	100.03	100	101	.18	87	100.09	100	101	.29	2.80	.096
SATI_12	76	3.06	1	6	1.31	68	2.84	1	8	1.46	.91	.342
TZK_13	92	100.00	100	100	0.00	88	100.05	100	104	.43	1.05	.308
OC_TZK_1	93	4.69	1	5	.72	88	4.60	1	5	.77	.60	.438

the total share of inactive pupils is 62%, out of which 38% are schoolboys and 83% are schoolgirls. In comparison there is a greater share of active pupils in seventh grades, where the total of active pupils amounts to 71%, and inactive 39.6%. In eighth grades a decline of active students reappears and there are 50% of total active and 50% of total inactive pupils. The results show the trend of declining activation and almost two times more inactive schoolgirls compared to schoolboys. In this sample it is especially shown among sixth graders where 83.3% of schoolgirls are not involved in any kind of sport activity whatsoever outside the curriculum. Sudden decline in number among active schoolgirls is noticeable which can be a consequence of the lack of interest for existing sporting activities but also puberty, which, among schoolgirls, starts at this age, has the influence on abundance of different interests which appear at that age. Among schoolboys, a continuous trend in declining sport activation is noticeable, which can mean that the activity programmes are not attractive enough to keep continuous interest for doing these activities.

Table 4: Percentage of inactive and active pupils' parents who are doing sport

	Active children				Inactive children			
Variable	F_{da}	$\%_{da}$	F_{ne}	$\%_{ne}$	F_{da}	$\%_{da}$	F_{ne}	$\%_{ne}$
ROD_M_6	13	14.0	78	83.9	1	11.0	77	87.5
ROD_T_6	25	26.9	64	68.8	8	9.1	67	76.1
		N=93				N=88		

Pupils who have not responded: Act: Missing 2 (2.2%), 4 (4.3%)
Inact: Missing 10 (11.4%), 13 (14.8%)

Table 5: Average of parents' education level (M-mum, D-dad) of active and inactive pupils

	Active children				Inactive children			
Variable	F_M	$\%_M$	F_D	$\%_D$	F_M	$\%_M$	F_D	$\%_D$
A)	0	0.0	0	0.0	1	1.1	0	0.0
B)	13	14.0	5	5.4	8	9.1	8	9.1
C)	45	48.4	38	40.9	53	60.2	47	53.4
D)	11	11.8	12	12.9	17	19.3	13	14.8
E)	23	24.7	31	33.3	8	9.1	16	18.2
MISSING	1	1.1	7	7.5	1	1.1	4	4.5

Table 6: Percentage of pupils according to criteria: involved in a sporting activity in a sport club or a school sport club

	M	F	Total
Sport club	52 88.1%	26 76.5%	78 83.9%
School sport club	7 11.9%	8 23.5%	15 16.1%
Total	**59**	**34**	**93**

Table 7: Percentage of pupils who are temporary excused from PE

	F	%
Boys	3	3,3
Girls	10	11.2
Total	13	13.7

Conclusion

Regular physical activity is necessary factor for child's regular growth. The required curriculum for physical education in schools does not have enough influence for maintaining and improving the psychophysical abilities of pupils. Compensation for child's activation is possible in extracurricular and out-of-school programmes, which give qualitative and quantitative satisfaction for child's needs. That is why in this research pupils' activation in their free time and possible parents' influence on their engagement was looked into. Results obtained through questionnaire, on a sample of 181 pupils, indicated the inadequate children's activation in sports, and this negative trend was increasing considering the age of the respondents, meaning the activation itself, as well as the interest were declining as the children were growing older. The questionnaire showed that a large number of schoolgirls are not involved in any extracurricular sporting activity which can tell us about many problems and crises in society, such as economic, social, culture, educational and similar. There is no excuse for such a state and society should be concerned about its future. Parent's influence is extremely important in children's activation, but not everybody can afford any of the programmes of sport recreation, but the results say that active parents have active children. It is certain that our society should find an optimal model which will enable everyone to do sports and which will at first help children's many-sided development and preserve their health.

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GENDER AND AGE IN SPORT INFORMATION ACQUISITION

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Abstract

The development of sport related symbolic knowledge acquisition was researched on the sample of 318 urban elementary school pupils, boys and girls aged 10 to 15 years. The subjects were given 40-items paper-and-pencil knowledge test concerning history, official rules, organisation, competitions and competitors, etc., of soccer, volleyball, handball and basketball. The analysis of variance was done with gender and age as independent variables. The results show that both, as well as interaction of gender and age, have significant effect on knowledge acquisition. The results are not simple, and do not follow usual gender stereotypes. Female students are better informed in volleyball in all grades, exceed male result in soccer in 8th grade, and are almost equal with boys in basketball in the 8th grade. It seams that with age, girls achieve more sport related symbolic knowledge than boys, specially in most popular sports.

Key words: *elementary school students, soccer, volleyball, handball, basketball*

Introduction

Gender differences in the amount and content of specific knowledge are mainly the product of gender stereotyping and different expectations that societies put before males and females (Vizek-Vidović at al., 2003). Sport was traditionally male activity (Oglesby and Hill, 1993) and girls are often discouraged to participate in it (Plaisted, 1995). Gender differences could be found not only in the level of motor activity and sport performance (Thomas Thomas et al., 2001) but in attitudes and symbolic knowledge about sport (Busch et al., 2002). The directive hypothesis could be proposed that elementary school boys have more symbolic knowledge about popular sports and that the difference is apparent at various age levels. The aim of this work is to verify gender differences in sport-specific knowledge in four different sports and in four age categories.

Methods

The sample of this study consists of 156 female and 162 male elementary school students. The research included all 5th to 8th grade students from an urban school who attended classes of physical education in the week of measurement. The students were given the paper-and-pencil knowledge test having 40 choice-response questions about history, official rules, organisation, competitions and competitors, etc., of soccer, volleyball, handball and basketball. Each sport was represented by 10 questions forming four subscales of test. The total result in each scale was calculated as the sum of correct answers. The analysis of variance was done. Independent variables were gender and grade and dependent variables were four total results in soccer, handball, volleyball and basketball-related symbolic knowledge scales.

Results and discussion

Table 1. Means (M) and standard deviations (SD) of results on knowledge about soccer scale, knowledge about handball scale, knowledge about volleyball scale, and knowledge about basketball scale in male (M) and female (F) elementary school pupils.

grade	gender	soccer		handball		volleyball		Basketball		n
		M	SD	M	SD	M	SD	M	SD	
5	M	5.318	1.443	4.432	1.301	3.023	1.089	4.818	1.808	44
5	F	4.178	1.497	4.556	1.501	3.489	1.325	3.556	1.816	45
6	M	5.057	1.589	4.486	1.704	3.229	1.190	5.486	2.356	35
6	F	5.485	1.395	4.242	1.542	4.000	1.521	3.606	1.731	33
7	M	6.098	1.446	4.780	1.423	3.683	1.150	4.878	2.100	41
7	F	5.586	1.240	3.828	1.167	4.207	1.292	4.172	1.513	29
8	M	5.485	1.845	4.929	1.552	3.571	1.438	5.524	1.714	42
8	F	6.098	1.721	4.612	.953	3.857	1.399	5.469	1.697	49
total		5.528	1.686	4.519	1.416	3.607	1.338	4.730	1.991	318

In the Table 1 there are means, standard deviations and number of subjects in each gender and grade group, and in total of 318 subjects of the results in soccer, handball, volleyball and basketball scale. The average number of correct answers in total sample is highest for soccer, five and the half. The lowest value is really small, 3.6 in volleyball scale. The mean values follow

Table 2. The results of analysis of variance: summary of all effects. Wilks' lambda (L), degrees of freedom (df), the level of significance (p) on soccer, volleyball, handball and basketball related symbolic knowledge scale.

FACTOR	L	df 1	df 2	p
grade	.813569	12	812	.000000
gender	.885321	4	307	.000000
Interaction grade*gender	.884498	12	812	.000158

ranges of popularity of these team sports in our society. The analysis of variance (Table 2) show that both, gender and grade, as well as interaction of gender and age, have significant effect on knowledge acquisition. As is seen from Table 1 as well as from Figure 1, the "grade" as the main effect has almost linearly ascending results only in soccer. Soccer is the most popular sport in our society and news about it take greatest amount of space and time in media. Children are daily exposed to information about soccer. The other sports do not have the same treatment in media. They can exceed the same attention as soccer only when some important event is going on, like Olympic games or world championship, and our national team have the chance for medal. The permanent exposure to soccer information could explain almost uniform increase in children soccer knowledge.

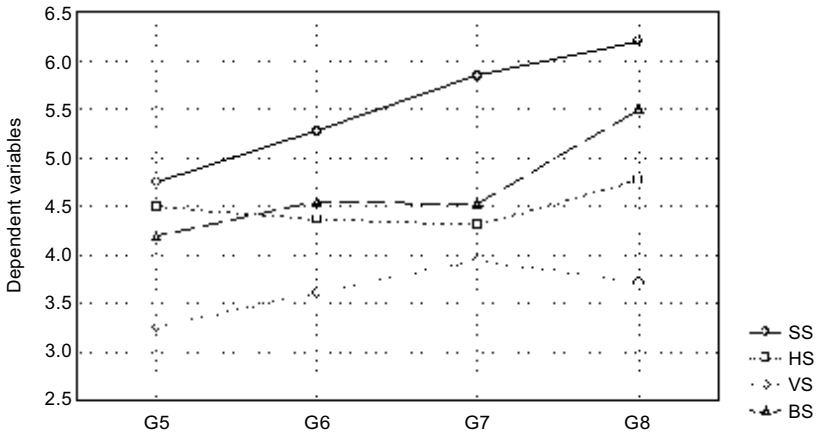

Figure 1. Plot of means for the main effect "grade" (G). SS denotes soccer scale, HS denotes handball scale, VS denotes volleyball scale and BS denotes basketball scale.

Results of the analysis of main effect "gender" (Table 1, Figure 2) only partially confirm hypothesis that elementary school boys have more symbolic knowledge about sports. Male students are better in knowing basketball and handball, and only slightly better in soccer. No difference in soccer knowledge could be explained by high exposure to soccer information in both, males and females. Girls are clearly better in knowing volleyball. It was found that interest in volleyball in our population of elementary school children is much stronger in girls than in boys (Bosnar, 2000), and they more often play volleyball as non-obligatory school sport.

The plot of means for the interaction of gender and grade is in Figure 3. The increment in knowledge with grade is seen in soccer and basketball for girls and in soccer, volleyball and handball in boys. The increment is more visible for girls, and it seams that with age they achieve more sport specific knowledge than boys.

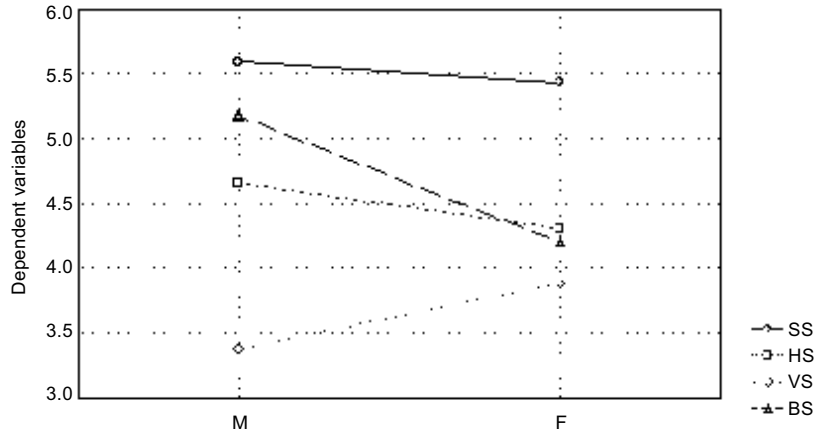

Figure 2. Plot of means for the main effect "gender". M is for males and F is for females. SS denotes soccer scale, HS denotes handball scale, VS denotes volleyball scale and BS denotes basketball scale.

Table 3. The results of univariate analyses of variance: F-values (F), degrees of freedom (df), the levels of significance (p-level)

	Factor	df 1	df 2	F	p-level
soccer	grade	3	310	14.67481	.000000
	gender	1	310	.82145	.365460
	Interaction grade*gender	3	310	5.81202	.000710
handball	grade	3	310	1.779751	.150953
	gender	1	310	4.750362	.030044
	Interaction grade*gender	3	310	1.916426	.126836
volleyball	grade	3	310	3.86619	.009725
	gender	1	310	11.88582	.000644
	Interaction grade*gender	3	310	.45392	.714710
basketball	grade	3	310	8.16165	.000030
	gender	1	310	21.33264	.000006
	Interaction grade*gender	3	310	3.47562	.016391

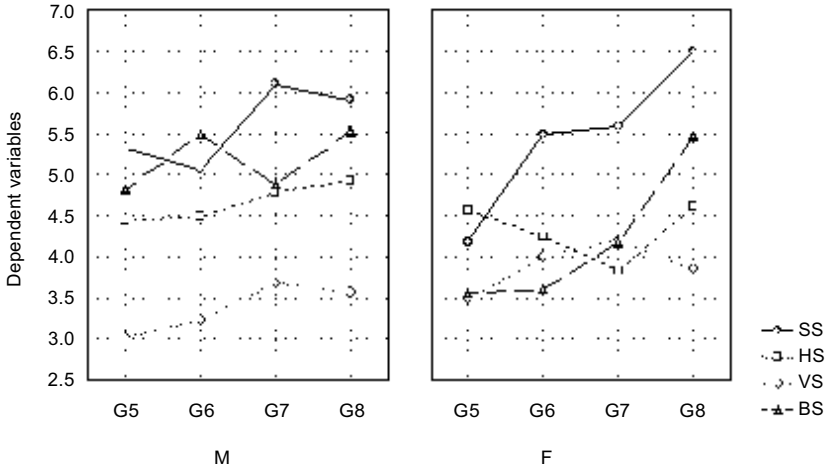

Figure 3. Plot of means for the "gender" and "grade" (G) interaction. M is for males and F is for females. SS denotes soccer scale, HS denotes handball scale, VS denotes volleyball scale and BS denotes basketball scale.

The results show that gender and age effects in acquisition of sport related knowledge are not simple, and do not follow usual gender stereotypes.

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COMBINING ELITE SPORTS AND EDUCATION IN SLOVENIAN SECONDARY SCHOOLS

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Abstract

A sample of 86 potentially successful secondary school sportspeople was analysed to examine how they coordinate their academic and sporting commitments. Data, collected with a questionnaire, were analysed using discriminant analysis, t-tests for independent samples and relevant correlation coefficients. The pre-announcement of oral exam dates and the tolerance of frequent absence from the academic process are some of the systematic solutions that are most commonly used in schools. A high proportion of secondary school sportspeople does not use any organised special learning assistance, supplementary learning materials or the distance learning via Internet to fulfil their academic commitments, even when they available. Organisationally speaking, the most efficient ways to coordinate academic and sporting obligations are offered in special sports classes in gymnasiums.

Key words: *academic opportunities, talented sportspeople, coordination of obligations, school results, absence from the school*

Introduction

Various models for co-ordinating academic and sporting obligations have been introduced in Europe (Metsä-Tokila, 2002; Güllich, 2004) to improve young sportspeople's educational opportunities, guarantee a vocation and subsistence at the end of one's sports career and consequently reduce some of the anomalies of elite sport. Some countries (Poland, Czech Republic) start taking care of the talented sportspeople at the beginning of their education, but most of the countries focus on the secondary school and university population (Metsä-Tokila, 2002; Güllich, 2004).

In Slovenia, there are some system solutions (Jurak, Kovač, & Strel, 2003b): legally defined modifications of academic obligations (already in the primary school), the organisation of gymnasiums sports classes, sports schools of national importance for individual disciplines (gymnasiums sports classes that include only talented sportspeople from certain sport), subsidised monitoring of suitable training processes, scholarships for talented sportspeople and super-standard health insurance. It should be emphasised that the educational system for talented young sportspeople (accept the sports schools of national importance for individual sports) in Slovenia is decentralised. Slovenian educational system does not include talent search programmes but only tries to ease talented sportspeople's co-ordination of academic and sporting commitments. Slovenian educational practice has considerable experience with such co-ordination (Kovač & Cankar, 1992; Kovač & Strel, 1998; Kline Suzič, 1999), but all the researches that have been carried out have so far included only sportspeople from gymnasiums sports classes and not all talented young sportspeople in higher education.

The primary aim of the research was to analyse the past and present co-ordination of academic and sporting commitments of those secondary school and university students who are momentarily capable of achieving elite competitive results.

Methods

Subjects. The research was carried out in September 2003 in co-operation with the Slovenian Olympic Committee (SOC) as part of a scholarship programme for the talented sportspeople. The criteria for financing (www.olympic.si) set very stringent conditions as far as the sporting results are concerned, whereas the academic result is not a criterion for receiving the scholarship. The scholarship can be awarded to the most successful sportspeople who are still involved in full-time education. These are mostly sportspeople who finished in the top eight at the Olympic Games, World and European Championships for seniors, younger seniors or juniors, and at the European Youth Olympic Days (EYOD). 86 out of the invited 124 sportspeople agreed to participate in the research. There were 65 males and 21 females. The average age of the measured subjects was 19.68 years (±2.01 years). They were competitors in 15 sports. Some of them won medals on World Championships for juniors and at EYOD in the last season. The subject with the poorest results achieved 11th place on World Championships for younger juniors and 6th place at EYOD.

Procedures. The prepared questionnaire contained both closed and open answers, depending on the type of question and the functionality of the required information (available in Jurak et al., 2003b). The questions were constructed in regard to the existing model of coordinating sporting and academic obligations in Slovenia (Kovač & Strel, 1998; Kovač,

1999) and its functioning. The questions were divided in the following themes: basic data about sportsperson, academic achievements on different educational levels (absence from classes, school's help with coordinating sporting and academic obligations, final grades), sporting achievements (the best results, training obligations) and health status.

Data analysis. Discriminant analysis was used to estimate the differences between subdivisions of subjects for the selected variables of school support that has been used to coordinate sportspeople's academic and sporting commitments. Adequate correlation coefficients were used to calculate the correlations between individual variables according to their characteristics.

Results

Sportspeople were asked to evaluate various types of benefit that have been offered by their schools in order to help them co-ordinate their academic and sporting commitments (see Figure 1). Zero points were given if a school did not offer certain benefit, whereas marks 1 to 6 were used to express how often they have used that benefit. One point was given if they have not used that benefit at all and 6 points if they have used it very frequently.

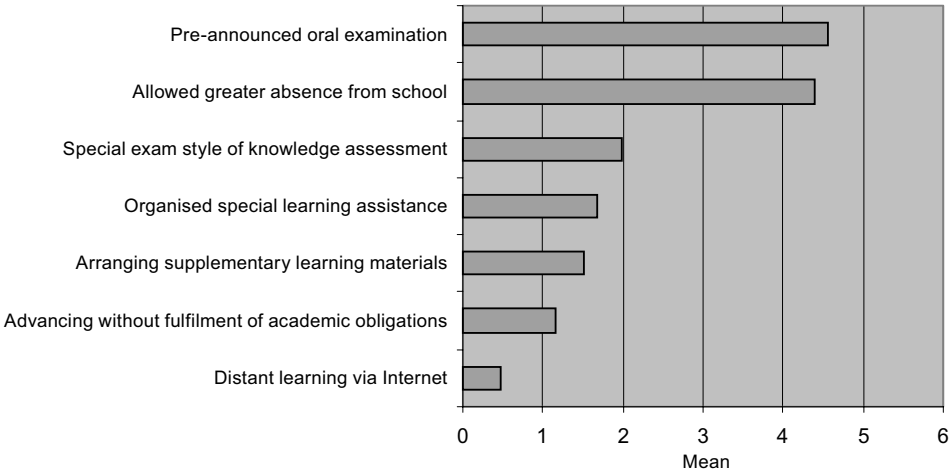

Figure 1: Use of the different types of support schools offered to sportspeople in order to co-ordinate their academic and sporting commitments

A detailed analysis has revealed that a large proportion of schools do not offer certain types of benefit and, furthermore, that many secondary school sportspeople do not use the benefit offered to them (Jurak et al., 2003b). As certain changes in the area of co-ordinating academic and sporting commitments have only happened in the last few years, an analysis of the use of benefit was carried out chronologically in relation to the period of attending secondary school. Subdivisions of current secondary school sportspeople and former secondary school (i.e. current university) sportspeople were created.

The results of the discriminant analysis (λ=.281; can.corr.=.468; Wilks'λ=.781; χ^2=17.186; df=7; p=.016) show a difference between the two subdivisions of sportspeople with reference to the analysed variables of benefit, which help co-ordinate academic and sporting commitments. The discriminant structure matrix shows that formation of the discriminant function is mostly affected by the following variables: *pre-announced oral examination* (.572), *arranging supplementary learning materials* (.538) and *organised special learning assistance* (.511). Values for other variables are: *allowed greater absence from school* (.448), *distant learning via Internet* (.447), *advancing without fulfilment of academic obligations* (.352) and *special exam style of knowledge assessment (-.050).*

Discussion

The five types of benefits that are most frequently used by secondary school sportspeople are those benefits that are offered to them by schools (Jurak, Kovač, & Strel, 2003a). Similar types of benefits are offered to talented sportspeople also in other European countries (Güllich, 2004) although the educational systems in other European countries organise also other kinds of learning help: dilating curriculum, lessons at training facilities, lessons shifted to weekends/vacations, fostering family and reduced exam demands.

A partial explanation of differences in the use of types of benefit between sportspeople, currently in secondary schools and those who used to attend them in the past is that the majority of schools started to comply with the 1998 Regulation on the co-ordination of academic commitments in the academic year 1999/2000 (Kovač, 1999). Current university sportspeople had by then already finished secondary school or were well on the way to finishing it. There had been some recommendations prior to the Regulation, but the schools followed them at their own will.

The formation of the discriminant function as a result of the influence of the different types of benefit schools offered in order to co-ordinate their academic and sporting commitments to current and former secondary school sportspeople can be explained by the increased absences of secondary school sportspeople compared to previous years (Jurak et al., 2003b). This should be seen less as a result of change in the demands of training and competition programmes and more as a result of changes in the academic environment which, by offering various benefits, also allow sportspeople to be absent from the academic process for longer periods. Long absences from the academic process can today be counterbalanced because knowledge can be acquired in many ways: with the use of textbooks and other materials, by distant learning

via the Internet, by access to learning materials via the Internet and e-mail. However, two of the most suitable types of benefit – *distant learning via Internet* (ρ=-.047) and *supplementary learning materials* (ρ=.222) – are not among the types of benefit which are statistically significantly correlating with the increased absence. It is noticeable that those secondary school sportspeople who experience long absences from the academic process often fail to use the available support (Jurak et al., 2003b). According to experience of other European educational systems (Leiss, 2004; Matsin, 2004) these sportspeople's academic achievement could benefit from dilating curriculum but lessons at training facilities and lessons shifted to weekends/vacations would be very hard to organise inside the Slovenian educational system. All talented sportspeople are attaining public schools together with other pupils which would make the coordination of the courses very difficult and expensive.

Some sportspeople do not experience any difficulties when coordinating their sporting commitments and academic life, or they obtain the compulsory studying materials from their friends without any organised help from their school. The findings of the research on attendance at organised special learning assistance by Kline Suzič (1999) lead to the conclusion that this benefit does not reach those pupils who need them the most. This consequently means that such type of benefit is not efficient enough. Schools are today more active than they were in the past, but their help reaches just a small proportion of secondary school sportspeople. In order to operate more successfully, schools need to analyse the types and contents of supplementary learning materials according to the learning abilities of sportspeople and their sporting commitments. It should also be ascertained whether sportspeople use the out-of-school tuition that demands additional financial resources from either their parents or sports clubs. Schools could prepare individual learning programmes and introduce alternative types of teaching: project work, co-operative learning, empirical learning, learning via the Internet etc.

Similar conclusions can be drawn from the analysis of the distant learning via Internet. Schools offer this type of assistance more frequently than they did before (Jurak et al., 2003a) but the majority of secondary school sportspeople do not use it (Jurak et al., 2003b) despite of the popularity of the medium and their high mobility. Further steps in this area should include the analysis of the different ways in which schools can offer their pupils to fulfil commitments via the Internet, and an estimation how many of these pupils own a computer and have access to the Internet. Previous analysis of the use of such media among Slovenian pupils indicates that more than 80% of the pupils own a computer and slightly less than half of them also have access to the Internet (Nadoh, 2001). The first steps in this direction were made by the development project of Distance learning that built the web portal for elite sportspeople (www.mirk.si/snd/sportniki.html).

In order to get the more complete insight some other factors that influence the fulfilling of academic commitments and consequently the knowledge of the sportspeople should also be studied: other obligations that are not linked to school or sport, daily arrangements of obligations, the influence of physical tiredness on learning abilities, the distance of school from home, living in boarding houses during schooling etc.

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STARTING-POINTS FOR INTEGRATION AT SCHOOL PHYSICAL EDUCATION IN SLOVAKIA

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Abstract

The trends for the past 10 years in Slovakia showed that pupils with disability have the possibility to move from special segregate education to general integrative education enviroment. More schools slowly adopting integration models and principles, some of research studies showed positive effects for students with disabilities included in general schools. But during the realisation of physical education teaching exists many problems, for example: non adequete recommendation from doctors, low level of P.E professional preparation, lack of material conditions, non adequete content of education, etc. The aim for increasing the quality of P.E. teaching is oriented to offer adequete and sufficient range of opportunities for pupils with disability.

We wanted to find some of factors for development of integrative P.E.teaching hours at schools. We analysed pupils and faculty students answers from questionnairy and dates from teachers, evaluated their attitudes about integration. Research study included 45 secondary schools, 102 faculty students, 142 P.E. teachers. Results showed that only 9-10% pupils with health impairments from primary schools, 8-13 % from secondary schools, 5-7% from universities had regulary physical education teaching. 39,6% of boys and 48 % of girls from secondary schools do not exercise at P.E.hours. Students of our faculty answered that they have a lack of knowledge about integration, 91% of them spoke about organize demanding of integrative teaching. 19,6% of P.E.teachers directed towards realisation of professsional preparation, 47 % at missing of study materials, documents. This aspects were the impuls for preparation new study plans for adapted physical education and integrative physical education at schools and for inovation of faculty curriculum. We constructed new programme for 16 health impairments: blind, visual impairments, deaf, hearing impairments, wheelchair users, impairments at upper and lower extremities, spine impairments, cardiovascular, respiratory, metabolic, digestive, gynecology impairments, neurological, psychical and intellectual disabilities.

Key words: *Integration, school physical education, attitudes of students and teachers, study plans, curriculum*

Integration is relatively a new concept that has been widely discussed and spread across schools of european countries. We take into consideration school education process, where the participants and partners are disabled and non disabled pupils. Many countries prepared for this education concrete legislative initiatives. In Slovakia there is for example Code of Laws No 409/1990 about special classes in normal schools for pupils with physical, visual and hearing impairments. This was completed in the year 1998 for special classes of pupils with cardio-vascular diseases, haemophilia, oncological diseases, diabetes mellitus, allergy, chronical respiratory and cutaneous impairments, metabolic and hormonae impairments.

One of the result is the integration of different disabled groups into normal schools, another there is the urge to include the pupils with disabilities to regular physical education lessons. We understand the terms integration as a form of education process that aims to avoid any kind of exclusion and fights for a full participation in quality of all pupils with disabilities in school physical education (Labudová, 2001a).

Succesful integration practice depends on the level and quality of initial, specialised and in service teacher training (Mikelkeviciute, 2004). Special characteristics of teacher´s personality and the technical support of the integrative process are also needed for the positive results (Habšudová, 2001). Especially special equipments have an important role for the better socialisation and integration in school teaching with disabled pupils. In all countries cooperation between regular physical education teachers , adapted physical activity prefessionals, medical doctors, researcher in adapted physical activity as well as parents of the disabled pupils should be developed in the near future (Dinold – Válková, 2004).

The possibility to be integrated into school sport activities to depend on these following facts:

- the teacher´s willingness to include pupils with disability and the expertise or formation in adapted physical education,
- the teaching conditions,
- the kind and severity of the disability,
- additional financial support (Boursier – Kahrs, 2004).

The trends for the past 10 years in Slovakia showed that pupils with disability have the possibility to move from special segregate education to general integrative education enviroment. More schools slowly adopting integration models and principles, some of research studies showed positive effects for students with disabilities included in general schools (Janotová, 1996, Levčíková-Marušincová, 2001). The results showed, that pupils with disabilities are adapted to work slowly, as a nondisabled pupils. But during the realisation of physical education teaching exists many problems, for example: lack of interest in teaching integrative physical education lessons, non adequete recommendation from medical doctors, low level of P.E professional preparation, lack of material conditions, non adequete content of education, etc. (Labudová, 2001b). The aim for increasing the quality of P.E. teaching is oriented to offer adequete and sufficient range of opportunities for pupils with disability.

Goals and methodic

We wanted to find some of factors for development of integration in P.E.teaching lessons at schools and to prepare new curriculum for teaching. This was the main goal of our research project VEGA No.1/0228/03. In this paper we will analyse participation in school physical education of pupils with disabilities by means of records from physical education teachers and teacher´s answers from questionnaire with evaluation their attitudes about integration. Research study included answers from 55 secondary schools, 34 high schools in Slovakia.102 faculty students answered about their preparation for integration in physical education teaching.

Results and discussion

The official statistical dates from the year 2003 (ÚZIŠ, 2004) showed us, that number of pupils who needed the medical dispensary care was unfavourable. For example there was 910 children with respiratory diseases of 0-14 years old (on 10 thousand born children), 444 children of 15-19 years old with diseases of muscle and skeletal system, 208 cases of mental and behavior impairments, etc. In total of all diagnosis there were 3833 cases of 0-14 years old children and 3778 cases of 15 – 19 years old pupils (on 10 thousand born children). It was more than in 1996, when there were indicated only 2409 cases of diseases of 0-14 years old children and 1682 cases of 15 – 18 years old girls and boys.

We analysed the pupil´s participation in school physical education lessons and we obtained following facts about all school pupils:

- in the classes 1.- 4. (primary school) did not practise P.E. lessons 10 % of boys, 11 % of girls,
- in the classes 5.- 9 (secondary school) did not practise 22 % of boys, 30 % of girls,
- in the classes 1.- 4 (high school) did not practise 32% of boys, 54 % of girls.

To the reason of this situation besides other belong existence of pupils impairments and diseases (7 – 12 % of non exercise pupils).

In the separate classes of high schools we found up18% to 31% of pupils with locomotor impairments (table 1), up 10% to 17 % of pupils with cardiovascular impairments.

Table 1. Health impairments of high school students (in percentage)

	BOYS				GIRLS			
Impairment	1.class	2.class	3.class	4. class	1.class	2.class	3.class	4.class
Locomotor	30	21	24	31	20	21	18	16
Respiratory	19	9	11	12	9	7	11	5
Spinal	10	9	7	8	18	18	19	26
Cardiovascular	11	12	10	15	17	16	12	16
Convalescence	9	14	13	8	9	8	11	7
Allergy	6	10	9	6	5	10	6	13
Other	15	25	26	20	22	20	23	17

But in case of health impairment pupils results showed that only 9-10% pupils with health impairments from secondary schools, 8-13 % from high schools had regulary physical education teaching in segregate groups of adapted physical education.

To the goals of professionals belong to create conditions for pupils with disability into regular compulsory physical education lessons. The important element of successful integration is the physical education teacher. Is she/he well ready for integration and what attitude to integration does she/he have? We found out that only 40 % of teachers of secondary and 38 % of teachers of high schools have positive attitude to integration. The rest of P.E teachers persisted on conviction that the best way for pupils with health impairments is school adapted physical education in segregate groups. Students of

our faculty answered that they have a lack of knowledge about integration, 91% of them spoke about organize demanding of integrative teaching. 19,6% of P.E.teachers directed towards realisation of professsional preparation, 47 % at missing of study materials, documents.

To the reasons why the teachers do not want to teach in integration classes belong:

- doubts about exercise security,
- difficulties to different content and work with pupils,
- heterogeneous of health impairments,
- load for both groups of pupils can not be harmonized

These all aspects were the impuls for preparation new study plans (curriculum) for adapted physical education and integration in physical education at schools. There is stressed that pupils with disability should:

- understand positive working of specific as well as other motor activities on their health impairments,
- reach the development of efficiency, of physical organs functions, increase of functional fitness and optimal motor development,
- to submitt ability to evaluate own motor possibilities, reach personal motor performance,
- be able to organise themselves motor activities in daily regime and manifest permanent interest for physical activity, etc..

We constructed new exercise plan and programme for 16 groups of health impairments: blind, visual impairments, deaf, hearing impairments, wheelchair users, impairments at upper and lower extremities, spine impairments, cardiovascular, respiratory, metabolic, digestive, gynecology impairments, neurological, psychical and intellectual disabilities.

The realisation of physical education lessons for pupils with disabilities according the curriculum for secondary and high schools are:

1. in segregate groups, special lessons of adapted physical education, 2 – 3 times per week. In one teaching group are:
    a) 10 – 12 pupils with various impairment in regular school
    b) 4 – 8 pupils with the same basic disability in special school (classes 1. – 4.)
    c) 5 – 10 pupils with the same basic disability in special school (classes 5.- 9.)
    d) 3 – 6 pupils with the same basic disability combinate with mental disability
2. in integration physical education lessons, in regular school, 2 – 3 times per week. In one teaching group are:
    22 non disabled pupils and 1 disabled pupil, or
    20 non disabled pupils and 2 disabled pupils, or
    18 non disabled pupils and 3 disabled pupils, etc.

To teach at the school integration physical education lessons can physical education teacher, who is certificated for adapted physical education too. This new conception started in school year 2003/2004 and get slowly in the school practice.

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PHYSICAL ACTIVITY WORKSHOP AND COGNITIVE TRANSFER

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Abstract

The work that is here presented is the synthesis of a research concerning the didactics of motor activity, commissioned from C.O.N.I. in the year 2004 (year of sports), and carried out by the collaboration group belonging to my chair of "Theory, technique and didactics of motor activities for the development years". If the motor activities are largely used to "educate the body", for over ten years the effort of us researchers has been to "educate to reach knowledge through the body" because we consider this and the movement as "alternative keys to knowledge". Our intend is to promote a transfer of learning, that utilizes the motor skills approach to gain other knowledge, and utilizes a sport's environment as workshop.

Key words: *Transfer, learning, workshop, leaving through the body, cognitive plurality*

Introduction

The motor activities in a scholastic environment have been considered for a long time synonym of "physical education" and focused mainly on the execution of exercises and training. For this reason the value of the relationship, very debated today in the neuroscientific environment, between body and learning, where the body is considered an active part of the gaining of knowledge, has been neglected.

In fact, any information which we perceive as coming from the outside world, that we consider, learned, will have provoked in us a change, long lasting or not, in our synaptic connections (LeDoux, 2002).

The effort of our research group is to clarify the relationship between learning through sports and transferring in other areas of knowledge.

The reference paradigm used in our research is based in particular on:

- the reflections faced by Gardner (2002) on the plurality of the intellectual types that take us to consider learning as a complex process that includes different types of intelligences.
- On an attempt to apply in didactics Hebb's theory (2002) based on *discharge and connect*: "when the weak and strong inputs towards a cell are active at the same moment, the weak road results intensified thanks to an association with the strong road." The learning is consolidated when a weak stimuli is associated with a strong stimuli.
- On the studies of Boncinelli (2003), and more in general on neuroscientific studies, that have re-evaluated the roots of cognitive movement, its knowledge transfer capacity, its role in the construction of a plasticity which touches other mechanisms of human knowledge and especially, the relationship between motor skills and human learning skills.
- On Freeman's theories on the perception (2002) which look at this last as "a continued process for the most part subconscious, that is sampled and titled in an intermittent way, of the awareness, and what we remember are the samples, not the process". Our duty as teachers and researchers in didactics places us in front of a necessity to make sure that there are different learning processes and our didactic action needs to point towards modifying those "processes" which Freeman talks about, without belittling the awareness of the subject who is learning.
- On what Damasio stated regarding learning processes (2002). For the author "the prospective of experience is a source of metaphors in organisms rich in cognitive capacity as a wide conventional memory, operative memory, language and capacity of manipulation which classify as intelligence". This prospective of experience "is built on the elaboration of signals which come from a large variety of sources" and stimuli that involve all human activity.
- On the contribution of human sciences and in particular on the philosophy of Maurice-Merleau Ponty (2003) who sustains the necessity of "finding the origin of the object in the heart of our experience". Our experiences suggest us meanings, which lead us to make hypothesis and "such a process highlights the spontaneous method of perception… that kind of life of meanings which makes the concrete essence of the object immediately tangible and lets out its sensitive capacities only through itself". In fact the object/subject of our research results to be the body and its interaction and full integration with a specific learning environment in which the sensory stimuli predisposed in the right way have offered a particular access key to disciplinary and non disciplinary knowledge. In fact "the flow of information coming from the sensory organs and the continued interaction with the environment determine the method in which the brain takes shape".

Methods

The workshop constitutes a protected and privileged didactic space for research activities, since the common denominators for all the workshop experiences are the active role of the subject who is learning, the creativity in the use of materials and in the predisposition of the setting and especially the rigor of the experimental method. The activities which we have proposed in our research have been inserted in a workshop path of motor skills nature accompanied by music.

To carry out a correct analysis of the starting situation we based ourselves on the emergent theories of the human sciences, to be able to reach those characteristics which are peculiar to subjects of a determined age. Even though aware that "every individual is unique" and that the theories that we have exposed are not applicable to all the subjects who are involved in the research path that we have developed, such preliminary analysis have been necessary to individuate a macro-area of research. The receivers of our project have been children between the age of 7 – 9 (3rd grade). According to the theory of the evolutionary steps of Piaget, we place this age level in a phase of "concrete operations". In this state the children reach a symbolic system of organized and coherent thought. The principal cognitive structure in the concrete operational phase is the grouping: children are capable of recognizing the members of a true logical class and of organizing the objects and the events in a series, which means they gain the capacity of organizing the objects by classifying them by weight and dimensions. This is the time when operational schemes develop. The operation "is an interior action: it is the capacity to act, to operate on representations (images and symbols) to reach a logical conclusion" (Militerni, 2003).

It is necessary though that the events remain inside the immediate perception, since the subject is not able yet to carry out the same operations only on the base of mental, abstract representations.

In our research project we have used deduced hypothesis. Basing ourselves on the theory of Gardner on multiple intelligences, on the basis of the thoughts deducted by LeDoux and Boncinelli and based on what has been said, we have demonstrated that:

A didactic workshop based on a pre-sports motor skills education (3rd grade) stimulates the activation of cognitive processes of a logical nature.

In having formulated the objectives, we had to: a) take into consideration the age of the subjects who will be involved in the research project; b) take into consideration the state programs of the elementary school; c) define how to evaluate the results of the research, an operation closely related to the formulation of the hypothesis and to the definition of the other phases of the research (e.g. time, space, methodology of the conditions, etc.).

Our samples are made up of 3rd grade students of the Suore Betlemite Institute (officially recognized) situated in Via Bernardo Cavallino, an area of a middle class social level in the city of Naples.

To be able to carry out the research using a rigorously scientific sample we could not avoid taking into consideration the area of research. This included:

- conductors and observers of the activities: teachers of the motor activities and sports;
- teachers of the classes who worked along with the conductors during the carrying out of the activities, sometimes taking on the role of "mediator" between the conductors and the students;
- students who would act as the receivers of the stimuli and by whom we expect a change;
- a specific project which identifies the learning objectives;
- a methodology of research of an experimental type which confronts the various phases of the path with attention and punctuality, in spite of the difficulties which are always encountered when the protagonists of the research are people;
- an evaluation system capable to verify the reaching of the sought after results in a social and environmental context which conditions the origin, the carrying out and the results and which used:
  1. an entry test to register the starting situation;
  2. observation grids free and structured to monitor the carrying out of the activity;
  3. an exit test to verify the results of the didactic intervention.

The modality that has characterized our research is experimental.

The phases of the experience have been carried out as follows:

EXPERIMENTAL GROUP (22 3rd grade students A)

ENTRY TEST: given 4 days prior to the 1st meeting

WORKSHOP: 4 meetings lasting 2 hours in 4 weeks

EXIT TEST: given 4 days after the last meeting

CONTROL GROUP (24 3rd grade students B)

ENTRY TEST: given the same day as 1st meeting

DIDACTIC: ordinary

EXIT TEST: given the same day as the last meeting

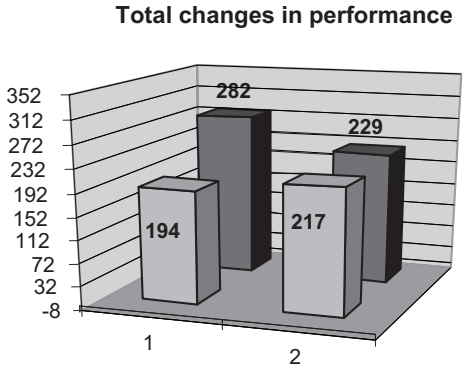
The entry test, the same as the exit test, has been structured based on the evaluation of related processes: a) the numerical progression; b) the logical sequence; c) the topical cognition.

The observations and the observation instruments have been applied systematically through open questions and answers and multiple choice. The object of observation was the behaviour of the subjects, especially in the body and motor skills manifestations. They have contributed to the interpretation of the results of the tests. Through a process of "crossing" the data (test and observations), in fact, it has been possible to obtain a higher precision to the research. A process finalized to limit the possibility of reaching positive results in an unexpected way and to validate even more the hypothesis of experimental research.

The proposal during the motor skills workshop, divided in 4 meetings, had a playful character and have been based on activities that pointed to enhance the development and the consolidation in the children of space-temporal capacity. So we have realized: exercises with rhythmic running, jumping with one foot and two feet; exercises supported by music in which the children with their hands, with their feet and with small objects reproduced diverse rhythms which they heard…At the end of all the meetings based on the reflections of the children we have constructed a conceptual map using the "brian storming" method.

Results

For the results, taken from different remark instruments, see Figure 1.



	1[a]	2[b]
entry test	194	217
exit test	282	229

[a] group 1 contains students of the 3rd grade A
[b] group 2 contains students of the 3rd grade B

Figure 1. Changes in performance exhbited by student groups 1 and 2 in the entry test with respect to exit test

Discussion

From a first observation of the graphs which emerged from the verification of the tests, we can see that the experimental group has found an improvement from the didactic workshop. We also see that both the children of the experimental group and the control group have sometimes gained improvements, but that were not of the same entity for all the subjects involved. Instead in the experimental group, the improvements have been definitely more constant, in the control group, these improvements have reached only certain children, while others have definitely gotten worst. We will now give the motivations which, based on the studies that I have exposed and based on what I will expose, justify the preceding results.

During the activities of experimentation, in fact, the sports' workshop has let the children operate in a setting rich of strong stimuli derived from: the outside conductors, the materials utilized that are outside of the expected ones for the common didactic activities, music, a direct confrontation with their group of peers, the games, corporal experience.

We can finally state what follows:

- The children belonging to the control group, whom improved in the exit test compared to the entry test, have incorporated into their long term memory the first carrying out of the test.
- Vice versa, the children belonging to the control group, who did not improve in the exit test compared to the entry test, is presumed to not have incorporated in the long term memory the first carrying out of the test. We also have to specify that in whatever didactic intervention which points to any type of learning, the subject only gives a minimum of attention. We suppose that in the cases of worsening the children were not attentive to the directions, either at the entry or at the exit, or that the conductors have not been capable to adequately stimulate their attention level.
- The children belonging to the experimental group, who have improved in the exit test compared to the entry test, have incorporated in their long term memory, not only the first carrying out of the test but they have also used ulterior important stimuli gained through the sports' workshop. This last has resulted, based on LeDoux, as a strong stimuli which together with the weak one (entry test), has emphasized the learning level.
- The children belonging to the experimental group, who have not improved in the exit test compared to the entry test, are presumed to have paid little attention in the reproduction of the test or that the conductors were not capable of adequately stimulating their attention level.

We can also suppose that such subjects did not assimilate in a positive way the numerous strong stimuli proposed in the central phase of the research. This could be attributed to the theoretical summary of LeDoux, who states that "we are our own synapsis"and that "every individual is unique", due to this we can not hypothesize a didactic intervention which can bring results related to learning and or memory which are the same for all.

Human beings, in fact, are a synergy between genotype and phenotype, more precisely they are characterized on one side by synaptic connections which set them apart and on the other from the biological modifications, that the environmental stimuli determine.

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PHYSICAL EDUCATION AND SPORTS AT ZAGREB AND OTHER CROATIAN UNIVERSITIES

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Abstract

According to the Law on Higher Education, University Senate has accepted the new Statute in which Physical education is an obligatory course. Besides the Physical education, many students are enrolled in University sports competitions that take place every academic year in Zagreb and they cover more then 20 sports. We presented almost every form of physical activity our students have, and as it turns out, our students like Physical education and sports so we owe it to them to try and make the society understand their need for proper sports facilities and financial support.

Key words: *Physical education, University sports, University of Zagreb*

Introduction

Goals and tasks of the Physical education as tought at the University of Zagreb are:

- to meet bio-psycho-social needs for physical activity,
- to teach and proclame the importance of the frequent and continuous physical activity through the entire lifetime,
- to teach about the positive impacts that physical activity has on the antropometric characteristics (funkcional and motor abilities, cognitive and conative dimensions and morphological characteristics)
- prevention of health and improvement of the working abilities.

According to the Law on Higher Education, University Senate has accepted the new Statute on the february 25th, 2005. on it's 10th meeting in 336th academic year. In the article 69. (12) it says: "Physical education and extracurricular activities of the students are done outside the scedual determened by article 4., it is obligatory for first and second year students, and nonobligatory for other years. Physical education does not gain any ECTS points."

Universities of Rijeka, Osijek, and Higher school of Karlovac follow and support the Zagreb University in modernizing the programme with new activities and according to the student preferences.

Besides the Physical education, many students are enrolled in University sport championships that take place every academic year in Zagreb and they cover more then 20 sports. Other Croatian Universities also have competitions like Zagreb and once a year the winners of each University meet and compete at the Croatian University sport championships.

Means and methods

Physical education at the University of Zagreb

Physical education as an obligatory course is provided for two hours a week in the first four semesters and it represents the last step in organized physical activitie for young people in our country. Physical education has the goal to make physical activity a positive habbit for young students so that thay practice recreational sports and leisure-time recreational activities their whole lifes.

By attending the Physical education they improve their knowledge and skills of sports activities and they learn something new by trying out some sports activities for the first time. By frequent and constant physical activity we're trying to improve student's funkcional and motor abilities, reduce fat, increse muscle strength and by doing that, improve and maintain their health.

Taken in consideration, student needs and interests also determine elective courses which are used to modernize physical education programmes. Physical education aims towards making the student specialise for one type of physical activity and reach the high level of it so it would become his/hers everyday routine.

Physical education programme accepted by all the Croatian Universities during the 13. Summer school of Kinesiology, Rovinj, 2004. consists of BASIC and ELECTIVE contents made according to:

- analysis of the student's questionaire results about active participation in recreational sports,
- student's health status according to the medical results performed on them by the Institute for Public health of Zagreb,
- material and staff abilities of each Faculty,
- history of investigations of the student preferences for certain physical activities.

Table 1. shows 10 most prefered activities by the students who did the questionarie paper at the University of Zagreb.

TOP 10	
MALE STUDENTS	FEMALE STUDENTS
soccer	aerobics
basketball	dancing
swimming	volleyball
table tennis	basketball
gym	gym
handball	swimming
waterpolo	ice-skating
volleyball	rollerblading
rowing	table tennis
tennis	mounteniring

Basic programmes of the Physical education are athletics, basic kinesiological transformations (gym, aerobics), basketball, handball, volleyball, socker, swimming, table tennis, badminton, dancing, exercising for the students with special needs.

Elective programs of the Physical education are mounteniring, tennis, squash, shooting, marshal arts, yoga, rollerblading, ice-skating, waterpolo, water-sports (sailing, rowing, kajak, kanu, rafting, scuba-diving).

The problem of conducting the Physical education is the lack of the facilities - sports gimnasiums, their poor maintenance and unfair usage of the capacities that exist. Because of these facts, working conditions are not the same for all the Faculties of the University of Zagreb.

Physical education Professors that are employed by the University of Zagreb try their best to give students the best possible working conditions with as many physical activities possible. Driven by their dedication to their work, the professors formed an Association of the Physical Education Professors at the University of Zagreb founded in 1999, to insure better working conditions, importance of their work, better financing, and to promote daily physical activity to students, incourage the students to participate, insure the proper conditions, and education for the members, etc. Association is always in touch with the University officials and Ministry of science, education and sports. Association also initiated the idea of writing a Textbook on Physical education for students which is in publishing process right now.

Professors of Physical Education are well aware of the responsibility they carry in preserving and improving the health of their students; they give their best in educating them about the importance of the physical activity througout their lives, in order to have a happier and healthier future.

At the University of Rijeka Professors are organized in the Assossiation of Physical Education Professors at the University of Rijeka, working conditions are OK, and students are satisfied with the programme, swimming, sailing, rescuing the drowning and running are on top of their list of prefrences.

At the University of Osijek, professors are organized in the Sport Committie, but working conditions are poor, students are disoriented and offered by very little activities, basketball and soccker are at the top of their list of preferences, but they have shown interest for new progremmes such as swimming and aerobics.

Higher school of Karlovac is a member of Zagreb Assossiation of Physical Education Professors. Working conditions at Karlovac are OK, students are satisfied with the programme, and aerobics and soccker are at the top of their preferences.

At the University of Split professors are organized in the Assossiation of Physical Education Professors at the University of Split, besides standard programme students are involved in scubba diving and sailing which is on top of their list of preferences.

To conclude, representatives of the Croatian Universities met in Crikvenica/Selce this year at the Croatian University Championship and disscused the importance of forming the State Assossiation of PE Professors so they can share information, solve problems, help each other especially now that Bologna Declaration is installed and the ECTS points are delt.

University sports of Zagreb

University sports competitions in Zagreb started fourty years ago. During the 90-ties politics and war did their part in stopping the interest for sports, in general. At the beginning of this century interest for University sports rapidly incresed, and it's now on the new improved higher level.

Student's University sports competitions are carefully planed and professionally conducted according to the laws for each competative sport.

Organization of the student University sports competition is handled by the Physical education professors and students, Student Coure of the Zagreb University as a financier, Association of the University sports Zagreb as the competition organizers, Croatian sports union as the finantial sports financiers in general, leaders of the sports, leaders of the Faculty

teams and other necessary staff such as referies, notaries… Competitions take place of 12 different locations in the town of Zagreb. To interupt this list of positive facts here's a bad one: there is only 0.22 m^2 for one student of Zagreb, and 3-5 m^2 for one European union student. University sports competitions are facing the same problem of lack of space like Physical education.

Results and discussion

Presented are the analysis of the results for the last four academic years of University sports competitions:

Table 2 shows the growth in the number of sports in the academic years:

- 2001./2002. there were 19 sports
- 2002./2003. there were 20 sports
- 2003./2004. there were 21 sports
- 2004./2005. there were 22 sports.

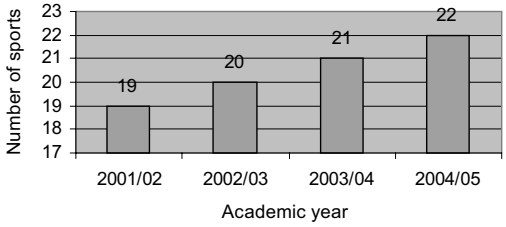

Table 2.

Table 3 shows the increase of the number of teams participating in team sports of socker, volleyball, basketball, handball, waterpolo, beach volleyball and beach handball for both male and female in the academic years:

- 2001./2002. participated 253 teams
- 2002./2003. participated 303 teams
- 2003./2004. participated 338 teams
- 2004./2005. participated 354 teams

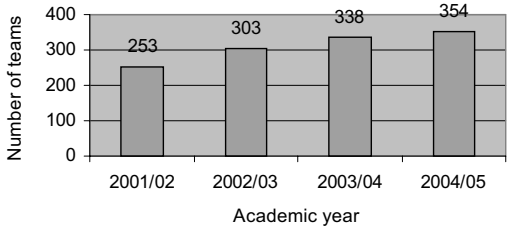

Table 3.

Table 4 shows the increase of the number of students participating in the academic years:

- 2001./2002. participated 2989, 1968 male, 1003 female
- 2002./2003. participated 3550, 2441 male, 1136 female
- 2003./2004. participated 4517, 2680 male, 1837 female
- 2004./2005. participated 4700, 2800 male, 1900 female

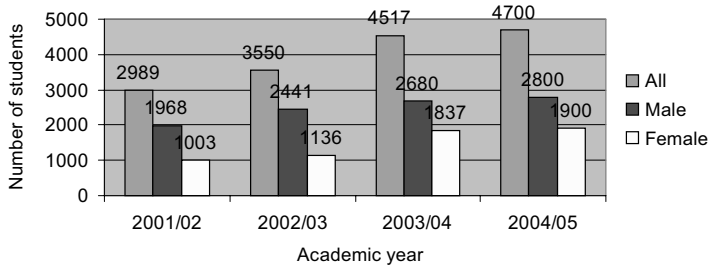

Table 4.

Table 5 shows the increase of the number of Faculties that were represented by male or female teams participating in the academic years:

- 2001./2002. 28 Faculties with male teams, 23 with female teams
- 2002./2003. 33 Faculties with male teams, 24 with female teams
- 2003./2004. 34 Faculties with male teams, 28 with female teams
- 2004/2005. 34 Faculties with male teams, 30 with female teams

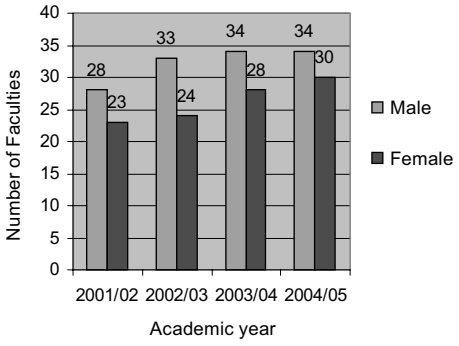

Table 4.

These results show great effort made by the Professors of Physical education at the University of Zagreb in organising teams, training them and leading them while they participate at University sports competitions. The competitions take place during the entire academic year. The winners are joined with the winners of the other Croatian Universities (Rijeka, Osijek, Split, Zadar, Dubrovnik, Higher school of Karlovac) and they compete at the State Championship. The State winners participate in the European and World University competitions.

In the academic year of 2003/04. the students of the Zagreb University were the winners of the European University competition in male volleyball (Phylosophycal Faculty) and were the runner-ups in the European University competition in male soccer (Faculty of electrical engineering and computing).

Besides this, students, led by their Professors, participate in the humanitarian and recreational sports manifestations such as Terry Fox run, Cross SN, With sports against smoking and drugs, World sports day, World mountaniring day etc.

Students and student organizations (Student coure, Student associations) organize other sports activities such as University rowing run for eights, Soccer leage, Chess tournament, Sailing regata, University rally, and professional sports games such as “Humanijada”, “Tehnologijada” etc.

Conclusion

At the State sports awords “Franjo Bučar” in Split, Minister of Science, Education and Sports, dr. sc. Dragan Primorac stated: “There is only 10% of the people in Croatia that are active in sports activities, while abroad that number is 40-70%. With the new Law of Sports we will try to emphasise this important segment. We will support the growth of the University and School sport.” (Sportske novosti, 26. 11. 2004.)

Considering the small number of the adults that participate in any form of physical activity or sport, we the professionals are facing great challange in trying to change that. We are all familiar with the importance and value of the frequent and continuous physical exercising in preserving the health and strengthening the working ability, so we have to spread that to all our young people starting with the preschoolers, elementary, high school and University to the recreational sports activities at the grown age population and senior citizens.

We presented almost every form of physical activity our students have, and as it turns out, our students like Physical education and sports so we owe it to them to try and make the society understand their need for proper sports facilities and financial support. With the larger number of the sports facilities, with continuous working and educating one day we might expect to reach the European standards, even in the number of the people who are involved in any kind of physical activity or sport. Our fight is aimed towards getting the ECTS points for Physical Education at all the Croatian Universities.

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ATTITUDE OF FIRST YEAR STUDENTS OF FACULTY OF ELECTRICAL ENGINEERING AND COMPUTING TOWARDS PHYSICAL ACTIVITY

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Abstract

We are daily witnessing the negative influences of the sedentary way of life on the motoric genetic potential, leading to its progressive decrease. This is unfortunately most obvious among students, mainly due to increasing responsibilities and informatization imposed on the new generations. Sometimes the only physical activity they perform is the one during the obligate physical education, and this more often than not skipped on purpose. The aim of this questionnaire was to identify the magnitude of the mentioned problem and possible solutions. We present the results of the questionnaire answered by hundred first year students of Faculty of electrical engineering and computing University of Zagreb on their free time sport activities and their attitude towards physical activity in general. Questions were based on the weekly habits. Students were asked to choose among the list of physical activities their favourite ones and also to identify those activities they dislike and would not want to perform in the free time.

Key words: *questionnaire, free time sport activities, weekly habits*

Introduction

Sedentary way of life, potentiated by increasing responsibilities and informatization imposed on the students leads to decrease of motoric genetic potential, and unfortunately change of their attitude towards physical activity.

Materials and methods

Hundred students of Faculty of electrical engineering and computing University of Zagreb answered the questionnaire. They were all in the first year of study during academic year 2003/2004, in which physical activity is obligate in both semesters. Fifty of them were male and other fifty female students. The data obtained were analysed by STATISTICA 5.0 FOR WINDOWS.

Results and discussion

One of the aims of this study was to determine the importance that first year students give to physical activity. They were given the questionnaires with four different answers of which they were to pick only one. Questions were as follows:

How important is the physical activity to you, and the answers:

1-physical activity is of no importance to me

2-it is of small importance to me

3-it is important

4-physical activity is extremely important

Table 1. The results are given in table

Importance	Numbers of students	percentage (%)	cumulative %
1	2	2	2
2	12	12	14
3	55	55	69
4	31	31	100

The results obtained from the first question lead to the conclusion that students understand the importance of the physical activity, while only two of them pay no attention at all to the physical activity and another twelve pay only small attention to it. The majority of students (altogether 86 of them) find physical activity important i.e. extremely important.

The other issue of the questionnaire was how many hours students spend weekly in physical activity, either professionally or in their leisure time. The results of this question are summarized in table 2.

Table 2. Hours spent in physical activity during one week time

Hours	Number of students	Percentage (%)	cumulative %
0	45	45	45
1	5	5	50
2	8	8	58
3	13	13	71
4	11	11	82
5	5	5	87
6	3	3	90
7	2	2	92
8	2	2	94
9	2	2	96
10	2	2	98
11	1	1	99
12	1	1	100

It is evident that 45% of our students except the obligatory physical education don't spend any time in physical activity. Five students spend one hour weekly in physical activity, other 37% of students are active two to five hours per week. This can be partly explained by the tight and strenuous schedule those students have. It is also interesting that 10 % of students are active in different sport clubs and spent more than seven hours weekly in different sport activities.

Students were given tables with 22 different physical activities in order to choose the most preferable ones they would like to be involved in during obligatory physical education as well as free time. They were asked to grade the activities in a scale of 1 to 5 (Likert's scale) in a way where:

1 - presented the least popular physical activity they would never choose

2 - presented physical activity they would choose in lack of other possibilities

3 - presented physical activity they were not entirely sure they would choose

4 - presented physical activity they would like to play

5 - presented physical activity they would definitely prefer

Results are obtained in tables 3 and 4. Some of the physical activities mentioned are already in the program of the obligatory education, while in others students can participate in the extracurricular time. All the data is given in the percentage form, and the marks most used are given in bold. In tables are also summarized results, which are negative and on the other hand positive poles of the Likert's scale.

It is interesting that yoga was negatively graded by 78% of male students. The negative trend was also noticed for inline skating (64%), squash and hiking (60%), ice skating (52%), followed by athletics (54%), skiing (46%) and rowing (44%). On the other hand swimming seems to be the most popular physical activity among male students (58%), and also favourable results are obtained for basketball (52%), table tennis and tennis (42%), shooting (44%) and rafting (40%).

Table 3. Frequency matrix for 50 male students

Variables	1	2	3	4	5
ATHLETICS	28	26	26	12	8
BODY BUILDING	16	8	38	22	16
MARTIAL ART	18	26	20	18	18
SAILING	28	22	34	4	12
BASKETBALL	10	10	28	**34**	**18**
ICE SKATING	**36**	**16**	34	4	10
SOCCER	10	22	26	24	18
VOLLEYBALL	16	16	38	16	14
HIKING	**34**	**26**	20	16	4
SWIMMING	14	18	10	**40**	**18**
RAFTING	24	10	26	**14**	**26**
INLINE SKATING	**38**	**26**	22	10	4
HANDBALL	22	20	42	12	4
SKIING	**30**	**16**	18	14	22
SQUASH	**36**	**24**	20	14	6
TABLE TENNIS	14	20	24	**30**	**12**
SHOOTING	20	18	18	**16**	**28**
CHESS	36	24	22	10	8
TENNIS	18	14	26	**28**	**14**
WATERPOLO	20	28	32	10	10
ROWING	**26**	**18**	24	20	12
YOGA	**60**	**18**	18	4	0

Table 4. Frequency matrix for 50 female students

Variables	1	2	3	4	5
ATHLETICS	**14**	**36**	30	12	8
BODY BUILDING	24	24	28	8	16
MARTIAL ART	16	14	22	**34**	**14**
SAILING	18	16	28	26	12
BASKETBALL	20	26	26	20	8
ICE SKATING	10	18	20	**26**	**26**
SOCCER	**42**	**24**	16	10	8
VOLLEYBALL	20	12	16	**24**	**28**
HIKING	20	14	32	28	6
SWIMMING	2	10	26	**26**	**36**
RAFTING	10	24	26	12	28
INLINE SKATING	12	18	16	**30**	**24**
HANDBALL	**32**	**38**	26	0	4
SKIING	18	18	24	**16**	**24**
SQUASH	24	26	32	12	6
TABLE TENNIS	**12**	**34**	18	26	10
SHOOTING	**28**	**24**	22	20	6
CHESS	**46**	**26**	16	6	6
TENNIS	**18**	**26**	20	24	20
WATERPOLO	**38**	**32**	12	14	4
ROWING	**26**	**30**	26	10	8
YOGA	14	14	26	**28**	**18**

Results presented in table 4. show the attitude of female students. As already seen for male students female students prefer swimming (62%). They are also interested in inline skating (54%), volleyball and ice skating (52%), martial arts (48%), yoga (46%) and skiing (40%). Female students dislike water polo and handball (70%) and soccer (66%). They are not very keen on chess (72%), rowing (56%), shooting (52%), athletics (50%), table tennis (46%) and tennis (44%).

According to the results presented in tables 3 and 4 it is obvious that female and male students differ in their interest in physical activities. This reflects in already known importance of different programmes for males and females. The observed differences have to be respected and the effort has to be made to offer activities according to interest in order to improve the results in obligatory and extracurricular activities.

Further in the analysis of the results the discriminatory analysis (according to sex) was used and its results are given in table 5.

Table 5. Correlation between variables and discriminatory function

Variables	Root 1
ATHLETICS	**0,049**
BODY BUILDING	-0,115
MARTIAL ART	**0,058**
SAILING	**0,122**
BASKETBALL	-0,189
ICE SKATING	**0,261**
SOCCER	-0,256
VOLLEYBALL	**0,076**
HIKING	**0,151**
SWIMMING	**0,144**
RAFTING	**0,036**
INLINE SKATING	**0,312**
HANDBALL	-0,158
SKIING	**0,061**
SQUASH	**0,054**
TABLE TENNIS	-0,047
SHOOTING	-0,146
CHESS	-0,079
TENNIS	-0,05
WATERPOLO	-0,131
ROWING	-0,076
YOGA	**0,456**

Results show the correlation between the variables and sex. Structure of the discriminatory function is bipolar. Tables graphically show the variables characteristic for one pole and different for another pole. The positive pole was female students and negative pole of the discriminatory function were male students. Variables best describing female students are: athletics, martial arts, ice skating, volleyball, hiking, swimming, rafting, inline skating, skiing, squash and yoga while male students are characterized by variables as: body building, basketball, basketball, soccer, handball, table tennis, shooting, chess, tennis, water polo and rowing.

Table 6. Results of the discriminatory analysis

	Eigen value	Coefficient of canonical discrimination	Wilks' Lambda	χ^2 test	df	p-value
0	2,358	**0,838**	0,297	105,403	22	0.00

Table 6. shows high coefficient of canonical discrimination (0,838) indicative of great difference between the two groups at the level 0,00 ($p<0,00$). Wilk's lambda of 0,297 at the significance level 0,00 also supports the statistically relevant difference between the sexes.

Results of the t-test give the insight in the variables, which discriminate between female and male students. At p level < 0,05 variables: basketball, ice skating, soccer, hiking, swimming, inline skating, handball, shooting, water polo and yoga discriminate female and male students while athletics, body building, martial arts, sailing, basketball, volleyball, rafting, skiing, squash, stable tennis, chess, tennis and rowing can not be used in order to discriminate the mean values of the two groups at the level of statistical significance.

Table 7. Results of t-test

Variable	Mean value female G_1:0	Mean value male G_2:1	t-test	df	P level (p < 0.05)
ATHLETICS	2,64	2,46	0,758	98	0,449
BODY BUILDING	2,68	3,14	-1,751	98	0,082
MARTIAL ART	3,16	2,92	0,894	98	0,373
SAILING	2,98	2,5	1,869	98	0,064
BASKETBALL	2,70	3,4	**-2,882**	98	**0,004**
ICE SKATING	3,40	2,36	**3,977**	98	**0,000**
SOCCER	2,18	3,18	**-3,903**	98	**0,000**
VOLLEYBALL	3,28	2,96	1,161	98	0,248
HIKING	2,86	2,3	**2,305**	98	**0,023**
SWIMMING	3,84	3,3	**2,202**	98	**0,029**
RAFTING	3,24	3,08	0,556	98	0,579
INLINE SKATING	3,36	2,16	**4,751**	98	**0,000**
HANDBALL	2,06	2,56	**-2,413**	98	**0,017**
SKIING	3,10	2,82	0,938	98	0,350
SQUASH	2,50	2,3	0,822	98	0,413
TABLE TENNIS	2,88	3,06	-0,727	98	0,468
SHOOTING	2,52	3,14	**-2,223**	98	**0,028**
CHESS	2,00	2,3	-1,210	98	0,229
TENNIS	2,86	3,06	-0,761	98	0,447
WATERPOLO	2,14	2,62	**-1,995**	98	**0,048**
ROWING	2,44	2,74	-1,159	98	0,248
YOGA	3,22	1,66	**6,939**	98	**0,000**

Table 8. Classification matrix of males and females based on discriminatory function

	Classification %	G_1:0 p=,50000	G_2:1 p=,50000
G_1:0 (female)	90	45	5
G_2:1 (male)	96	2	48
Total	93	47	53

According to the results 45% of female students are a part of homogenous population, while 5% cannot be classified. The percentage of male students is even higher for 48% of them can be classified to a homogenous group, which confirms that variables used are good in classifying subjects according to sex.

Conclusion

The results of our study indicate that students are knowledgeable of the importance of physical activity. Unfortunately, this knowledge by it self does not lead to awareness of the beneficial effect sport and physical activity in general have on health while as many as 45% of students, besides the obligatory education, don't spend any spare time in physical activity. It must be emphasized that the students questioned, being a good representative of nowadays students, are under enormous academic pressure, spending more and more time sitting in front their pc monitors. The interesting results also lie in the fact that there are great differences among male and female students, which must be taken in account when offering obligatory and extracurricular physical activities in order to obtain the greatest possible effect. A fact that swimming is the most popular sport between both sexes lies in the specific geographic of our country. Further investigation is planed among students of other Faculties within our Universities, which could give the global results and could lead to general improvement of physical education programmes.

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DANCING ACTIVITIES IN TEACHING PHYSICAL EXERCISE AND HEALTH CULTURE ON FACULTY OF PHILOSOPHY IN ZAGREB

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Abstract

Department of Kinesiology on Faculty of Philosophy in Zagreb started a pilot program of dance activities in the academic year 2003./04. which included folk and social dance, classical ballet, jazz dance, cheerleading – supporting dance group and pom pom squads. Criterion for enrollment in these dance groups was not students' previous knowledge nor motorical predispositions for certain dance. Students chose a sport activity based on their personal interests and motifs. The basic program of dance activities was based on theoretical and practical aspects, which were adapted to their initial knowledge and general abilities. In the next academic year, due to great interest of female students, this modern and attractive program has become part of regular teaching program of physical and health culture on the Faculty of Philosophy in Zagreb.

Key words: *Dancing activities, female students, physical exercise and health culture.*

Introduction

Female students of Faculty of Philosophy in Zagreb expressed great interest in dance activities in the survey conducted in academic year 2001/02, on the sample of 2206 students (1st to 4th year).Out of 62 proposed sport activities, dance was ranked second on the scale, as the most wanted activity. (Gošnik, Fučkar, Alikafić, 2003). Due to these results, Department of Kinesiology on Faculty of Philosophy in Zagreb, started a pilot program of dance activities in the academic year 2003/04. 1st and 2nd year students could attend these classes as their compulsory classes, while 3rd and 4th year students were offered to attend these as optional classes within *physical exercise and health culture.*

The pilot program included 5 dancing activities:

- Folk dances
- Social dances
- Classical ballet
- Jazz dance
- Cheerleading – supporting dance group and Pom Pom Squads

The selection of these activities was primarily based on personnel and material conditions of the Faculty as well as on the attractivity of each dance. Classes were held twice a week (for 60 min.), which means 30 hours per semester, or 60 hours per year. Criterion for enrollment in these dance groups was not students' previous knowledge nor motorical predispositions for certain dance. Students chose a sport activity based on their personal interests and motifs. The basic program of dance activities was based on theoretical and practical aspects, which were adapted to their initial knowledge and general abilities.

Folk dances – basic program in physical and health culture

1. BASIC INFORMATION ABOUT FOLK DANCES

a) the role of folk dances in cultural and social life
b) folklore in Croatia
   - historical development
   - the importance of perserving croatian cultural heritage

2. CHARACTERISTICS OF CROATIAN DANCE ZONES (ZONES ARE DETERMINED GEOGRAPHICALLY)
   (dancing structures, type of music, musical instruments, costumes)

a) Alpine dance zone
b) Pannonian dance zone
c) Adriatic dance zone
d) Dinaric dance zone

3. DEVELOPMENT OF DIFFERENTIAL TECHNIQUE IN RELATION TO LEVELS OF STUDENT QUALITY

a) basic steps of folk dances
b) dance variants
c) choreography

4. BASIC METHODOLOGY FOR INDIVIDUAL AND GROUP WORK
5. PRACTICE PLANNING AND PROGRAMMING

Social dances - basic program in physical and health culture

1. BASIC INFORMATION ABOUT SOCIAL DANCES

a) the role of social dances in cultural and social life
b) historical development of standard and hispanic dances
c) dance etiquette

2. DANCE CHARACTERISTICS (movement structure, type of music, rhytm and tempo)

a) English waltz
b) Viennese waltz
c) Disco fox
d) Foxtrot
e) Cha-cha-cha
f) Rock'n'roll
g) Blues
h) Samba
i) Rumba
j) Jive
k) Tango
l) Mambo
m) Salsa

3. DEVELOPMENT OF DIFFERENTIAL TECHNIQUE IN RELATION TO LEVELS OF STUDENT QUALITY

a) basic steps of individual dances
b) combinations
c) choreography

4. BASIC METHODOLOGY FOR INDIVIDUAL AND GROUP WORK
5. PRACTICE PLANNING AND PROGRAMMING

Classical ballet - basic program in physical and health culture

1. BASIC INFORMATION ABOUT CLASSICAL BALLET

a) historical development of classical ballet in the world
b) historical development of classical ballet in Croatia

2. DEVELOPMENT OF DIFFERENTIAL TECHNIQUE IN RELATION TO LEVELS OF STUDENT QUALITY

a) basic concepts
b) leg position
c) arm position
d) body position and posture
e) classical ballet poses
f) transitions and side movements
g) bounces
h) leg swings and circular movements
i) cross-bar exercises
j) floor exercises
k) choreography

3. DEVELOPING MOTORICAL AND FUNCTIONAL CAPABILITIES
4. BASIC METHODOLOGY FOR INDIVIDUAL AND GROUP WORK
5. PRACTICE PLANNING AND PROGRAMMING

Jazz dance- basic program in physical and health culture

1. BASIC INFORMATION ABOUT JAZZ DANCE

a) historical develpoment of jazz dance in the world
b) historical development of jazz dance in Croatia

2. CHARACTERISTICS OF DIFFERENT TYPES OF JAZZ DANCE

a) regarding movement structures based on different techniques (ballet jazz, modern jazz, free style)
b) regarding movement structures based on different kinds of music (funky, funky jazz, soul jazz, MTV jazz)

3. DEVELOPMENT OF DIFFERENTIAL TECHNIQUE IN RELATION TO LEVELS OF STUDENT QUALITY

a) basic concepts
b) classicall ballet basics
c) leg position
d) arm position
e) body position and posture
f) bounces
g) leg swings and circular movements
h) spins and rotations
i) choreography

4. DEVELOPING MOTORICAL AND FUNCTIONAL CAPABILITIES
5. BASIC METHODOLOGY FOR INDIVIDUAL AND GROUP WORK
6. PRACTICE PLANNING AND PROGRAMMING

Cheerleading – supporting dance group and Pom Pom Squads - basic program in physical and health culture

1. BASIC INFORMATION ABOUT CHEERLEADING AND POM-POM SQUADS

a) historical development in the world
b) historical development in Croatia

2. CHARACTERISTICS OF CHEERLEADING GROUPS

a) equipment use
b) choreography
c) cheering

3. CHARACTERISTICS OF POM POM DANCE SQUADS

c) use of pom poms
d) choreography

4. DEVELOPMENT OF DIFFERENTIAL TECHNIQUE IN RELATION TO LEVELS OF STUDENT QUALITY

a) basic positions and postures
b) pyramids and support (basic holding and catching movements)
c) pyramida and support
d) bounces
e) gymnastic elements
f) dance elements
g) pom-pom use
h) cheerleading groups choreography
i) dance groups choreography

5. DEVELOPING MOTORICAL AND FUNCTIONAL CAPABILITIES
6. BASIC METHODOLOGY FOR INDIVIDUAL AND GROUP WORK
7. PRACTICE PLANNING AND PROGRAMMING

Conclusion

Due to great interest of female students, dance activities have become part of regular teaching program of physical and health culture on the Faculty of Philosophy in Zagreb. All dance activities are still a part of compulsory lesson-plan, except cheerleading; due to many competitions and sport events, the number of lessons has increased (there are more choreography practices).

In order to equalize number of male and female students, the teaching of social dances is organized in cooperation with the Faculty of Electrical Engineering and Computing.

By introducing this modern and attractive program , we fully use all the potentials at disposal in the physical and health culture, both in pedagogical and educational way. There is also a positive influence on the whole anthropological status of the students. Primarily, this refers to impotance of being healthy and improving health. Also, one aquires a number of motorical information, necessary for rational and meaningful use of free time.

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DIFFERENCES IN CERTAIN MOTOR ABILITIES OF THE FULL-TIME KINESIOLOGY STUDENTS AND PART-TIME SPORT COACHING STUDENTS

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Abstract

The differences in some motor abilities between full-time kinesiology students and the part-time sport coaching students, specialized in fitness was established by the T-test, analysis of variance and discriminant analysis. The results showed a difference in the tested motor features between the two groups. The obtained differences can be presumably explained by the morphological differences between these two groups of students. Greater muscular mass and shorter limbs of the part-time students of the High School for Coaches, specialization in fitness, resulted in the statistically significant differences.

Key words: *motoric tests, bodybuilding, students*

Introduction

Motor abilities are responsible for several numbers of motor responses. One part of the motor abilities is under a considerable influence of genetic factors, whereas the other part is susceptible to various exogenous factors, especially sports training. There are many scientific articles dealing with motor properties, studied in the manifest as well as in the latent space (Kondrić, et al. 2002; Metikoš, et al. 2003). Information about the differences in manifested motor abilities between the bodybuilding students (part-time students of the Coach Education and Training Department with the specialization in fitness) and full-time kinesiology students (from the Faculty of Kinesiology, University of Zagreb) who participate in a large number of various sport activities are considered to be important to trainers and PE teachers for the proper selection of exercises that will be applied during the process of training.

Therefore, the aim of the present article is to define the differences in motor manifestations between the kinesiology full-timers who participate in a large number of various activities, and the sport coaching part-timers with the specialization in fitness predominantly occupied with only one sport activity (bodybuilding).

Methods

The research was conducted in October 2003 on a sample of 216 subjects. All the subjects were male, aged 21-25 yrs. A total of 149 of them were the full-time Faculty of Kinesiology students, whereas 67 were the part-time sport coaching students of the Coach Education and Training Department of the Social Sciences Polytechnics, Zagreb, with the specialization in fitness. Subjects were tested with seven motor tests selected in order to investigate the latent dimension with a minimum of three tests imitating the hierarchical model of the structure of motor abilities. Tests for assessment of the latent dimension of explosive strength and of speed of movement were selected. Explosive strength was tested by Sargent test (MFESVM), sitting basketball chest throw (MFEBMS), broad jump or standing long jump (MFESDM) and medicine ball throw from the supine position (MFEBML). Speed of movement was assessed by the leg tapping (MBFTAN), hand tapping (MBFTAP) and two-hands tapping (MBFTA2) tests. The collected data were processed by STATISTICA FOR WINDOWS, ver. 5.0.

Results

The central and dispersion parameters show the difference in all the speed of movement variables (MBTAN; MBFTA2, MBFTAN) between the kinesiology full-timers and the sport coaching part-timers specialized in fitness. The arithmetic mean differences favour the sport coaching students who, on average had better results in the tests assessing frequency of movements (MBFTAN 6,06; MBFTA2 0,7; MBFTAN 0,49).

Table 1. Central and dispersive parameters

Full-time students of the Faculty of Kinesiology, Zagreb							
	AS	MIN	MAX	RAS.	SD	SKEW	KURT
MFESVM	52,02	38,00	74,00	36,00	6,68	0,60	0,53
MFEBMS	6,09	4,27	7,87	3,60	0,63	0,05	-0,03
MFESDM	235,43	202,67	281,67	79,00	14,89	0,46	0,57
MFEBML	8,03	4,90	10,73	5,83	1,15	-0,13	-0,42
MBTAN	21,34	16,33	26,33	10,00	1,97	0,14	-0,10
MBFTA2	19,34	12,00	27,33	15,33	2,78	0,09	0,21
MBFTAP	40,45	33,33	52,07	18,73	3,88	0,57	-0,05
Part-time students of the Coach Education and Training Department of the Social Sciences Polytechnics in Zagreb							
MFESVM	53,67	30,00	75,00	45,00	9,60	0,24	0,30
MFEBMS	5,82	3,60	7,60	4,00	0,79	-0,55	1,17
MFESDM	237,34	182,00	286,00	104,00	21,60	-0,03	-0,06
MFEBML	7,93	3,60	11,00	7,40	1,42	-0,26	0,65
MBTAN	27,40	17,00	34,00	17,00	4,09	-0,72	0,05
MBFTA2	19,40	10,00	25,00	15,00	2,98	-0,40	0,38
MBFTAP	41,04	28,00	53,00	25,00	4,30	-0,28	0,87

The biggest difference in the tested motor dimensions between the kinesiology full-timers and the sport coaching part-time students specialized in fitness was found in the variable assessing speed of leg movement (MBFTAN). The advantage of 6.06 repetitions more in favour of the part-timers in fitness makes us to suppose that this variable will contribute mostly to the differentiation between groups at the global level. So obvious difference between the groups (MBFTAN 6,06) does not exist in the variables assessing explosive strength (MFESVM, MFEBMS, MFESDM, MFEBML). The biggest arithmetic mean differences between the groups were obtained in the variables assessing explosive strength of the legs (MFESVM and MFESDM). As regards the variables assessing arm and shoulder explosive strength the results show much smaller differences, this time in favour of the full-time kinesiology students. The difference in the variable MFEBML is 0.1cm, whereas in the variable MFEBMS it is 0.27cm. Dispersive parameters values pointed out to a greater standard deviation and a greater result span for the sport coaching part-timers in most of the variables. Smaller standard deviation value and smaller result span emphasizes greater homogeneity of the results of the full-time kinesiology students. The results of Kolmogorov-Smirnovljev test applied on every motor variable show no statistically significant deviation in the distribution of the results obtained in the motor tests.

The supposed differences between the observed groups at the global level, was proved by a statistically significant discriminant function ($p<0,01$). Partial differences have been determined by the *t*-test, analysis of variance and structure of the discriminant function (Table 2).

Table 2. t– test, ANOVA and structure of the discriminant function

	t-test	p	ANOVA	p	Structure of dis. fun
MFESVM	-1,46	0,15	4,69	0,03	- 0,09
MFEBMS	2,72	0,01	7,78	0,01	0,18
MFESDM	-0,75	0,45	0,56	0,45	- 0,05
MFEBML	0,54	0,59	0,38	0,54	0,04
MBTAN	-14,67	0,00	0,45	0,00	- 0,94
MBFTA2	-0,14	0,89	0,04	0,84	- 0,01
MBFTAP	-1,00	0,32	1,09	0,30	- 0,06

The used *t*-test for independent samples showed statistically significant difference between the two groups in the variables MBFTAN ($T=14,67$; $p<0,01$) and MFEBMS ($T= 2,27$; $p<0,05$). The ANOVA showed statistically significant differences in the variables MBFTAN ($F=0,45$; $p<0,01$) MFEBMS ($F= 7,78$; $p<0,01$) and MFESVM ($F= 4,69$; $p<0,05$).

Discussion

The analysis of dispersion parameters showed greater standard deviation value and result span in the group of sport coaching part-timers, specialized in fitness, in all the applied motor variables. ANOVA showed statistically significant differences on the majority of the variables.

The differences in the variable MFESMV ($F=4,69$; $p<0,05$), in favour of the part-timers could be explained by the specific characteristics of sport branch. The aim of bodybuilding is to enhance muscular mass, so students of the Coach

Education and Treining Department, with the specialization in fitness have bigger muscular mass than the full-time students of the Faculty of Kinesiology, as determined in a previous research (Sporiš et al., 2004). It is known that a muscle with a bigger cross sectional area produces a greater muscle force. That was, presumably, the main reason for the better results of the part-timers in the variable MFESVM, assessing leg explosive strength. Statistically significant differences in the variable MFEBNS ($F=7,78$; $p<0,05$) are turned into advantage for the full-time kinesiology students. One of the reasons for that may be in the fact that the full-time students have longer arms (Sporiš at al., 2004). If we observe arms like levers, it becomes obvious that the longer the arms, the longer the levers, so longer levers produce greater force (Zatsiorschy, 1975). That is just one of the reasons why the full-time students achieved better results in the MFEBMS test. The other reason may be a better basketball technique of two handed throwing the ball from the chest. The full-time kinesiology students are due to enrol in the university one-semester subject Basketball which allows us to suppose how their better throwing technique may contribute to statistically significant difference in the variable MFEBMS ($F= 7,78$; $p<0,05$). The biggest statistical difference between the groups was obtained in the MBFTAN variable ($F=0,45$; $p<0,01$). The students of the sport coaching study course, specialized in fitness, had on average 6,06 more repetitions than the full-time kinesiology students. It is reasonably to presume that one of the possible explanations might be leg length. The part-timers have shorter legs with bigger muscle mass (Sporiš, et al., 2004). It was mentioned before that the subjects with bigger muscle mass (bigger cross sectional area) can exert greater force. In our case this force acts on a shorter lever (shorter legs), eventually resulting with the statistically significant differences between the groups in the MBFTAN ($F=0,45$; $p<0,01$) variable. Partial differences were established with *t*-test and ANOVA analysis of variance. Unfortunately, by applying this analysis we cannot certainly assert which variable contributes most to the differences at the global level. The discriminant analysis, can give an answer to this question with the structure of discriminant function. The variable assessing speed of movement MBFTAN (-0,94) has the highest correlation with the discriminant function. All the other variables have lower correlations with the discriminant function. The obtained differences may be attributed to the bodybuilding specific characteristics. As said before, the aim of bodybuilding is to enhance muscular mass, which results with the morphological differences between the groups (Sporiš et al., 2004). This study proved the differences between the group of part-time students of the Coach Education and Training Department with the specialization in fitness and the full-time students of the Faculty of Kinesiology in the tests for assessment of explosive strength (MFESVM; MFEBMS) and speed of movement MBFTAN. The obtained differences in the measured motor spaces are a consequence of the morphological differences between the two groups, as well as of the difference in their motor knowledge. According to the results of this research we think that the programme of the sport coaching part-timers should be enriched with various sports. The goal of the new program should be the enlargement of the motor knowledge of the part-time sport coaching students.

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EVALUATION OF DIVING TASKS OF THE FACULTY OF KINESIOLOGY STUDENTS

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Abstract

Basic principles of free diving are taught as part of the swimming classes at the Faculty of Physical Education in Zagreb. The theory lecture takes 2 hours, while the practical work is carried out through 8 hours of pool classes. As part of the diving classes the students are introduced to basics of free diving. The framework program includes: usage of fins, mask and snorkel, swimming technique with fins, mask and snorkel, equalization of pressure, breath holding, the vertical dive, orientation under the water, diving in depth and distance, equipping under the water, breathing technique directly before submersion and surfacing method. Preliminary exam in free diving consists of four tasks: the vertical dive, orientation under the water (spirals), equipping under the water and length dive.

The primary aim of this research was to establish if the diving classes can lead to positive changes in apnea, and if the length of time one holds his breath under water could influence the success of performing diving tasks.

The research was carried out on a sample of 85 students Faculty of Physical Education. Prediction variables are apnea after inspiration, apnea after expiration, length dive and vital capacity. Criterion variables are the vertical dive, spirals and equipping under the water.

We conducted a t-test of difference for dependent samples in order to test the significance of difference between initial and final condition. After this we conducted a regression analyses for determining the significance and relative magnitude of influence of prediction sets (the vital capacity, apnea and length dive) on the criterion variable (the evaluation of diving tasks).

According to the research results it can be concluded that the students have significantly improved their initial results of apnea and length dive after eight hours of practical diving classes. Evaluations of diving tasks they achieved at the end of the classes have the expected middle and even higher values, which speaks to the appropriateness of set diving tasks for student population. Influence of apnea on the performance of diving tasks proved significant only when performed after inspiration and even then it was rather modest. The vital capacity, as lung capacity, did not manifest a significant influence on any diving tasks.

Key words: *free diving, apnea, students*

Introduction

Free diving includes diving in inspiratory apnea duration of which depends on several factors, like: age, gender, vital capacity, body readiness, motivation, level of mental readiness, pressure and environment temperature (Detić, 2004). Also with swimming, in certain segments of swimming laps there are short phases of breath holding, which is especially occurs with swimming starts and turns. Basic principles of free diving are taught as part of the swimming classes at the Faculty of Physical Education in Zagreb. 105 hours swimming course is held for students in the fifth and sixth semester, and diving is done in some 10 hours near the end of the course. The theory lecture takes 2 hours, while the practical work is carried out through 8 hours of pool classes. As part of the diving classes the students are introduced to basics of free diving. The framework program includes: usage of fins, mask and snorkel, swimming technique with fins, mask and snorkel, equalization of pressure, breath holding, the vertical dive, orientation under the water, diving in depth and distance, equipping under the water, breathing technique directly before submersion and surfacing method.

In order for students to pass the swimming exam they have to pass the preliminary exam in free diving. Preliminary exam in free diving consists of four tasks: the vertical dive, orientation under the water (spirals), equipping under the water and length dive.

The primary aim of this research was to establish if the diving classes can lead to positive changes in apnea, and if the length of time one holds his breath under water could influence the success of performing diving tasks.

Research method

Examinees

The research was carried out on a sample of 85 Faculty of Physical Education third year male students who passed the preliminary diving exam.

Variables

At the beginning of diving classes students were tested through three initial tests (1,2,3). After eight hours of practical training students were again tested with three tests and three evaluations of diving tasks (4,5,6). All tasks were carried out with the aid of basic diving equipment i.e. fins, mask and snorkel.

1. **Apnea after inspiration**: From the upright position in the water, hands holding the edge of the pool, dive after the maximal inspiration and stay as long as possible under the water surface.
2. **Apnea after expiration**: From the upright position in the water, hands holding the edge of the pool, dive after the maximal expiration and stay as long as possible under the water surface.
3. **Length dive**: Starting from the water dive the maximal length with the mask, fins and snorkel.
4. **The vertical dive**: Evaluation of vertical dive performance. From floating position in the water, bending the upper body by diving into the water bring the body in the vertical position on legs, lift the legs in the vertical position outside of the water and vertically dive into the water with the whole body.
5. **Spirals**: Evaluation of performance of a task consisting of a vertical dive, a horizontal diving position, a 360° turn around the longitudinal axis of a body to one side, a 360° turn around the longitudinal axis of body to the other side, a forward somersault and surfacing. The whole task must be performed at the length of about twenty meters.
6. **Equipping**: Evaluation of a task consisting of diving to the bottom of the pool (220 cm) without the equipment, which lies at the bottom, putting on fins, placing the mask on the face and clearing it, placing the snorkel, rising to the water surface and blowing the water out from the snorkel.

After descriptive parameters of measured variables we conducted a t-test of difference for dependent samples in order to test the significance of difference between initial and final condition in the three measured variables. After this we conducted a regression analyses for determining the significance and relative magnitude of influence of prediction sets (the vital capacity, apnea and length dive) on the criterion variable (the evaluation of diving tasks).

We calculated: multiple correlation coefficient (R), square of multiple correlation coefficient (R2), F-test for significance testing of multiple correlation coefficient (F), levels of significance of multiple correlation coefficient (p) in criterion variable.

The results and the discussion

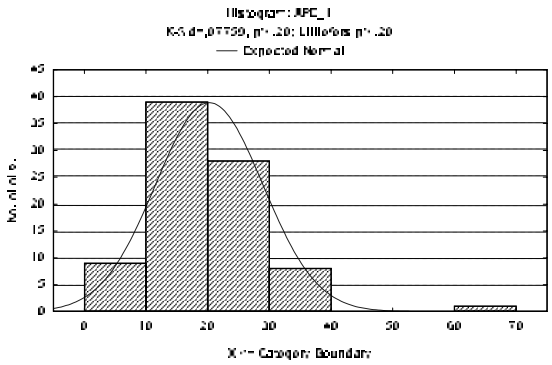
Table 1. Descriptive parameters of students (N=85)

		Mean	Min.	Max.	S. D.	Skew.	Kurt.
Age	number	22,66	20,00	26,00	1,33	0,35	-0,28
Height	cm	182,42	169,00	201,00	6,47	0,48	0,37
Weight	kg	80,20	60,00	103,00	8,54	0,19	0,30
Vital capacity	liter	5,69	4,28	7,84	0,72	0,67	0,65
VK %	%	92,93	71,00	118,00	9,64	0,22	-0,02
Apnea inspiration 1	sec	41,17	12,00	86,40	17,40	0,68	-0,02
Apnea expiration 1	sec	20,25	7,80	60,10	8,72	1,32	3,85
Length dive 1	meter	32,01	7,00	50,00	11,92	-0,09	-0,99
Apnea inspiration 2	sec	59,76	14,40	151,00	32,81	0,91	-0,01
Apnea expiration 2	sec	24,13	8,68	68,20	11,71	1,18	1,59
Length dive 2	meter	46,87	23,00	53,00	6,64	-2,57	5,72
Vertical dive	grade	3,53	1,00	5,00	1,20	-0,54	-0,46
Spirals	grade	3,53	1,00	5,00	1,04	-0,63	-0,04
Equipping	grade	3,28	1,00	5,00	1,58	-0,39	-1,42

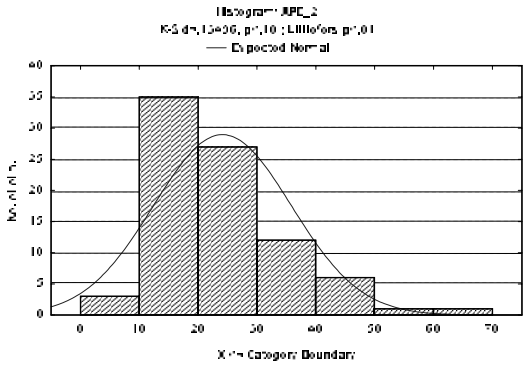
Variables age, height and weight were necessary in order to calculate % of excepted value of the vital capacity, which was measured with COSMED Pony spirometar graphic. Average result of the vital capacity of students was 5,69 liters, which is 93 % of excepted value. According to Žuskin (Heimer and sur., 1997) men of same height and age have the average vital capacity of 6,18 liters, which is more than our students have. Value of the vital capacity of a healthy man according to Guyton (1980) is 4,6. In his book, Potočnik (2000) states that an average value of Slovenian students that singed up

for diving course is 6,1 liter, however many authors place this lung capacity in anthropometric measures because they have found out that this value is more dependant on longitudinal and transversal characteristics of an individual than it is of functional character.

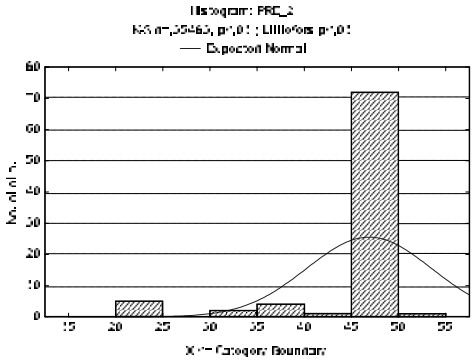
In his book, Potočnik (2000) states that an average value of Slovenian students that singed up for diving course is 6,1 liter. This is a little bit more than our students but closer than according to Guyton. By examining table 1 it is possible to see that asymmetrical values (skew.) point to mainly normal distributions besides the variable apnea expiration 1 and 2 and



Apnea expiration 1.



Apnea expiration 2.



Length dive 2.

variable length dive 2. Similar thing happens with the measure for length (kurt.), where again the mentioned variables are separated. All three variables express the larger homogeneity of group while with others there is presence of heterogeneity.

With Apnea expiration variable majority of the results is in the zone of lower results because several individuals significantly stood out with very good result. With Length dive variable 2 (the final result) majority of examinees has achieved values between 40 and 50 meters because it was necessary to dive the length of 50 meters for the preliminary exam , i.e. all of them wished to meet the norm straight away in the first final measurement.

Results of difference between initial and final conditions

Table 2. t-test of the initial and final condition of students in the Apnea inspiration variable

	AS	SD	N	t	df	p
Apnea inspiration 1	41,17	17,40				
Apnea inspiration 2	59,76	32,81	85	-6,57	84	0,00

According to results from table 2, we can conclude how arithmetic means of the first and second measurement in the variable Apnea after inspiration is statistically significantly different at the importance level from 99%(p = 0,00) while the t-test value is 6,57. Mean value of initial condition was 41 seconds, of final 59 seconds. Which is a positive difference of 18 seconds. Duration of apnea of ordinary person on land is 0,5 to 1,5 minute (Detić, 2004). Consequently the final result of students' apnea has ordinary person's average value but if performed on the dry land which is surely much easier. Trained free divers usually dive to the depth 25 meters, which requires apnea in the duration of about 2 minutes. World record in apnea in the water is 8 minutes and 58 seconds, and it is held by German Tom Sietas. (EFSA, 2004.)

Table 3. t-test of the initial and final condition of students in Apnea after expiration variable

	AS	SD	N	t	df	p
Apnea expiration 1	20,25	8,72				
Apnea expiration 2	24,13	11,71	85	-3,13	84	0,00

According to results in table 3, it can be concluded that arithmetic means of the first and second measurement in Apnea after expiration is statistically significantly different at the importance level of 99% (p = 0,00) while the t-test value is -3,13. Mean value of the initial condition was 20 seconds, and of final 24 seconds. This makes a positive difference of 4 seconds. As this is about holding one's breath after expiration the received values cannot unfortunately be compared with similar results, as they were not found. This test must have been very hard for students because of the water medium, possible psychological confusion due to diving in without air, which certainly lead to fear. Further on, results must be taken with a grain of salt because results of apnea after inspiration and expiration were very similar with some students. However the improvement after the diving classes was statistically significant.

Table 4. t-test of the initial and final condition of students in the LENGTH DIVE variable

	AS	SD	N	t	df	p
Length dive 1	32,01	11,92				
Length dive 2	46,87	6,64	85	-13,17	84	0,00

According to results in table 4, it can be concluded that arithmetic means of the first and second measurement in Length dive is statistically significantly different at the importance level of 99% (p = 0,00) while the t-test value is -13,17. Mean value of the initial condition was 32 meters dived, and of final 46,9 meters. After the diving classes students progressed for approximately 15 meters, that, however, was not good enough because to successfully pass the preliminary exam it was necessary to dive for 50 meters

Regression analysis results

The following tables (tables 5-7) show the regression analysis results of significance and extent of influence of final testing on evaluation of diving tasks. By checking the tables it can be noticed that all relations between final measuring of vital capacity, apnea, length dive and evaluation of diving tasks are statistically significant.

Table 5. Regression analysis results of VERTICAL DIVE variable

Multiple R = 0.362, R^2= 0.13, F (4,80)=3.02, p<0.02						
	Correlat.	**Part.Cor.**	**Beta**	**B**	**t(80)**	**p-level**
Vital capacity	0,15	0,08	0,08	0,13	0,72	0,47
Apnea inspiration 2	0,31	0,20	0,23	0,01	1,85	**0,06**
Apnea expiration 2	0,17	0,03	0,03	0,00	0,29	0,77
Length dive 2	0,24	0,17	0,17	0,03	1,52	0,13

Table 5 shows the regression analysis results of the influence of predictors on the vertical dive performance evaluation. All four predictors can foresee the success of vertical dive performance with 13 % certainty at the significance level of 95%. Only duration of apnea after inspiration has marginal statistical significance. Therefore to perform vertical dive well the most important thing is how long can students stay under water after maximal inspiration.

Table 6. Regression analysis results of SPIRAL variable

Multiple R = 0.366, R^2= 0.13, F (4,80)=3.09, p<0.02						
	Correlat.	**Part.Cor.**	**Beta**	**B**	**t(80)**	**p-level**
Vital capacity	0,15	0,08	0,08	0,12	0,76	0,45
Apnea inspiration 2	0,28	0,17	0,19	0,01	1,51	0,13
Apnea expiration 2	0,14	0,02	0,02	0,00	0,19	0,85
Length dive 2	0,29	0,22	0,22	0,03	2,05	**0,04**

Table 6 shows the regression analysis results of the influence of predictors on the Spiral performance evaluation. All four predictors can foresee the success of the performance of spiral with 13 % certainty at the significance level of 95%. Only length dive variable stands out as statistically significant. This means that for the task of orientation under water, which is performed at approximately 20 meters distance, the most important segment of diving is the length of the dive. In this case breath holding was not significant. When performing this task, students obviously only think of performing the task at the assigned length as soon as possible and not taking into consideration that slower performance of the task might get them a better evaluation. With slower performance duration of apnea would probably also be significant.

Table 7. Regression analysis results of EQUIPPING variable

Multiple R = 0.438, R^2= 0.15, F (4,80)=4.76, p<0.00						
	Correlat.	**Part.Cor.**	**Beta**	**B**	**t(80)**	**p-level**
Vital capacity	0,13	0,04	0,04	0,09	0,39	0,69
Apnea inspiration 2	0,35	0,24	0,27	0,01	2,21	**0,03**
Apnea expiration 2	0,15	-0,01	-0,01	0,00	-0,09	0,93
Length dive 2	0,35	0,28	0,27	0,06	2,57	**0,01**

Table 7 shows the regression analysis results of the influence of predictors on the Equipping task performance evaluation. All four predictors can foresee the success of the performance of spiral with 15 % certainty at the significance level of 99%. Variables length dive and apnea after inspiration stood out as statistically significant. Equipping under water was the hardest diving task for students which can be seen from an average grade that is lower then the two other (table 1). A longer stay under water is necessary to successfully perform this task, which is manifested through the ability of breath holding under the water. The positive influence of length dive in this task is also connected with the ability of breath holding under the water, and it is obvious that these two significant variables are in high correlation.

Conclusion

According to the research results it can be concluded that the students have significantly improved their initial results of apnea and length dive after eight hours of practical diving classes. For majority of students the swimming classes were the first time they encountered the basics of diving and usage of fins, mask and snorkel. There of the differences between starting and final condition are significantly evident. Evaluations of diving tasks they achieved at the end of the classes have the expected middle and even higher values, which speaks to the appropriateness of set diving tasks for student population. Influence of apnea on the performance of diving tasks proved significant only when performed after inspiration and even then it was rather modest. The vital capacity, as lung capacity, did not manifest a significant influence on any diving tasks. It could be concluded that the performance of diving tasks does not depend on the amount of available air but on anaerobic sources of power in muscles.

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CHRISTIAN-ANTHROPOLOGICAL ASPECTS OF PHYSICAL EDUCATION

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Abstract

Different anthropological aspects of physical education of man, among which only Christian Anthropology gives the man as appearance and similarity Divine, are given. A man is an incarnate spirit and inspired body, and its still human spirit is expressed corporal. A man is nature which the whole world coincides in: world of nature, world of other people, and world of own consciousness and personalities, in which she can find God.

Key words**:** *Physical Education; Christian Anthropology; God; Man; Body; Spirit; Sport; Christian Ethics; Religion.*

Introduction

Physical education is above all directions of introduction of physical culture. It is called to provide development of physical, moral-volitional, mental capabilities of a student. Revolutionary genetic and biological technologies (foremost, clone, transplantation of organs, impregnation of in vitro, substitute maternity and practice of transsexual operations), unexpected and unusual processes of transformation in the questions of floor (forming of homosexual marriages and, more than that, families), and today make actuality of researches of man in the river-bed of questions of corporal.

Methods

The methods of theoretical analysis of sources from the problems of spiritual-moral aspects of physical education were used. Various directions of physical education and sport were explored by facilities of Christian anthropology, psychology and religion.

Results

Modern anthropology considers a number of types of people: homo religiosus – man, who is capable to glance for the scopes of the corporal measuring and gives oneself up to the comprehension of transcendent; homo sapiens – man clever (is to be reconstructed under the wire of mind from clean individuality approach ("cold mind") to the partner one, that requires respect attitude toward nature, interests and persuasions of other people, groups, nations, peoples); homo spiritus (animus) – man spiritual (transmitter of spiritual values of high morality standards); homo somaticus vivens - a man as a creature is corporal, that lives; homo liber – man how a free creature is; homo loquens - a man as a creature is speaking; homo socialis - a man as a creature is social; homo creator, culturalis – man the creator and user of culture; homo simplex – man simple; homo faber - man, the worker for Anri Bergson (friendly and thrifty attitude toward nature, native and positive changes of individual and public consciousness of man in its attitude toward nature did not happen); homo politicus – man the politician (carries on state activity); homo ludens (for Y.Heyzinga) – man the player (man with unrealized mental abilities, who is unconscientious of its behavior. Its acts are similar to the acts of a child, which is sometimes cruel in relation to others, as an internal moral criterion is not yet formed. They are in a great degree dependent upon natural instincts and social terms, than foresight of its mind); homo duplex – man double; homo students – man who studies; homo noospherato – man of noosphery (after V. Vernadskij and Teilard de Chardin. A man goes out outside a planet Earth); homo absurdus – man of the special social type - "man of absurdity", which is limited, by a complacent ignoramus.

A man is nature which the whole world coincides in: world of nature, world of other people, and world of own consciousness and personalities, in which she can find God. A man is nature a material-world and must honor outward things and earth. It is nature substantially to public, therefore must give itself to others. The man is nature of consciousness, therefore must find itself and confirm, and, finally, is the opened nature, is therefore able to go out from the center and unite with "other", that is be ready to auto transcendent.

A man is an incarnate spirit and inspired body, and its still human spirit is expressed corporal. Body and soul of man – this is not two realities, that are separated one from the other. Body – it is the organized matter composite with a soul. Body, having a need for the feed, motion, rest, reproduction falls under the laws of matter, that is, in particular, under the law of death. A still human soul revives a body, exposes spiritual possibility more abstract to think, to create ideas, estimations, reasoning, freely to make decisions. The man does not test corporal death and can not decompose. The soul of man is immortal, has its beginning from the moment of conception and is responsible for the acts of the person.

A man has a value in itself and can not be a mean. A man is an incarnate spirit and inspired body, and its still human spirit is expressed corporal. Body and soul of man – they are not two realities, that are separated one from the other. Body – is the organized matter connected with a soul? Body, having a need in the feed, motion, rest, reproduction falls under the laws of death. A body is provided with five sense-organs. A still human soul revives a body, expresses spiritual possibility more to abstract thinking, to create ideas, estimations, reasoning, to make decisions. It does not test corporal death and can not decompose. The soul of man is immortal, has beginning from the moment of conception and is responsible for the actions of person. According to the Christian study a man gets a body through the parents and soul directly from God. A spirit is the deepest part of soul, because he represents our consciousness. Spirit – this is our own "Ego", through which we directly touch the God. Not by a chance, large Ivan Franko wrote: "Spirit that a body tears to the fight tears for advancement, happiness, will, he did not die, and he lived still". A spirit is under act of the Saint Spirit, plenty Divine operates in him. A spirit shows up in fear to Divine, conscience and search (to thirst) of God. By a body we are similar, heartfelt displays also are near, and spirit we not identical, because he creates our uniqueness, that is -personality.

A still human soul has mind, free will and sense. A faith operates in the mind of man, in will - love, and in senses - hope. The mind of man searches the greatest true – God and road to goodness, specifying laws – rules of correct conduct. Will desires to understand a true as the greatest goodness, to hold correct conduct and ethics laws. That a man lived in accordance with the nature, mind has freely and sincerely to search truth, and will - is always to desire offered by mind truth as the goodness. Will of man is always to act after the wire of mind. Man – this three worlds: corporal, which instincts, sense, are operated in; cognitive (perception, thought, memory, imagination, feeling); affect (emotions, touching, passions). From the point of view of Christian anthropology is something absolutely single, which is person as a soul and body is together taken, that other by the essence, calling, activity, dignity, with difficulties and setting. A term "person" includes something sacred, appearance is Divine, which is natural similarity to God by the soul and its signs: by a mind, will, memory, power, talents. Not by a chance, that objection of God deprives the face of its basis. Understanding of person as similarities of Divine consists in its eldritch similarity to God through aspiration to perfection, holiness according to Christ: "accomplished, as Father is your celestial accomplished" (Mt. 5.48). Not by a chance St. Atanasiy the Large taught: "For that God became a man, that a man became similar to God".

A man is the blacksmith of his happiness. When spirit, soul will dominate above a body, a man will act morally well, and when, opposite, a body will manage a soul, a man will get in a sin. A man will be well morally formed, if will have such order of costs: spirit, sense (emotions), and body. Christian anthropology divides the spiritual life of man on three component parts: thought sensuality and will. Man as well as the whole world results from God. Its dependency upon God and has substantially the important relationships with Him. A man consists of soul and body, from a matter and spirit, from premature and eternal. It cognizes truth about the world, about itself and about God. Only then, when it tries to understand, who it is that makes its grandeur, and also grandeur of other people and grandeur of Creator Which created all on good of man, will realize itself as a person. A still human face can be the transmitter of the following values: religious (holiness, personal faith, aspiration to perfection), moral (humility, cleanness, generosity, mercy, meekness), aesthetically beautiful (beauty, charming, wit, artistic taste), intellectual (penetrating, reasonableness, intuition), vitalis (sexuality, playfulness, energetic) and other values. A man is called in the life to be the transmitter of such values, and does not have various material, intellectual values. Christian principle of life sounds: search King of Divine above all things, and all the rest to you will be added (Mt. 6.33).

Sport as one of varieties of physical education directly unites with religion which was always engaged in the questions of morality education. Cherishing of dignity of person and harmony of still human body is a primary purpose and sport function. Sport fastens a body, does it healthy and strong. That to achieve this objective, a body must submit to a definite discipline. Sport trains a man to self-control, teaches to be brave to the dangers. Sport is a school of patriotism, responsibility, courage, solidarity, honesty, friendship, endurance, mutual support, wisdom, courage, restraint, justice. Per aspera ad astra – "Through sloes to the stars", learns the winged Latin utterance. Sport is instrumental in the healthy way of life, making of character, will and integral development of personality. He carries out ponderable payment in the peaceful understanding among peoples, religions, is instrumental in construction, according to the Pope John Paul II, civilization of love. Sport must not become the mean of commercialization only, and to be the universal mean of corporal and heartfelt perfection, moral growth in natural and eldritch virtues.

Physical education requires complete development of body and spirit (healthy spirit in a healthy body!). Health, physical development, strengthening, forming of body are similarly important, how the same properties, that it is up to a soul, is because one thing is impossible without the second. Not only development of cognitive activity but also development of emotional and volitional chart, freshness and playfulness of senses, strength of mind, hardness of decisions, in a word, all formation of character to a great extent relies on physical properties of the individual.

Sport must serve not only to the healthy way of life and active and useful public activity, but also to serve God. So the sport built on Christian attitude, induces people to direct the physical efforts and moral virtues which He develops exactly for achievement of such purposes. If an infidel man got used to submit to the strict mode of sporting order only for that to extract the temporary large monasteries of winner, the Christianity submits for a higher purpose – eternal reward.

Christian Ethics is a science of physical and corporal life on the absolute values background that Christian Culture is filled with. It is based on universal moral law of humankind that is Ten Commandments of God and Two Fundamental Commandments of Christian Love and on Seven Corporal and Spiritual Works of Mercy, Evangelical Counsels and Beatitudes. Christian Ethics calls on respecting of life as the God's Gift.

Religion and sport perfect and form a man in its spiritual-corporal posing. It is two educate processes which mutually complement each other. Therefore and work in relation to harmonization and forming of personality proper institution must carry out concertedly, in a complex; and this activity can not be contradictory) both after the essence, and after a form.

Discussion

Christian-anthropological aspects of physical education help to understand the task of physical and spiritual development of man on a modern stage. Understanding of transition of man from homo somaticus to homo sapiens is important, and also to homo spiritus.

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Management of Sport – Developmental Aspects of Tourism and Sports

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THE MAIN FEATURES OF THE POSITION AND THE ROLE OF HUMAN FACTORS IN TOURISM INDUSTRY

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Introduction notes

Each discussion about the development factors of a certain economic sector or economy as a whole puts the development factors in a different context. Development factors of a sector can be analysed from the standpoint of the macroeconomic functioning of a sector or from the standpoint of the economy as a whole; they can also be putt in the context of the functioning of entrepreneurial resources. The characteristic of all of them is a relative scantiness, which implies the basic question which is raised for all bearers of economic policy: How to allocate scarce resources? Similar question is raised on the level of each individual person: For what to educate themselves, in which economics branches to invest?

Our analysis deals with one specific development factor and that is the human factor. It does not imply only a common context which can be met in discussions about population, employment, unemployment, etc. The short analysis should show the position and the role of the human factor in tourism industry. Tourism is a specific economic activity. In distinction to some capital intensive activities the characteristic of tourism is a relatively high share of working force in realizing its activity. The human factor in tourism industry has specific characteristics that distinguish it from the position of the human factor in other economic sectors. The limitation of some very important «technological» characteristics of the environment of human factors (automatization, robotization, informatization) gives it a special position and role in the process of tourism industry. The necessary quality of human resources is not revoked by the love towards work in tourism. Further, we are going to talk about these and some other aspects of labour input in tourism.

Three-partition of the factors of tourism industry

Development of tourism industry is simultaneously determined by the operation of different factors. Beside human and production factors, which stand out as determined, the so called a factor of tourist attraction (nature, art, cultural, historical and similar contents) has a special meaning for tourism industry and tourism output. Dynamics of the development of world tourism warns of specific conclusions concerning the importance of the particular factor for growth rate of tourist expenditure in particular country, or region. The dynamics analysis of the movement of tourism output in certain world regions shows the fact that the factor of tourist attraction is not a condition sufficing for the development of tourism capacity. Therefore, comparative analysis of the movement of the global tourism output of highly developed and less developed countries in the time period from 1990 to 2000 shows that there was no significant movement in creating the world tourism output: in 1990 developing countries had 23% in the total world tourism output, and in 2000 their share was about 30% (Družić, 2003:364).

The undisputable factor of tourist attractiveness of some regions of the world (Latin America, Caribbean, Middle East) is not a sufficient reason that could cause a substantial tourism-related effect. A more popular hypothesis is that a country must surpass a general development level in order for the tourism industry to achieve a higher share in the total economic output. In order to satisfy the preconditions for the development, agrarian and industrial transition must be completed and considerable steps in building the infrastructure must be taken. The inevitable part of the tourist infrastructure consists of adjusted capital and labour inputs.

In what follows we will analyse fundamental functions of the human factor in tourism industry: related to employment and management.

The position and the role of the human factor in tourism industry

The analysis of economic functions of tourism shows that tourism is a service. It means that human labour is of high importance in the activity: the process of "tourism production" directly links the producer of the service and its consumer. So, prominent connoisseurs in the area of tourism industry believe that the possibility to apply automatization and mechanization in tourism is limited to a large extent (Krapf, 1963:14). On the other hand some argue that implementing computer technology in tourism can promote its faster development (Barnes, 1981:11-23). Therefore, it could be said that there is an evolution in comprehending the roles of the human factor in the process of tourism output creation.

Without denying the first two notions, we still conclude that tourism as a tertiary activity can lead to high employment possibilities. This fact is of special importance for countries facing the problem of structural unemployment. Fast economic development causes surplus of labour input in the primary and secondary sector, which can then be employed in tourism. But as the competitiveness of tourism is increasing, the following issue arises: Where are the limits of employment in

tourism industry? Although there are no exact data for Croatia, the competitors' data show a high percentage of tourism-based employment in the total employment and in the tertiary sector employment on the level of a growing labour productivity in tourism.

The restructuring process of Croatian tourism must take into account the efficiency of the labour input. Thus it cannot be argued that there is uncritical employment which neglects educational and professional qualities of the workforce.

Employment and tourism output

Tourism in Croatia as a main economic activity, as was mentioned before, has based its development upon environmental and human resources and traffic potential. There are two main functions of tourism on which its fundamental importance for Croatian economy is based. The first is the role of stabilizing the national balance of payments account and the other is the stabilization of the national employment market. The latter causes both an increased interest and a controversy in the scientific and professional milieu, especially in the area of the multiplier effect of employment in tourism, and educational and professional adjustment of human resources in tourism

Today, it is almost impossible that the tools of economic policy have only a one-way effect on the aimed area of economic development. Moreover, consequences of the activities taken in one area will cause the effects in other areas as well. And given evidence is a concept of a so called 'multiplication of tourist spending', that has been employed in the tourism economics since 1961. Originally premeditated as an analytical concept to calculate the effect tourist spending on the economic growth, i.e. national income, later it has been put into the context of 'multiplication of employment' (Clement, 1961:18-26). The standard model of the multiplier of employment shows a multiplicative effect of employment in tourism on an increase of employment in economy as a hole.

For example, certain authors give concrete calculations: in the case of Great Britain it is shown that on every 100 employees in a tourism sector 4 new employees are employed in other economic sectors. Furthermore, the results of some authors concerning the multiplicative function of tourist consumption show much lower costs in employment in tourism in relation with other economic sectors.

Some rare attempts of calculating the multiplicative effects of tourism consumption in Croatia on the national economy showed at the end of 1980s of the previous century that the realised tourism turnover of 2.4 billion US$ generated indirect effects on generating approx. 8.4 billion US$ (Cicvarić, 1990:266). All calculations can be considered partly arbitrary because of the inconsistency of some particular macroeconomic aggregates, but we can see the positive relation of tourism turnover and production in national economy. Still, the question is raised about the actual effects on the growth of employment in the country concerning the fact that in the period we are talking about the phenomenon of employment was dominantly considered as a social and not as an economic category.

Nowadays, when the labour in Croatia is evaluated by market, it is clear that new tasks are given to tourism. This is especially true of employment as a significant stabiliser of the labour market in Croatia. The problem of overcoming the seasonal character of earning in this very important economic sector, however, stays open.

Table 1. The share of employment in tourism in total employment in Croatia

Year	Total in 000	Growth rate of employment (%)	Tourism	Growth rate of employment in tourism (%)	Share of employment in tourism in total employment (%)
1987	1628		85		5.2
1988	1624	-0.2	87	2.4	5.3
1989	1618	-0.4	86	-1.1	5.3
1990	1568	-3.1	78	-9.3	5.0
1991	1432	-8.7	61	-21.8	4.3
1992	1201	-16.1	52	-14.8	4.1
1993	1238	3.1	51	-1.9	4.1
1994	1211	-2.2	49	-3.9	4.0
1995	1196	-1.2	45	-8.2	3.8
1996	1195	-0.1	45	0.0	3.8
1998	1272	6.4	36	-2.7	2.8
1999	1263	-0.7	33	-8.3	3.1
2000	1258	-0.4	43	30.3	3.4
2001	1273	1.2	44	2.3	3.5
2002	1289	1.3	45	2.3	3.5
2003	1330	3.2	46	2.2	3.5

Source: Statistical Yearbook, Central Bureau of Statistics, Zagreb, different years
Remark: Until 1996 the annual average was calculated as an arithmetic mean of two positions: 31 March and 30 September. The annual average of 1996 and 2002 is based on monthly positions corrected by data of full coverage with the position of 31 March.

Indicators in Table 1 show several important facts. The first one refers to the problem of comparing the indicators of employment in tourism in a respective period. Until 1997, according to an economic activities' classification in Croatia, the respective activity was treated as an activity "catering and tourism", and after that year it was classified as "hotels and restaurants" in the national statistics.

The other fact refers to a problem of different sensitivity of the total employment and the employment in tourism industry. One can easily notice a descending trend of total employment and employment in tourism. But, employment in tourism has particularly decreased, and by a higher rate than total employment, in the war period (1991, 1992 and 1995). Of course, it is important to emphasize that the process of restructuring tourism industry had a "destroying" impact on decline in tourism. There are a lot of cases in which the final aim of privatization was not the maintenance and development of tourism activity and employment. That process has still not finished. The quality of privatization in tourism will be crucial also for the level of potential employment growth.

The third fact is evident through a stable share of employment in tourism in a total employment at the level of 3.5 percentage points. Directives of higher employment in tourism mentioned previously (in the first place, the quality privatization that is expected to lead to a higher level of investment!) could be a factor of a higher share of employment in tourism.

Seasonal character of tourism activities – the real possibilities of higher employment

When analyzing the role and position of the human factor in tourism a time and space dimension should be taken into account. In general, one distinguishes between two time periods of doing business in tourism:

a) annual activities,

b) seasonal activities.

In the first case tourist facilities are located in an urban environment with a low level of capacity usage over weekends or during a tourist season. The objects of seasonal business, after the period of a total standstill, are utilized for various activities through three different periods: preseason, season and post-season. From the perspective of the human factor, the complexity in tourism, we would like to emphasize that there is a great need for seasonal labour force in Croatian tourism: approximately 35% of the total number of the employed.

The business dynamics of economic agents active in tourism has a significant influence on the labour force demand, especially in urban and pronounced touristy areas. Relevant analyses of labour force demand in tourism show that only 30% of the required labour force is recruited from the local seaside population pool. That opens up the opportunities of employment for the population from other parts of the country, especially as the Croatian tourism is characterized by a high share of complementary accommodation facilities, as well as a highly concentrated tourist season. The increasing seasonal labour force demand, on the other hand, opens up the issue of the qualified labour force deficit. The potential employment in the Croatian tourism of 110,000 to 135,000 people questions the real possibilities of reconciling the educational and professional structure of labour demand and supply.

The data provided by the Ministry of Science, Education and Sports of the Republic of Croatia and the Employment Agency indicate a pronounced discrepancy between the actual and the required structure of labour in tourism. The demand for certain educational profiles (hotel technician, hotel manager) is almost non-existent. On the other hand, there is a constant deficit of certain other professions (cook, receptionist, assistant caterer, chambermaid). Rather worrying is the fact that around 40% of the total labour force is unqualified.

The provided data indicate that enhancing the competitiveness of Croatian tourism cannot be achieved through uncritical seasonal employment of labour. There is a need for aimed cooperation between the Ministry of Science, Education and Sports and the Ministry of the Sea, Tourism, Transport and Development. In order to implement this cooperation, one must change the syllabi and the educational programs, matching them to the real needs of tourism industry. Of course, when doing so one must take into account the peculiarities of the supply of different counties (for example, continental vs. Mediterranean Croatia).

Table 2. Distribution of monthly tourist turnover in Croatia in 1987 and 2002 in %.

Months	Year	Tourists	Days
January	1987	4.1	2.7
	2002	1.1	0.5
February	1987	4.0	2.6
	2002	1.3	0.6
March	1987	4.7	2.7
	2002	2.3	1.2
April	1987	6.2	3.7
	2002	4.1	2.3
May	1987	8.7	6.2
	2002	8.6	6.5
June	1987	11.1	11.5
	2002	13.7	12.5
July	1987	16.9	23.4
	2002	24.2	29.7
August	1987	18.9	26.4
	2002	27.8	32.7
September	1987	10.7	11.8
	2002	0.1	10.3
October	1987	6.7	4.7
	2002	3.8	2.5
November	1987	4.0	2.2
	2002	1.6	0.7
December	1987	4.0	2.0
		1.4	0.6

Source: Calculated according to Tourism Statistical Reports of the Croatia Central Bureau of Statistics, various years.

The seasonal character of tourist spending is generally considered as one of the most important limiting factors of this sector. Although the official statistical calculations in Croatia do not register the time distribution of tourist spending, the relevant calculations of this distribution are highly significant. At the beginning of the 1990s the number of tourists in Croatia (foreign and domestic) was concentrated in summer months (June, July and August) (Cicvarić, 1990:334). From Table 2 we can see that the trends of seasonal oscillations in 2002 have increased. The warning signals are the indicators of the number of tourists and overnight stays.

Regarding the overcoming of seasonality problem in Croatian tourism and better job opportunities, there is hardly any improvement in sight. Experiences, not only from Croatia, suggest that tourism is not prone to sudden turnovers and high oscillations in growth rates. Thus, there is more talk on construction of sustainable growth of tourism including natural environment harmony on the supply side, tourist spending and employment.

The elements of macroeconomic and microeconomic management in tourism

In tourism, as in any other activity, everything starts and ends with the basic development input – the human capital. Any noteworthy activity has its leader, goals and measures. On the macroeconomic level it is good to have the consistency of goals and means of tourism strategy and policy in tourism. Identification of development goals in tourism (the balanced growth of supply and demand in tourism) cannot be viewed isolated from the strategies and policies overall economic development of a country. Following this notion, there is a question of the macroeconomic management quality: is there a country that aims at creating a propulsive tourist sector without a suitable ministry? What is going on with the strategy (long-term) and policy (short-term) of tourism development? And what about the human resources and cooperation between the decision makers - government, ministry of tourism, other ministries, chamber of economy, local authorities?

In the nature of any type of management, there is a process of coordinating business factors for reaching certain goals.

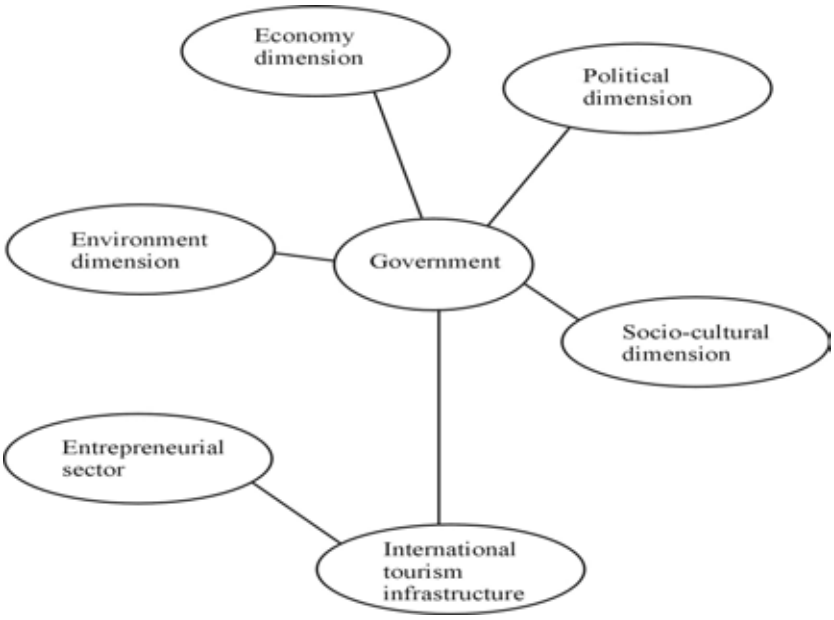

Figure 1. Policy and management model in tourism

The model presented in Figure 1 shows a network of a number of subjects in macroeconomic policy in tourism. Only a synergy effect of all relevant factors can spur the acceptable output in tourism.

If we put all into context of the role of human capital in tourism, it is necessary to stress that firms in tourism in ever more competitive domestic and foreign markets need to decentralize their offices, sections and management offices. The firms in tourism demand from their employees specific knowledge of procedures and general skills. The employment composition of a firm consists of full-time employees, and part-time employees when needed. Those special needs for special orders can be foreseen, and with mediation of the Employment Office part-time workers can be selected in advance.

Unlike some other economic activities, there are a portion of "aficionados" for work in tourism, which is considered as a benefit for the work motivation.

For overall advances in tourism in the years to come there is a special place for the growth of entrepreneurship, and entrepreneurial sector in particular. This sector will ensure growth rates for tourism. Thus, positive attitude in a society

toward entrepreneurship is needed, along with legal security as a support for entrepreneurial space for creation and innovativeness. With the development of entrepreneurship in tourism and with making the competition stronger, there is an increase of business efficiency of tourism.

Since an entrepreneur is always in search for changes and opportunities, there is an increasing importance of knowledge in entrepreneurial enterprises. Thus there are expectations from the basic input in tourism, human capital, in terms of education and expert qualities.

It is necessary to distinguish several levels of knowledge that an entrepreneur in tourism should possess. The first level is related to the so called conceptual knowledge. Knowledge and skills in the area of corporate governance, human resources management, communication skills and teamwork. Other knowledge (foreign languages, information technologies) is the so called minimal threshold of skills which is necessary for most employees. In the end, personal characteristics of entrepreneurs in tourism (ability of fast and constant learning, mobility, physical and psychological endurance, and accuracy) can hardly be detached from any manger.

Instead of a conclusion

The role of human capital in tourism is discussed in this article. The development factors in tourism are called for through the role of environment base, human and physical capital. Great portion of labour and its specificities demands from a decision maker of tourism policy very tangible actions. From the point of view of the quality of labour input it is necessary to combine the needs and the actual structure in the labour market: indicators for Croatia show that the education output of schools that are dedicated to tourism is not related to the needs and expectations in tourism. Therefore, stronger relations between Ministry of Science, Education and Sports and the Ministry of the Sea, Tourism, Transport and Development for the improvements in education structure in order to increase the quality of human capital in tourism.

From the viewpoint of quantity, with an efficient restructuring process and privatization in tourism, there is a possibility to increase employment. There is still the question of seasonality in employment. This problem can be dealt with by a better policy in tourism and by creating a strategy. For the strategy and policy of tourism development the macroeconomic strategy is of a particular meaning which includes the Government, the respective ministries and complementary organizations, as well as the international tourism infrastructure.

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INTEGRATED DESTINATION MANAGEMENT

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Abstract

The objective of this paper is to show the approach of integrated quality destination management, necessary for the development and to represent the tourism destination product on the Kvarner Riviera, (County Primorsko-Goranska), Republic of Croatia. This includes identifying opportunities, selecting the best options available, and realizing the benefits of these decisions. We surveyed tourists, residents, tourist renters and tourism managements on various elements of the tourist offer on the Kvarner Riviera on: (1) the quality of area, resources and environment, (2) quality of content, (3) organization of tourists' destination, (4) quality of information and level of security, and (5) quality of personnel. Responses were scored on a one to five scale, with five being the most positive. This paper reports the results of surveys that provide information about current perceptions and thus can be used to indicate where immediate attention should be focused. The results can then be used as a benchmark to assess progress.

Key words: *tourist destination, destination management, qualitest, Kvarner Riviera*

Introduction

The goal of tourism destination management is to make effective and efficient use of the tourist destination product. This includes identifying opportunities, selecting the best options available, and realizing the benefits of these decisions. Careful data collection is essential for identifying opportunities and the available options. Effective management is enhanced with the collection of information on customers, understanding the market, and employing the best organizational model. Therefore, the size, location, and type of destination management organization should be based on `best practice` (benchmarking). The basic assumption of benchmarking is that performance can be best judged by comparison with others that are comparable but have a high level of achievement. The idea that one way to learn is from the experience of others, but modified to consider specific local needs (measuring, monitoring). The objective of this paper is to show the approach of integrated quality information systems, necessary for the tourism destination companies on the Kvarner Riviera, (County Primorsko-Goranska), Republic of Croatia.

Research of tourist destination's offer

Defining the geographical boundaries of Kvarner Riviera was a key activity, leading to identity with, and ownership of, the destination by tourism stakeholders in the region. The Kvarner Riviera follows the municipal boundaries of the cities, because it can facilitate political cooperation and ease of data collection in the management process. It is based on the concept that a destination may vary from an area within a local council to an area spanning several municipalities but the central issue is that it has its own identity and, ideally, responsibility for its management has been determined, i.e. there is a destination manager in place. Research of tourists` satisfaction at the Kvarner Riviera (Blažević et al., 2003), shows that the tourists are maturing and demanding higher levels of quality (*www.dmma.at).*

We surveyed tourists, residents, tourist renters and tourism managements on various elements of the tourist offer on the Kvarner Riviera on: (1) the quality of area, resources and environment, (2) quality of content, (3) organization of tourists' destination, (4) quality of information and level of security, and (5) quality of personnel. Responses were scored on a one to five scale, with five being the most positive. The results of the surveys are reported in Table 1. An attempt was made to determine whether these groups perceive individual elements in the same way. The opinions of each group of stakeholders were rated with regard to issues of special interest to the group in question. The aim of the assessment was to determine the extent to which the current tourism offer of the Kvarner Riviera, and other more localized destinations, have adapted to the demands of the world tourism market.

Table 1: Tourist destination "The Kvarner Riviera" (research results)

Rank	Elements of tourist destination's offer	tourists	residents	renters	Tourist managers	mean
QUALITY OF AREA, RESOURCES AND ENVIRONMENT						
1	Healthy climate in the destination area	4.50	4.01	4.12	4.20	4.21
24	Attractive landscape	4.45	4.27	4.32	4.49	4.38
25	Preservation of the natural environment	4.05	3.54	3.78	3.63	3.75
26	Quality of the sea	4.32	3.46	3.87	3.50	3.79
	Ø	**4.33**	**3.82**	**4.02**	**3.96**	**4.03**

QUALITY OF CONTENTS						
21	Condition of the cultural heritage	3.72	3.05	3.10	3.27	3.29
27	Availability of playgrounds for children	3.45	2.49	4.18	2.83	3.24
31	Cultural events	3.50	2.66	2.78	3.29	3.06
33	Entertainment opportunities	3.38	2.42	2.71	2.85	2.84
34	Quality of cultural events	3.39	3.37	2.55	2.69	3.00
35	Quality of cultural events	3.43	2.46	2.66	2.82	2.84
36	Quality of sport facilities and events	3.45	2.51	2.63	2.82	2.85
37	Supply of therapeutic and curative amenities (health tourism)	3.43	2.32	2.39	2.53	2.67
38	Quality of therapeutic and curative amenities	3.49	2.42	2.33	2.55	2.70
39	Nautical supply	3.70	2.95	2.67	2.58	2.98
40	Quality of nautical supply	3.68	2.79	2.98	2.58	3.01
41	Travel agencies/ tourist offices and supply of excursion	3.93	3.16	3.12	3.25	3.37
42	Attractiveness of the cultural and other events	3.67	3.14	3.16	3.42	3.35
43	Quality of the type of the accommodation facilities	3.95	3.22	3.50	3.27	3.49
44	Quality of catering facilities	3.96	3,22	3.41	3.41	3.50
45	Health food supply	3.74	2.59	2.70	2.82	2.96
46	Quality of meeting and conference facilities	3.53	2.69	2.46	2.79	2.87
47	Possibilities of taking excursions to the surrounding areas	4.07	3.46	3.48	3.52	3.63
48	Price/quality relationship	3.64	2.56	3.17	3.14	3.13
	Ø	**3.64**	**2.81**	**2.95**	**2.97**	**3.09**
ORGANIZATION OF TOURIST DESTINATION						
5	Road/rail transport links	3.56	2.90	3.07	3.06	3.15
6	Airport organization and amenities	3.22	2.17	2.33	2.33	2.51
7	Local traffic	3.32	2.42	2.62	2.73	2.77
8	Availability of parking space	3.11	2.19	2.43	2.07	2.45
15	Standard of hygiene in the destination area	3.90	3.17	3.18	3.44	3.42
16	Urban design and planning	3.74	2.99	2.99	3.06	3.20
17	Availability and maintenance of walking lanes and promenades	3.85	3.16	3.38	3.28	3.42
18	Maintenance of street lighting	3.83	3.23	3.32	3.51	3.47
19	Maintenance and design of parks	3.87	3.56	3.33	3.66	3.61
20	Maintenance of the fronts of buildings, porches etc.	3.68	2.82	2.95	2.93	3.10
22	Maintenance of beaches	3.73	2.55	2.78	2.26	2.83
23	Crowded beaches	3.53	2.47	2.79	2.30	2.77
29	Working hours of restaurants and other services	3.90	3.03	3.44	3.59	3.49
30	Quality and level of restaurants supplies	3.72	3.19	3.36	3.62	3.47
	Ø	**3.64**	**2.85**	**3.00**	**2.99**	**3.12**
QUALITY OF RECOGNIZABLE, SECURITY AND LEVEL OF INFORMATION						
9	Good network of tourist information centers/ offices	3.71	2.91	3.05	3.33	3.25
10	User-friendly tourist landmarks in the destination area	3.71	2.85	3.06	3.36	3.25
11	Destination image (symbols, souvenirs, etc.)	3.70	2.84	2.78	2.80	3.03
12	Destination identity	3.70	2.96	3.14	3.20	3.25
13	Attractiveness of Internet presentations of the destination (www)	3.65	3.02	3.01	3.34	3.26
14	Internet presentation of accommodation supply and booking services	3.63	2.99	2.96	3.18	3.19
28	Personal security	4.06	3.43	3.49	3.78	3.69
	Ø	**3.74**	**3.00**	**3.07**	**3.28**	**3.27**
QUALITY OF STAFFS						
2	Friendly and hospitable population	4.27	3.28	3.74	3.65	3.74
3	Pleasant and hospitable restaurants personnel	4.21	3.17	3.56	3.52	3.62
4	Foreign language skills of restaurants personnel	4.05	3.05	3.27	3.26	3.41
	Ø	**4.18**	**3.17**	**3.52**	**3.48**	**3.59**

Source: Blažević,B, Magaš,D., Peršić,M, et.al. (2004).

The survey was given to a random sample of tourists, residents, renters (private accommodation providers), and tourist organization managers in the Kvarner Riviera. The samples were considered representative of the populations. The simple arithmetic mean of each of the five elements were: quality of area, resources and environment (4.03), quality of contents (3.09), organization of tourist destination (3.12), quality of information and level of security (3.27), and quality of staffs (3.59).

Other research has found that the tourists' satisfaction depends not only on their experience of specific tourist services, but also on more intangible factors, for example, hospitality, safety and security, and cleanliness (Luft, 2001). The success of a destination is therefore a function of many interdependent components. This underscores the need that Kvarner Riviera to introduce an integrated approach to managing its tourism offer (Kohl, 1993) based on total quality management (Injac, 2001). To satisfy this need, the concept of "integrated quality management" developed for the coastal, rural and city destinations (European Commission, 2000) would be very useful.

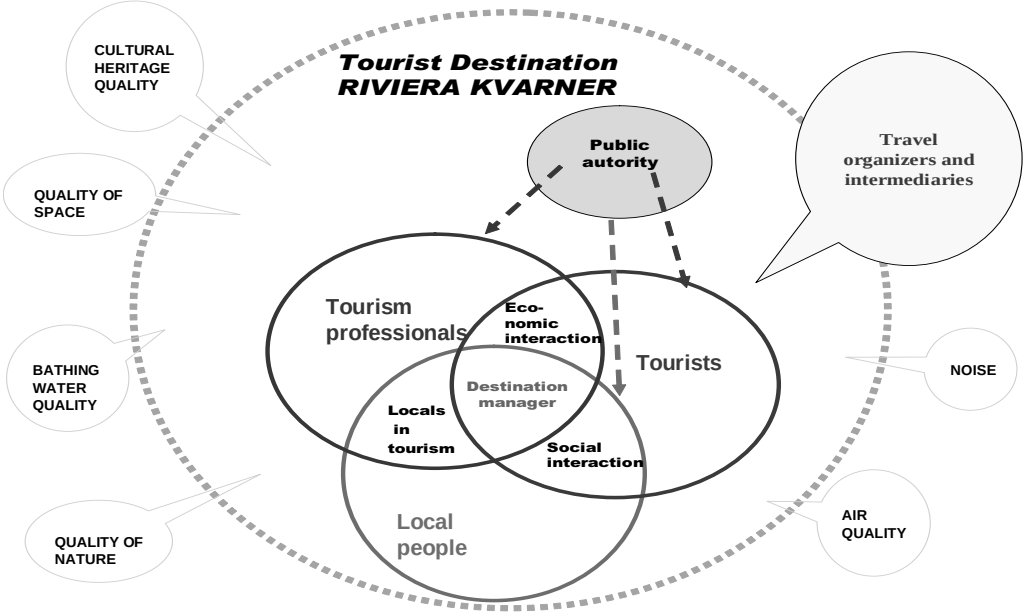
Individual producers of goods and services at tourist destinations are not in a position to guarantee the right assortment and quality of products. Destination management requires more than just coordination of the individual efforts by suppliers of tourism services such as hotels and restaurants. It has to be involved in the whole process of tourism product development, on the level of whole destinations (Kvarner Rivera). Objectives should be set and a strategy implemented to achieve those objectives. Output needs to be measured to evaluate the success of the actions. It is also necessary to monitor the impact of tourism upon the destination as a whole.

"Quality of contents" and "organization quality of destination management" of the tourist destination the Kvarner Riviera received the lowest rating in this study. Therefore, it is essential for the management of tourist destination to undertake the necessary steps to bring the tourist offer in line with demand.

Tourist destination management

The Kvarner Riviera is an area that can be separately identified and promoted to tourists as a place to visit. On this level, tourism products can be coordinated by one or more identifiable authorities or organizations, which we will call "destinations management". The identity of who the destination manager is or how the management is organized will be discussed on the destination level between different models. It is important to choose the best model of partnership. There are lots of views, opinions and a number of different approaches to the problem of an integrated destination's management model.

The manager has to be a leader, the "human" component of the integrated management concept. The manager must be able to coordinate between tourists, local people, tourism industry professionals, and the public authority on the destinations level. Based on the research of the European Commission, the circle diagram in figure 1 is an over-simplified presentation of the destination manager's relationship to the various stakeholders in the destination. It visualizes the links between the stakeholders in the destination and their relationships, and presents the various aspects of influence on the destination's management decision making. Destination Kvarner Riviera is represented by a large circle, and the responsible destination manager has to be in the middle of the destination circle.



Source: European Commission, 2000.

Figure 1. Integrated Tourism Destination Management

To be successful, destination management must have qualified employees, local authority, and the resources necessary to take an active role in the planning of tourism development. It has to be the catalyst for change within the concept of sustainable development. All segments must take an active role in the destination management, and the public and private sectors can not be independent. "Lead authority" must be identified and organized in the best form of the destination management, supported by a private-public partnership. Destination management oversees these aspects that are common to all successful tourist destinations (noise, bathing water**,** the quality of nature, cultural heritage, etc.), whether they work in the tourism industry or are tourists. Improving these elements will also contribute to improving the overall quality of life in the destination. Travel organizers and intermediaries are also important in the packaging of the tourist product and its marketing outside of the destination. Travel organizers and intermediaries are often represented in the destination management and may take an active part in the management process.

The role of the destination manager is to bring together the stakeholders in the destination and facilitate a constructive process whereby their inputs can be gathered. In the decision-making process, management needs information, which has to be related to the external and internal problems, and impacts on the level of tourist destination (Peršić & Šale, 2002). External information can relate the most important aspects of the globalization process in the field of tourism (markets, production conditions, corporate structures, organization structures, locations, culture, environment, etc.) and its impact (like opportunities and threats) to the particular tourism destination. The key factor is in determining the integrated information system, which includes strengths and weaknesses of all subjects the destination offers.

Within the framework of the project "Tourism Regionalization in Global Processes" (Blažević, Magaš, Peršić, Knežević, Stipanović, Smolčić-Jurdana, Alkier Radnić, Ivanović, Jelušić, A. & Medved, G., 2004) and "Master plan of tourism development in County Primorsko-Goranska" (Perić, 2005), the quality of regional tourist offer (tourist satisfaction, local tourism industry satisfaction, local people's quality of life, and the impact of tourism on the environment, destination's natural, cultural and man-made assets) was evaluated, because any imbalance in one of these tourism quality aspects can have a significant effect on the overall quality of the destination and the tourism product. Compared with the best world practice, those research present that destination management of the Riviera of Kvarner needs higher level of information transparency and better quality of reporting system. Because of that, the destination management curriculum at universities has to be changed, but also is necessity to implementing additional education for all hierarchical level, and make sure to implement certification - known as "integrated quality destination manager".

Integrated Quality Destination Management

A lack of attention to quality issues can have serious consequences later in terms of the loss of image and thus, expensive damage limitation and image restoration costs. The majority of quality information is based on ISO 9000ff

5 → STAGES	1- Identify the partners	2 – Decide on actions	3 – Imple-ment actions	4 - Measure effects	5 – Evaluate and adjust
EACH→ STAGE ↓	COMMON PROJECT	SRATEGI AND POLICIES	OPERATIONS	INDICATORS	RESULTS
Main concept	Dynamics of partnership	Dynamics of design	Dynamics of implementation	Dynamics of monitoring	Dynamics of evaluation & adjustment
Content	Lead authority (leading the partner); main participants and how they are linked	Analysis of the current situation	Public authority initiatives	Tourist satisfaction	Evaluation of results
		Objectives and overall strategy	The lead authority's services and support for professionals	Satisfaction of tourism professionals	Recommendations to the lead authority and public and private operators
	Division of roles between the partners			Local people's quality of life	
		Environmental and sustainable development	Tourist services offered by all partners before during and after the visit	Impact on the local economy	
		Human resources		Impact on the environment	
Partners involved	Lead authority and partners	Leader, public and private operators, local people	Leader, public and private organisations	Leader, public and private organisations	Leader, public and private organisations

Integration

Integration → Ongoing cycle

Source: Towards quality coastal tourism, 1999.

Figure 2. Five Stages in the Integrated Quality Management Approach

which is an international quality management standard (Helberling, 2002). For a quality approach an integrated destination management needs a roadmap of how a tourist destination can go about using the quality tools in practice and its successful application. Management needs to know the most important step, how to use the quality tools. Tourist satisfaction surveys and the tourism industry surveys are the fundamental information source for management decision making, Survey results should be compared with the results of internally generated data and compared with similar destinations' scores (benchmarking). The surveys should use the quality perception indicators, the quality management indicators, and the quality performance indicators.

To be a quality management, tourist destination management needs relevant information for its quality performance evaluation (Toward Quality, 1999). This is a part of a tourist destination's *qualitest* - a tool to facilitate the quality performance evaluation, a process to facilitate management decisions regarding a destination's quality performance by measuring and completing the quality perception condition indicators, the quality management indicators and quality performance indicators *Qualitest* is a tool that focuses on the service points that occur throughout the lifecycle of a destination's product, and incorporates them into the indicators developed using the life cycle of a typical holiday experience (Figure 2). Measuring means working through these stages, the destination manager has evaluated the quality of tourism in the destination. To be a quality destination management means to introduce the monitoring of results over time, and benchmarking those results against those from similar destinations.

The approach for destinations integrated quality management is a cyclical model, and any imbalances in these aspects have a significant effect on the overall quality of the destination and the tourism product. Identifying the partners is the first step of a plan, backed by a leader capable of rallying and influencing all the partners in the destination in question, develop a strategy and decide on actions that support that strategy, and evaluate resource requirements (human resources, natural resources, quality of life, cultural heritage, etc.), which can then be drawn up and offered by the partners involved, under the supervision of the lead authority. Destination management needs special knowledge to implement actions. This is the foundation for the implementation of measures by the various public and private providers of the different services to be provided, both within and outside the system.

Measurement is the using of a set of indicators, by the partners involved and the lead authority, to survey the satisfaction of the various target groups, integration into the community, and conservation of resources from the point of view of sustainable development. At the end, destination management is obligated to evaluate and adjust the whole interactive process. The authority leading the plan ensures that results are analyzed and lessons drawn from them. Corrections and additions felt to be needed can be injected at each level of the chain in order to ensure the correct functioning of the chain as a whole. It is this ongoing repetition that causes the system to operate as a loop.

Qualitest tools complement the integrated quality concept - a key element that a management in tourist destination needs, because it provides different types of information in order to be able to monitor the overall levels of tourism quality in the destination. *Qualitest* is of benefit to tourist destinations management, because it provides them with a different range of quality information. It is an integrated tool for measuring and monitoring the internal quality performance of the destination over time (Tourism, 2004), and a vehicle for benchmarking their quality performance externally with that of similar destinations. Information for quality management will be prepared for a cyclical process, and for the development of the quality strategy. Information is not the end of the process in the destination management, but just the beginning of the next cycle.

This means that integrated destination management needs a range of information, which a tourist destination should be measuring. Quality management is based on the principle of feedback and repetition within a cyclical process of ongoing improvement. Measuring quality is therefore a necessary step in converting an *ad hoc* approach into an evolving system. Each of the measurements of impact provided by the qualitative and quantitative indicators will help in taking appropriate corrective actions as needed, provided the partners involved examine their performance and ensure that the integrated quality management approach is permanently rooted.

Without measuring these aspects, it is impossible to document progress towards increased efficiency and competitiveness in a business, and makes the work of tourism development in the destination more difficult. If benchmarking takes place, destination management can compare the quality performance of each sector, for example "local environmental" "accommodation", "eating and drinking", "safety and security", "transportation", with the quality performance of the equivalent sector in a similar destination. This paper reports the results of surveys that provide information about current perceptions and thus can be used to indicate where immediate attention should be focused. The results can then be used as a benchmark to assess progress.

Conclusion

The Kvarner Riviera is a coastal tourism destination. Coastal tourism destination management is needed to meet increased competition. Modern tourists expect to find a range of activities and a variety of experiences. Monitoring progress in quality improvement provides the understanding that encourages proactive management, because quality gives the edge over competitors. Quality performance makes destinations and services easier to market, both to operators and

tourists. A quality product leads to customer loyalty, and a better quality means more profit. Quality management leads to a stable tourism industry and protects jobs. Quality improvements in a destination provide a better quality of life for local residents. Quality management improves access to finance, and effective monitoring of progress avoids repeating costly mistakes. Therefore, for numerous reasons, the Kvarner Riviera would benefit from an integrated destination management. Careful data collection provides the tool for making the right management decisions. Both the external and internal information are very important for tourist professionals, and all public and private organizations involved in tourism services on the destinations' level.

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BUSINESS ETHICS – A DIMENSION OF TOURISM QUALITY

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Abstract

Ethics is one of the dimensions and standards of the overall quality of a society. The aim of this paper is to emphasize ethics as a dimension of the overall quality of a community and of the quality of life and work of its people. After providing the definitions of ethics, business ethics and the social responsibility of business, the paper gives an example of ethics and social responsibility in the tourism and hotel industry, one of the world's greatest industry and also a social phenomenon with a great tendency for further expansion and development. The media serve as an instrument through which enterprises inform the public about their business achievements, with an increasing emphasis on their contribution to the development of the community and their social responsibility and business ethics. Promotional ethics increases the reputation and market competitiveness of an enterprise.

Key words: *quality management, ethics, morality, tourism.*

Introduction

Each society is characterized by ethics and morality since they present the frame for the behaviour of people and determine the quality of work and life. Affiliation to various international organizations and institutions demands that prescribed rules and standards of work and behaviour be accepted in all areas of human activity (economic, democratic and educational standards). Today, since Croatia is becoming a part of European Union, it is necessary to define and realize all dimensions of the quality of society, as well as to define all standards.

The aim of this paper is to establish ethics as one of the dimensions of quality and of total quality management systems. The paper focuses on business ethics as a dimension of the overall quality of a society. The paper presents an example of ethics in the tourism and hotel industry, which has a great influence on society.

In the paper the method of deduction is used: the paper starts with general definitions of ethics and morality, then defines the relationship between ethics and the society and, finally, clarifies this relationship through the example of ethics in the tourism and hotel industry. Tourism is closely connected with sport, which is emphasized in the text.

Ethics and business ethics

What are ethics, morality and business ethics? Answers to these questions can be found in detailed definitions of these terms. People think they know, but actually they do not know the meaning of these terms.

"**Ethics** (Greek ēthos - custom, habit, significance, disposition) - teaching doctrine on morality; its task is not only to acquaint us with what morality is, what its basic components are, but also to take a critical disposition towards the existing moral practices; the goal of ethics is not only to identify all the various views of people but also to give an evaluation and identify real and true values; critical-philosophical ethics should identify not so much the moral judgments that people make but how these judgments should be made concerning certain characteristics and procedures; an ethicist should focus not only on the description and analysis of the existing norms but also on discovering new norms; adj. *ethical* - one referring to ethics; *colloquial* - one who is honourable, morally correct, honest, who distinguishes good from evil, etc." (Klaić, 1979:395, 396)

Ethics is linked to morality. "**Moral** (Latin *moris* - custom) 1. a set of rules of a society and social classes on the contents and manner of interrelations between people and communities; 2. correctness, honesty, honour, chastity, virtuousness, ethics (*see above*) in general; 3. respectable sex life, chastity, decency; 4. vivacity, enthusiasm, awareness of discipline, mental mood, high spirit, readiness for task-fulfilment, bravery (ex. army moral); 5. message, lesson, meaning of a story; 6. manner of thinking, spiritual life; attitude toward life; 7. *moral insanity* lack of ethical sense and judgment, acting unscrupulously; type of insanity characterized by antisocial urges; adj. *moral* - following moral rules, chaste, honest, correct, virtuous, ethical, of reputable sex life, honourable, disciplined, committed to duties; psychological, spiritual, inner; legal." (Klaić, 1979:906)

Ethics is related to a profession, and we most frequently refer to legal, medical and journalistic ethics. Business ethics is often neglected and is referred to less frequently, although it is of the same importance (i.e. current Croatian problems of corruption).

"**Business ethics**, application of ethical principles in business relations and activities. Many companies have formal written codes of ethics which help managers and other employees synchronize their behaviour with codes and principles of business ethics." (Baletić, Ed., 1995:693)

"**Business morality**, a set of moral principles that define the behaviour of participants in business communication; unwritten rules of behaviour that every business person should obey. Even at litigations, courts as a rule rely on principles of business morality, which often supplement legal norms and serve the legal practice as a source of interpretation when drafting the contents of legal norms. Rules of business morality require correct, good, well-meaning, honest, etc. relations, as well as fulfilment of all obligations precisely and on time." (Baletić, Ed., 1995:696)

"**Etiquette** (Fr.: *bonton*, appropriate behaviour), a set of rules on refined (hospitable, polite) conduct in the company of others. These rules, which vary in different social environments and are constantly subject to change, regulate for example the form of greeting, encountering and addressing persons of various age, status, sex; table manners and the use of cutlery; dress-codes; forms of correspondence; manners of congratulating others or expressing condolence, etc. A number of strict rules of refined (gallant) conduct have been rejected in recent times as prejudices and anachronisms. Since the Baroque era, the rules of elegant conduct have often been formulated in special books called *The Book of Etiquette*." (Brozović, Ed., 1999:233)

The great philosophers paid special attention to ethics, honesty and fairness in their life and work, and taught other people that these are permanent values that should be cultivated, respected and applied.

According to Aristotle's system, problems of ethics should be classified as practical philosophy, since that part of philosophy investigates the actions of people and their aspiration for happiness and satisfaction. However, there is no generally valid specific norm in their actions that would define the contents of happiness, but reason (the influence of Socrates) enables the human will to always direct people's actions so that they can perform good and useful services. There are certain standards attached to reason and to the will that is related to reason and acts in accord with it, and people are responsible for their actions.

Aristotle classified virtues into two groups according to the rational and volitional activities of people:

1. rational
2. moral-ethical.

The virtues in the first group are higher in value, and great importance is placed on contemplation and a firm knowledge of what is being investigated. Importance is also placed on common sense when performing practical work.

Among the moral-ethical virtues (e.g. moderateness, justness), the *middle course* always proves the best option for us, that is, the option between what is considered as too little and what is considered as too much. Thus, for example, generosity as a virtue falls in the middle between selfishness and mindless prodigality. That practical aspect of ethics is much closer to people than Plato's demand that we reach what is *good in itself* (the idea of Goodness).

Aristotle's ethics includes notions characteristic of a stratified class society. Not all persons within one society hold the same position, nor are they equal in power, and therefore one cannot insist on equal ethical norms for all people. Each person is allotted his virtues according to his social rank and nature. Women should obey different rules than men; slaves in turn follow different rules than free men. People are equal only within the same rank (just distribution, *iustitia distributiva*), and in their rights and honours stand above people of lower ranks (?). However, a state should be founded on *justice* (formal equality of men and women) and should focus on the activities of men and women rather than on individuals. Only a just state can ensure the life of the whole, and these issues have already been stated in Aristotle's politics." (Bošnjak, 1956)

This text illustrates in the best way the importance of ethics and morality for the society, but also the connection between the development of society in a certain period of time with ethics and morality. Ethics and morality preserve the state of the society, social relations, humanisation of the society and other social dimensions. The society evolves and necessarily its ethics and morality change (i.e. to speak today of "a man and a woman" or different norms for people represents the violation of basic human rights).

Philosophers teach us that ethics is related to a human need, that it is necessary to do good and useful things in order for people to be happy. People should be responsible for their actions and should avoid all excess. A state should be founded on justice since only a just state can ensure a good quality of life and equality for all.

Socrates teaches us that knowledge is good and necessary, as only those who know can be good, whereas those who lack adequate knowledge often err. Education is one of fundamental dimensions of the quality of life and contemporary Total Quality Management (TQM) theory.

People cannot - Socrates thinks - act justly unless they know what justice is, nor can they be brave unless they have known bravery, etc. First one has to become cognizant of something, and then one will immediately achieve virtue, as virtue is identical to knowledge. The corollary of such a conviction is that "no one errs on purpose and that there is therefore no one to blame, as people err only out of ignorance, while someone who knows cannot err because he cannot act against his knowledge". Real knowledge is an absolute sign of security, and people can be classified as good according

to their knowledge and the philosophy they adhere to; otherwise they become prey to errors and evil, which is the main reason for their suffering." (Bošnjak, 1956)

Confucius taught that uprightness, wisdom, kindness, faithfulness and decorum belong to the category of permanent values. And today these are the real values.

Gandhi listed the following as society's sins:

- richness without work,
- leisure without conscience,
- wisdom without character,
- trade without moral values,
- science without humanity,
- cult without sacrifices.

All the previously named sins are present in Croatian society. Great ignorance and practical "moral principles": *if you help me, I will help you* and *try to do it yourself* prevail. To be fair means to be a fool.

If we want to succeed both in work and life, we have to work and live honestly. This is the basis of economic and social development.

Kant's ethics is founded on the concepts of free will and responsibility: we must have free will, yet we should not do all that we can.

How do we know whether our actions are ethical?

Blanchard and Peale (1990), the authors of the book *The Power of Ethical Management* suggest that, when we are in doubt during decision-making, we should ask ourselves the following three questions:

1. Is it legal? Will I thus break any civil laws or company regulations?
2. Has the relationship balance been achieved? Is it fair towards all it may concern, in both short- and long-term perspectives? Does it promote the relations of mutual profits?
3. How shall I feel afterwards? Will it make me proud? Would I feel good if my decision was published in the newspapers? Would I feel good if my family found out about it?

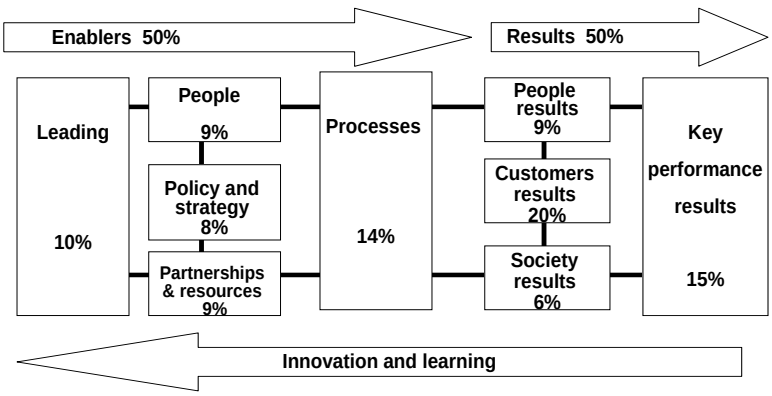
American business morality can be summarized by the following two recommendations:

- do as you say
- say as you do.

Ultimately one sentence can be regarded as a summary: **Ethics and morality is what you do, and not what you say.**

Ethics and social responsibility

Quality can be defined in various ways, but all definitions agree that **quality is something good**. Quality is a complex concept, consisting of several criteria, elements and dimensions, depending on the concept, object, phenomenon or activity that a particular quality refers to. Defining the quality of something or somebody implies getting well acquainted with that something or somebody prior to outlining all the quality elements that form the quality cluster or its total quality. Defining the Total Quality of a society is a difficult task and is not the goal of this paper. It can only be stressed here that there are many of dimensions that define the quality of a society and encompass all social phenomena (culture, politics, education, business, etc.).



Source: Introducing Excellence, The European Foundation for Quality Management, Brussels, 1999, p. 14.

Figure 1. EFQM Excellence Model

We shall isolate business and business ethics as dimensions of the total quality of a society. These dimensions of quality are characterized by the social responsibility of corporations, companies and enterprises and is becoming increasingly important for the preservation and development of the society and for market competitiveness and company reputation.

American practice proves that business ethics largely affects the development of the society. A company has responsibility not only towards its owners and employees but also towards the community within which it operates, and towards all people and the environment in the widest sense

of the word. The European Foundation for Quality Management (EFQM) provides a model of business excellence that clearly shows that business results should be evaluated with reference not only to profit but also to the community.

The model makes it possible to measure and evaluate the quality through a number of dimensions. Of the total amount of 1000 points, 6% refer to business excellence in terms of social responsibility, i.e. responsibility towards the local, national and international community.

Social responsibility can be monitored through the following activities:

Performance as a responsible corporate citizen: - disclosure of information relevant to the community, - equal opportunity practices, - impact on local and national economies, - relationships with relevant authorities, - ethical behaviour.	***Involvement in the communities where it operates:*** - involvement in education and training, - support for medical and welfare provision, - **support for sport and leisure,** - voluntary work and philanthropy.
Activities to reduce and prevent nuisance and harm from its operations and/or throughout the life cycle of its products: - health risks and accidents, - noise and odour, - hazards (safety), - pollution and toxic emission.	***Reporting on activities to assist in the preservation and sustainability of resources:*** - choice of transport, - ecological impact, - reduction and elimination of waste and packaging, - substitution of raw materials and other inputs, - usage of utilities e.g. gas, water, electricity, new and recycled materials.

Source: Model Scorebook: European Communications S.A., EFQM, Brussels, 1999, p. 65.

Figure 2. Monitoring of social responsibility

Ethics in the tourism and hotel industry

Tourism is an important social phenomenon, exerting great influence on society and social phenomena. The number of tourists today is nearing one billion, as every sixth inhabitant of the globe is classified as a tourist, and together they are often referred to as "the travelling humanity". Ethics in tourism influences the overall quality of a society.

Ethics is an important element of tourism and the hotel and catering industry, unified under the term Hospitality Industry. The very term 'Hospitality' implies welcome, friendliness, comfort, security, openness, communicativeness and kindness.

The aim of the Hospitality Industry is to please people, to give them the sense of well-being that everybody wants. This is what connects this industry and ethics as defined by Aristotle, who classified the issue of ethics as practical philosophy, investigating the activities of people and their tendency to pursue happiness and satisfaction.

All the activities of the Hospitality Industry are focused on making people happy by offering them entertainment, good food and drink, comfortable accommodation, sports and recreation, i.e. well-organized entertainment in their free time and the sense of prosperity and well-being. The ethical components of the tourism and hotel industry are also important due to its great international importance. Billions of people travel and that "travelling humanity" is served by millions of people. Travelling tourists expect a welcome and pleasant stay everywhere they go, the well-being that creates the feeling of happiness. The World Tourism Organisation (WTO) has accepted the Global Code of Ethics for Tourism which consists of principles and rules for work and behaviour of all participants in tourism. It ensures the respect and understanding among all people and societies, the sustainable development of tourism, protection of nature and environment, the freedom of movement, the rights of tourists and residents, and the rights and obligations of tourism specific professionals and authorities.

Certain questions arise:

- Is hospitality profitable?
- Does ethics limit the opportunities for profit?
- Can ethics and profit be compatible?

Yes, they can, because business morality prescribes profit-making, however with respect for the ethical principles.

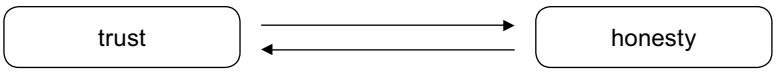
The great American hotelier Ernest Henderson (1897-1967), the founder of the "Sheraton" international hotel chain, was well known for his business motto: "Make profit, but with respect for high standards of business ethics". The success of his hotels has proved it possible and indispensable. There is a positive correlation between ethics and profitability. Managing the *value component* of a hotel (morality ethics) and managing the *material component* of hotel activities (profit, resources) are closely related.

Ethics is a component of quality to be attained only within the long-term perspective, in accord with the principles of the total quality management system. The short-term goal of "profit at any cost" carries the risk of low quality, which

can result in company failure and unemployment. One cannot earn a lot within a short time by honest means! However, managers often face the dilemma of whether to give priority to profit or ethics. Their sense of social responsibility should prevail in solving this dilemma. The main goal of hotel managers is to generate profits, but only within the legal framework and bearing in mind the rule: "Never cheat the customer!".

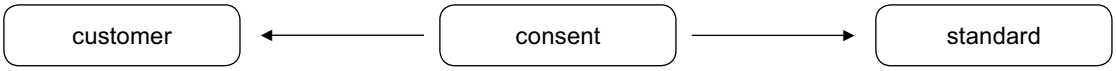
The training of hotel managers focuses mainly on economics and foreign languages and lacks focus on morality and ethics. However, honesty should be an integral part of the manager's personality, something taken for granted, and should be reflected both in his day-to-day decisions and in his behaviour not only towards his employees and business partners but also towards his family and society as a whole.

Catering is an honourable profession. It mediates a relationship between two persons, one requesting and expecting a good and honest service, the other expected to meet that request in a professional manner:



The hotel and its management should ensure quality for both its employees and its hotel guests, a quality attainable only through the maintenance of hotel standards. Quality is not an occurrence: it is a habit of working and living well. It entails a good estimate of customer desires, requirements and expectations and the establishing of appropriate standards.

Quality can be summed up as:



Quality is attained when what the customer requires is equal to what we offer. Quality is made up of people, good people and good employees, and good people are those who respect morality and ethics in both their life and their work.

Ethics should be a component part of all activities in all hotel departments, with the ethical elements defined according to the specific work and responsibilities of each department. Ethical standards and rules should be defined for each activity.

Conclusion

The quality of a society and tourism can be evaluated and measured via a number of quality criteria or dimensions. Two of these criteria are ethics and morality.

A community cannot achieve total quality without ethics and morality. In order to achieve quality in life and work, one has to meet certain ethical standards.

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SPECIAL INTEREST TOURISM AS A CATALYST FOR SUSTAINABLE TOURISM DESTINATION DEVELOPMENT – AN ECONOMIC PERSPECTIVE

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Abstract

As a result of global economic and political trends, in the next decade, tourism destination development is more likely to go for the optimization than maximization of tourism economic effects. Because of that, a mass tourism development concept is by now considered as undesirable, old-fashioned and of low potential in terms of its ability to generate noticeable economic effects and ensure sustainable development. Along with the growth of the global tourism market, a more fastidious and more sophisticated tourism demand has emerged, looking for more than just a sun, sand and sea holiday package. Such trends have encouraged the development of many diverse activities for tourists, known today as the special interest tourism.

Key words: *special interest tourism, market transformation, economic effects, sustainability*

Introduction

The main purpose of this paper is to comprise and point out some critical findings and characteristics of the special interest tourism which have cut across global tourism market for the last two decades. A continuous growth of the global tourist arrivals, tourism receipts, tourism employment and other economic benefits, as well as some increasing negative impacts of tourism concerning ecological, social and cultural issues, have put forward the initiative for a thorough analysis of the global (mass) tourism market transformation. The early scientific work in this field of research carried out in the 1980s has opposed the concept of mass tourism to ecotourism, naming the latter "alternative tourism" because of THE rising ecological problems in some European mass tourism destinations. Other proposals for differentiating ecotourism, such as "ethical travel", "appropriate tourism", "soft tourism", "green tourism" or "responsible tourism" were later put forward. The guiding idea was to underline the disadvantages of mass tourism and highlight the advantages of "new" ecotourism based on the principles of sustainable tourism development. At the beginning of 1990s, both theory and practice of tourism development have already developed some basic tools for segmentation, analysis and forecasting tourism demand in the "new" market niches. As a result of such efforts, up-to-date ecotourism and more than 20 other forms of tourism are recognized as special interest tourism market segments, each of them requiring different organisational and marketing approaches as well as a variety of specially designed facilities and qualified human resources.

The emphasis of such market segmentation is on defining primary tourist motives that push people to visit particularly attractive places, socialise with tourists of similar life style and satisfy their specific tourist needs. Special interest tourists are thus motivated by the desire to "pursue a particular interest, hobby or activity, be in a sport such as scuba diving or golf, an outdoor activity such as mountain climbing or bird-watching, a cultural or heritage interest such as folk music or period architecture, or an educational pursuit such as European history or archaeology" (Weiler & Hall, 1992). All these "push factors" should meet appropriate "pull factors" in the form of various specially designed attractions within particular tourism destinations, offering a better or unique way of facilitating the enjoyment of activity special interest tourists are passionate about. Meanwhile, such market trends have encouraged a significant growth in the number of specially designed package tours for special interest tourism market segments offered by tourism intermediaries. Along with a growth of interest for the specially designed travel programmes, many travel agencies and tour operators have focused their business activities exclusively on one or several complementary market segments (like sports and mega-events, gastronomic, wine and rural tourism, business travel and Meetings, Incentives, Conventions & Exhibitions tourism or so called MICE tourism).

As such, the introduction of special interest tourism concept does not mean a simultaneous appearance of any new form of tourism, but the initiation of a new demand-oriented concept of tourism destination development based on the principles of sustainability and systematic market research approach. Despite the fact that theoretical and practical knowledge about special interest tourism is somewhat deficient, because of the lack of specialized statistical methodology and useful market feed-back information, the growth of special interest tourism seems to be more rapid than the mainstream mass tourism market. Such statement can be substantiated by evident increasing sophistication of the tourism demand towards the more focused and high-quality tourism experiences. These experiences are derived from the values one could get by participation in some special interest tourism activity. Therefore, it seems that a special interest tourist does not seek only the "value for money", but also the "value for time", because within the modern society to travel is not a privilege

any more, but to experience a unique tourist product which differs much from the conventional mass tourist product. In that context, Opaschowski (2001, cited in Trauer, 2004) reveals that "holidays no longer just facilitate the traditional escape of tourists from daily living, but rather the search for personal fulfilment and happiness, highlighting the leisure as a part of quality of life".

Methods

On the basis of the issues discussed in the previous section, and partly on Cazes's (1989) pioneer contribution in this field of research, one could distinguish between two basic groups of criteria used for creating special interest tourism market segments. The first group of criteria is based on "push factors", i.e. tourist needs, motivation, behaviour and destination choice. This is used as the first step of market segmentation in order to split the whole tourism market in two parts: a special interest tourism *demand* market and the remaining part of mass tourism market. The second group of criteria relies on "pull factors" or tourist products containing various indoor and outdoor attractions, specific type of transportation, accommodation, adapted buildings, facilities, areas, and other resources. Such a group of criteria is used as the second step in market segmentation necessary for the classification of activities that indicate special interest tourism *supply* market segments (Figure 1).

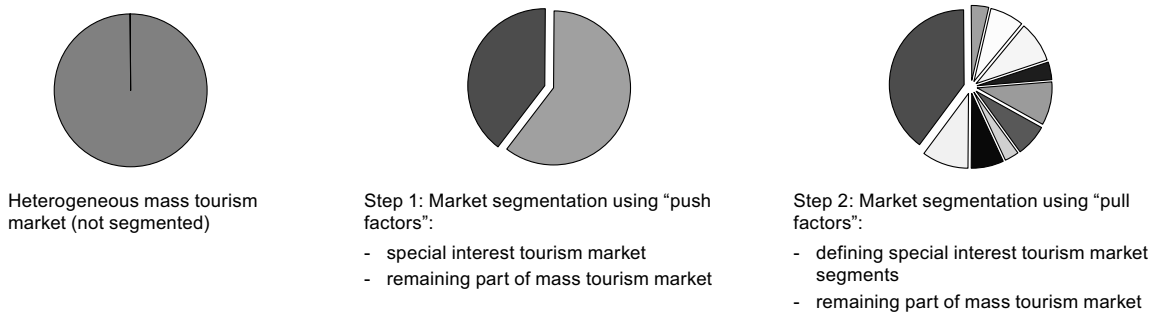

Figure 1. Two-step tourism market segmentation using "push" and "pull factors"

After the second step of market segmentation is taken using the "pull factors", special interest tourism *supply* market segments should be identified. These segments can be grouped into three categories according to the character of the resources and activities:

- *Nature-based tourism*: sports tourism (hard-adventure, like scuba diving, paragliding, climbing, rafting), nautical tourism (sailing, yachting, cruising), health tourism (swimming, fresh air breathing, mud-bath therapy), hunting and fishing tourism, ecotourism (visiting national parks and other protected natural areas), rural tourism, robinson tourism, nudism, etc.;
- *Purpose-built tourism*: sports tourism (soft-recreational, like cycling, golf, tennis, aquaerobics), health tourism (spa tourism and wellness), theme and amusement parks, mega-events, religious tourism, M.I.C.E. tourism, gastronomic and wine tourism, cultural and heritage tourism, urban tourism, gambling tourism, space tourism, etc.;
- *Other forms of tourism (not connected particularly with the nature or purpose-built attractions)*: business travel, shopping tourism, sex tourism, study tours, escapism, virtual tourism, etc.

Such classification represents a basis for further analysis of economic benefits and shortcomings of a designated special interest tourism segment, either for a specific tourism destination or a tourism receiving country.

Results

On account of the empirically confirmed economic benefits from tourism, many countries and destinations rely on this dynamic economic activity as an important and, in many cases, primary source of income, employment, tax revenues, etc. Moreover, tourism has been recognized as a powerful economic force for attracting multi-million dollar investments, providing specific export pathways, as well as ensuring the development of infrastructure, encouraging the entrepreneurship at local level and many others. According to the World Tourism Organization (WTO) assessment, current international tourism accounts for over 700 million international tourist arrivals and generates over US$500 billion of international tourist expenditure annually (WTO, 2004). As a result of such impressive growth, tourism has become the world's largest and most diverse economic activity, overtaking car industry, defence, manufacturing, oil, and agriculture (Lundberg, Stavenga, & Krishnamoorthy, 1995; WTO, 1997, Keyser, 2002), contributing with 10.2% in the world GDP of which 3.7% refers to direct contribution (WTTC, 2003).

As a part of such a global tourism economic outlook, the economic effects generated by a particular special interest tourism market segment are not fascinating, but deserve further consideration encompassing overall positive economic, social, cultural and ecological benefits for the host community. According to the fact that special interest tourism is basically a small-scale economic activity, in many cases profits for the national economy may appear small, but at the local level all the parties directly involved in delivering tourist services are in the position to experience a substantial increase in their profits during the tourist season or some mega-event. Yet, the aggregate value of the total economic effects generated by all special interest tourism market segments seems to represent a dominant share in the global tourism economic performance, compared to the remaining mass tourism market segment.

Considering the fact that special interest tourism market segments are demand-oriented activities based on tourist needs and motives, it is evident that each of them has their own characteristics, physical, institutional and human prerequisites for the development, tourism product life cycle and economic effects. In order to quantify some market potentials and economic effects, a short overview of a few real examples are provided below.

From the perspective of sports and mega-event tourism, winning the bid to host a prestigious sporting event such as the Summer or Winter Olympic Games, FIFA World Cup, ATP Tennis or FIS Ski Tournaments, is considered economically beneficial for the host country and is widely regarded as a catalyst for tourism development. Such a large interest in hosting big sporting events has increased since the mid-1980s when projects of the kind became financially positive. An example of a profitable sporting event is the 1998 FIFA World Cup in France which hosted approximately 900,000 tourists during the one-month tournament and attracted about 3 million of additional tourism demand in 1998 compared to the year before. From the financial point of view, it was estimated that such a big event had generated a net profit of €10.2 billion. Moreover, the World Cup had initiated an investment of nearly €1.3 billion, mostly in tourism and sport facilities including necessary infrastructure, of which 44% was invested by private investors (TTA, 2004). Apart from direct effects, there are also some indirect effects such as the worldwide media exposure and an increased number of tourist arrivals in the years ahead.

Apart from mega-events, there are other special interest tourism segments and the estimations of their market size and economic benefits:

- small-scale segment of the European *adventure* travel market was estimated at close to 500,000 tourists in 2003, with average consumption per trip of over €700 (TTA, 2003);
- more than 19 million tourists worldwide participate in *rural tourism* (TTA, 2004);
- total expenditure in *business travel* in Europe at US$190 billion with an increase of 75% in next 10 years (WTTC & TTA, 2003);
- *cruising industry* is expecting more than 16 million passengers on board in 2009 at the global scale (TTA, 2002);
- the average total tourism consumption for a *cultural tourist* group in 2002 was over €400 for foreign tourists and €300 for domestic tourist groups, while daily consumption of cultural tourists was over €70 comparing to a touring holiday (€52), beach tourists (€48) and those on a city break or engaged in rural tourism (€42) (TTA, 2004);
- potential *hunting tourism* market in 1995 for Europe was estimated at 6.5 million, with the average consumption of €1,500 per trip. Total consumption of hunting tourists in Europe is estimated at €10 billion, providing more than 100,000 jobs www.face.org);
- approximately 600 *theme parks* in the USA attracted 328 million tourists and earned US$10.8 billion in 2004. At the corporation level, Walt Disney Attractions had almost 97 million visitors in 2003, while "Magic Kingdom" at Walt Disney World in Orlando, Florida, USA, the world's largest theme park, had attracted slightly more than 14 million visitors in 2003 www.themata.com).

Discussion

Having in mind the previously cited economic facts, it must be noted that the growing tourism market has become both more challenging and more competitive than ever before. The emergence of new tourism destinations has increased the competition among the existing mass tourism destinations offering the sun, sea and sand, just in the same time as their market potentials as well as the economic effects have started to shrink. In order to differentiate and preserve highly attractive tourism resources from overuse, many tourism destinations have had to abandon the mass tourism market development concept and radically change the structure of their tourism products towards small-scale development projects which ensure not only the economic, but also the social, cultural and ecological sustainability. There are several reasons for such a change in development strategy:

- special interest tourism mostly is an individually arranged, independent, homogenous and small group activity;
- slow, long-term, internally (locally) controlled and regulated development that ensures a gradual transition through the phases of product and destination life cycles, aiming at the optimum rather than the maximum (in terms of the number of tourists and profits obtained), without putting a high pressure on available resources (physical, financial, human);

- special interest tourism is able to generate more revenue for all market entities (also because of the low economic leakage), employ more local workforce and significantly encourage family-owned small businesses, all because of the lower impact of seasonality;
- investments in attractions, facilities and events are more specific and of small-scale, comparing to investments on the mass tourism market;
- Weaver & Lawton (2002), accommodation facilities used for special interest tourism are also small-scale, dispersed throughout the area in order to keep low density, built in the vernacular style of unobtrusive and complementary architecture and are run mostly by the residents;
- Medlik (2003), special interest tourism is much of travel for the experience of host cultures and maintenance of traditional (authentic) values and societies.

Despite the fact that the special interest tourism market is in many ways more homogenous and independent than the mass tourism market, there are a plenty of differences among special interest tourism activities. It is only a question of whether a particular special interest tourism segment is feasible to a particular tourism receiving area or not regarding its natural resources, necessary infrastructure, adapted facilities and human resources. On the other hand, it must be also noted that the full sustainability of tourism development is practically impossible. It is considered too utopian to believe that the development of economically sustainable tourism activities will have absolutely no environmental impact. Therefore, a trade off between two competitive development goals must be done in order to find an optimal solution.

At last, all presented facts and figures point to the conclusion that special interest tourism, as a theoretical and practical concept, is more able to embody the principles of sustainable tourism development than the mainstream mass tourism market. Moreover, it provides a slow, long-term destination development where most of the residents are involved in some direct or indirect activity that supports specific tourism activities. Each of the special interest tourism market segments calls for a individual marketing and organisational approach, investments and employment, but also they generate different economic effects in terms of income, employment, and exports of locally-made products, handicrafts or services.

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DEVELOPMENT OF CONGRESS TOURISM

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Abstract

A sudden rise in the number of business journeys can be noticed after World War II, when the exchange of knowledge and experience became an important factor of economic and social development, both at the particular regional level and at the global level. Intensive industrialization, automatization and urbanization changed the way of living, and emphasized the need for physical and mental relaxation. Tourism became more and more a necessity of modern man, as well as of the participants in different kinds of conventions. The tourist component in international conventions gained in importance, so that a new form of selective tourism was created – congress tourism.

The Opatian Riviera has recognized the importance of developing congress tourism, particularly in resolving the inherent problems related to seasonal tourism. It is thus striving for a profile as a congress tourism destination.

Key words: *congress tourism, congress services market, development.*

Introduction

The present-day concept of congress tourism was not formed until after World War II. Political circumstances, scientific and technological development, and a large increase in the volume of international exchange and the number of journeys influenced the need for organizing international meetings of all kinds. During the decades after World War II, these conferences have been developing and have become a common form of meeting where scientists, politicians, economists and other participants exchange their knowledge and experience.

Nowadays, congress tourism plays a significant role in the international tourist market, and those in the business of tourism supply are becoming increasingly interested in it.

Historical overview of congress tourism development

The historical overview of conferences, particularly the international ones, goes back to ancient history (Lucianović, 1980). It includes meetings of Celts and other nations, the pilgrimages of Christians, Church councils, etc. But international meetings enter the sphere of tourism only when the requirements for it have been met. The development of traffic together with economic and social changes formed the basis for the development of congress tourism (Weber, 2001). The events occurring in the field of science, business, education, and regional and global cooperation after World War II were particularly favourable for its development. Today, modern business is unthinkable without business journeys (Dwyer, et al., 2000). In the year 2002, over 18 million Europeans participated in business journeys. The number shows a trend towards a faster and a more dynamic growth, especially in the number of congress and incentive journeys (Fischer, 2005). In 1999, the global congress market included 1.5 million national, and over 300,000 international conferences attended by approximately 200 million people per year (ETM, 2000). During the same year, congress tourism earned 21 billion USD, with international meetings accounting for a one-third share in it. The analysis of the total number of congresses in the world held from 1996 till 2001 (Table 1) shows an average yearly growth of 1.5 percentage points. Terrorist attacks in the year 2001 had an influence on the significant fall in the number of congresses against the previous year (-1.86%). But in the succeeding years there was a tendency of growth, so that in 2003 the recorded increase was 0.2% over 2002.

Table 1: Number of congresses held from 1996 – 2001 by regions in %

	1996	1997	1998	1999	2000	2001
Europe	+0.47	+0.56	+2.04	−0.42	+0.56	+0.41
Asia	+0.91	+0.22	−0.22	−0.20	+0.22	−0.52
Africa	+0.03	+0.69	−0.61	−0.06	+0.69	+0.15
Australia	+0.73	+0.64	+0.58	−0.46	+0.64	−0.35
N.America	+0.40	+0.32	+1.54	−	+0.32	−1.50
S.America	−0.40	+0.94	−0.36	+0.25	0.94	−0.03
	+2.14	+3.37	+2.97	−0.89	+3.37	−1.86

Source: Authors' calculations based on the data from http://www.uio.org (February 5, 2005)

The majority of international conferences take place in Europe (58.3% in 2003) and North America (14.9%). The world's leading countries in conference organization are: USA (11.31% of the total number of conferences held in 2003), France (6.85%), Germany (5.16%), Italy (4.63%), Great Britain (4.45%), while among cities, the leading ones are Paris (2.88%), Vienna (1.99%), Geneva (1.99%), Brussels (1.99%) and London (1.52%).

Table 2: Number of congresses held in 2003 by countries

1. USA	232
2. Spain	220
3. United Kingdom	177
4. Germany	161
5. Italy	146
Other	2.361
Total	3.297

Source: Authors' calculations based on the data from http://www.icca.com (February 5, 2005)

In the last decade, the development of congress tourism has followed the general trends of tourism development. It falls behind European tourism and it does not keep pace with modern tourism trends, which results in a significant overall decline. Croatian congress supply, faced with requirements greater than those set before the classical tourist supply, does not satisfy the requirements of the fastidious international tourism market. It is orientated primarily to the domestic congress demand. There are only a small number of destinations capable of organizing congresses on a national level, the number being even smaller when it comes to congresses on the international level (Zagreb, Dubrovnik, Opatija).

Development of congress tourism in the Opatian Riviera

The Opatian Riviera has a 160-year-old tourist tradition, at first offering leisure and excursion tourism, with health and spa tourism appearing afterwards (Blažević, 2004). In succeeding years, it built up its image with congress and nautical tourism.

The congress potential, together with the available accommodation capacities, makes the Opatian Riviera potentially one of the leading congress destinations in Croatia. There are approximately 20 congress halls in hotel premises with a seating of around 4,000. The largest hall is in the newly-built 'Grand Hotel 4 opatijska cvijeta'. It is equipped with 1,000 seats and up-to-date technical equipment, this making it possible to hold demanding events, such as seminars, congresses, workshops, presentations, etc. Other significant congress halls are in the Grand Hotel Adriatic, with a capacity of 600 seats, and in the Hotel Ambasador with 500 seats. The congress capacities of the Opatian Riviera are a sound argument for its diversification towards congress tourist supply. The attractiveness of the surroundings and a relatively good traffic accessibility also speak in its favour. Nevertheless, the numerous comparative advantages that Opatija has for a more intensive development of congress tourism are far from being utilized.

Congress tourism development, expressed in absolute numbers of conferences and participants (Table 3), shows a dynamic growth until the year 1999, followed by a significant stagnation and a downturn in the succeeding years. There have been several reasons for this; among them are the extensive construction activities carried out on hotel and utility premises, which reduced the possibilities of organizing congresses and accommodating the guests. Furthermore, statistical data show that more than 50% of conferences are attended by fewer than 100 participants. That implies that this segment is a lucrative market even for the smaller hotels (which are currently a trend on the leisure tourism market), but on the assumption that they are equipped with meeting halls and are able to satisfy high-quality requirements.

Table 3: Overview of congresses held in Opatija from 1996 to 2004

Congresses / Year	100 participants and less	101 – 250 participants	251 participants and more	Total	Congress duration in days	Number of participants	Number of overnights
1996	51	33	14	98	252	15 230	42 645
1997	106	34	28	168	477	24 283	70 597
1998	110	39	18	167	443	22 565	51 345
1999	288	39	24	351	539	24 724	25 185
2000	69	24	26	119	365	17 480	34 930
2001	64	38	23	125	346	20 365	39 720
2002	37	21	14	72	243	9 991	23 945
2003	32	34	17	83	252	15 892	36 994
2004	46	26	19	91	299	15 342	34 235
Index 2004/03	143	76.5	11.8	109.6	118.7	96.5	92.5

Source: Authors' calculations based on the City of Opatija Tourist Office data

There has been a fall in the number of tourist overnights per participant from 2.9 in 1997 to 2.2. The share of congress tourists' overnights in the total number of overnights on the Opatian Riviera remains a merely symbolic one. Congress tourists made the largest share in the number of tourist overnights in 1997 (9.0%), while in 2004 their share was a mere 4%.

Table 4: Number of overnights made on the Opatian Riviera in thousands

Year	Overnights – congress guests	Total	Share of congress guests in total
1996	43	632	6.8
1997	71	788	9.0
1998	51	752	6.8
1999	25	655	3.8
2000	35	852	4.1
2001	40	910	4.4
2002	30	904	3.3
2003	37	897	4.1
2004	34	843	4.0

Source: Authors' calculations based on the City of Opatija Tourist Office data

In contrast to leisure tourism, which is primarily concentrated in the period of 2 to 4 summer months, the majority of congress tourism activities take place outside the main tourist season (Franić, 1979). Congress tourism development thus contributes to alleviating or even resolving the problematic seasonal oscillations in resort destinations by positively influencing the utilization of accommodation capacities and extending the duration of the tourist season. Hotel managers in Opatija seek to effectively use this convenience by arranging the season's meetings time-table as evenly as possible. The experience of Opatija hotel managers and conference organizers show that the congress season on the Opatian Riviera actually lasts 10 months, excluding July and August (Table 5).

Table 5: Overview of congresses held in Opatija in 2004 by months

	Number of congresses	Percentage share	Participants	Percentage share	Overnights	Percentage share
January	5	5.5	900	5.9	1 110	3.2
February	6	6.6	1 440	9.4	3 580	10.5
March	6	6.6	730	4.8	1 180	3.4
April	5	5.5	1 120	7.3	2 540	7.4
May	10	11.0	2 190	14.3	5 050	14.8
June	4	4.4	570	3.7	1 485	4.3
July	0	0	0	0	0	0
August	0	0	0	0	0	0
September	13	14.3	635	4.1	1 260	3.8
October	28	30.7	4 402	28.7	11 570	33.8
November	12	13.2	3 255	21.2	6 460	18.9
December	2	2.2	100	0.6	0	0
Total	91	100.0	15 342	100.0	34 235	100.0

Source: Authors' calculations based on the City of Opatija Tourist Office data

The general tourism policy of differentiated prices for half-board and full-board services implemented on the Opatian Riviera during the 6 winter months (November – April) has had a stimulative effect on the demand for congress tourism services (and also on leisure tourism services). Furthermore, interest has been shown in congresses due in May and October as these 2 months have a 50% share in the total number of congress overnights in 2004.

The above-mentioned facts confirm Opatija's comparative advantages as a congress tourism destination. Sophisticated hotel accommodation (the 4- and 5-star hotels that the Opatian Riviera aims at), natural and social attractiveness, traffic accessibility and *value for money* are only a few of the comparative advantages that will make this destination competitive in the future. Furthermore, competitiveness implies: inclusion of every person participating in the Opatian Riviera tourist offer in the enrichment of the supply of congress services, the preparation of an animation programme, and a better presentation in the local as well as in the foreign congress services market. Another priority is to build a congress hall outside the hotel premises. The training of personnel for rendering congress tourism services in accordance with current trends in the tourism market is also of great importance (Tališman−Košuta, 1991). The targets for congress tourism development ought to be: a better utilization of favourable competitive circumstances, an increase in average spending per tourist, and attracting new tourist segments, particularly foreign guests. At the same time, the formation of a congress centre with the role of coordinating and initiating a joint congress supply and a congress office representing an independent organization to deal with location sales and organizing conferences would enable new assumptions for the Opatian Riviera's breakthrough into the congress services market to be made.

Conclusion

Although the dimensions of congress tourism are difficult to be defined numerically, as there is no world-wide common statistical evidence for its unique coverage, it can be suggested with certainty that this form of diversified tourism is taking an ever more important position in tourism movements. There are a number of reasons for this, resulting from the specific nature of congress tourism. The development of congress tourism in Croatia in earlier periods has followed the general trends of tourism development, which meant that it has fallen behind the trends present in the tourist market of congress services. Improving the quality of products offered by Croatian congress destinations such as Zagreb, Dubrovnik and Opatija, as well as expanding to other destinations, could produce a significant turnover in Croatian tourism.

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NATURAL AND GEOGRAPHICAL CHARACTERISTICS OF CROATIA AS THE BASIS FOR THE DEVELOPMENT OF TOURISM AND SPORTS ACTIVITIES IN TOURISM

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Introduction

Modern tourism has gone through significant changes and that is an unquestionable fact. These changes can be seen in an ever growing spatial concentration of the tourism demand; mass character of the industry (the number of tourists from lower and middle class is constantly on the rise); an increasing number of tourists travelling more than once a year; the increased use of free time for travelling; the changed structure of transport means used in tourism.

All the above changes have had an impact on the disappearance of the so called "visitor tourist" (Vukonić & Keča, 2001:19) or the *superficial visitor* whose chief objective was to either visit as many places as possible in as little time as possible or to lie on the beach throughout his or her stay. Contemporary tourist is increasingly more curious and keen to explore people and the area he or she is visiting. Tourists today are better educated and as a result there is a significantly different approach towards the way of how people spend their holidays and leisure time. Together with visiting and experiencing the cultural, social and other anthropogenic features sport and recreation become increasingly significant and a frequent part of tourist movements and leisure time (Vukonić & Čavlek, 2001:365).

Active holidays are no longer only a part but one of the main motives for selecting a tourist destination. Sport and recreation have become a special form of tourism and a key area of transformation taking place in contemporary tourism. This means that tourist destinations must adjust their offer to these changes as new active tourists bring very specific and different habits and behaviours.

Sport and recreation are becoming an indispensable part of stay in a destination and are frequently the main motivate for short or long stays in a destination; therefore, sport- and recreation-related tourism evolves as a specific type of tourism (Bartoluci & Čavlek, 1998:69).

Along with sports and recreation facilities, natural and geographical features are a very important contents of sports tourism product, and the development of its features and qualities must be based on natural and geographical resources of a specific area.

It is natural and geographic resources that meet sport- and recreation-specific requirements of visitors. These resources also determine and shape the economic value of an area, they influence the selection of sports and recreation facilities and create the activity zone.

The basic natural and geographical features of Croatia and its comparative advantages in the development of sports tourism

The Republic of Croatia occupies the geographic area of 56,538 km^2. The population is 4.6 million or 82 inhabitants per km^2. The population density ranges from 10-15 per km^2 in Lika to 140 per km^2 in upper Podravina and Međimurje. The population destiny is very high around regional centres and is closely related to historic and economic development of the region and its natural resources. Natural features (relief, climate, water, soil, flora and fauna) are not only the most important factor of economic development but also the basis for any regional development as well as the basis for physical and development plans for an administrative unit or state as a whole. For tourism, natural resources, that is, the level of their attractiveness, are amongst the key factors that bring tourists to an area. All other factors (political, transport, organisation, reception) can change and improve over time. The attractiveness of natural resources is a value that is constant and unchangeable. We wish to underline this since Croatia's wealth and composition of natural resources exceed those of many other European tourist countries. A particular comparative advantage of Croatia is that natural attractions are spread over three different tourist and geographical regions that differ greatly in their characteristics and features. This means that regions can and do develop a specific tourism product including various forms of sports and recreation activities.

As underlined in the previous paragraph, the area of the Republic of Croatia, based on natural and antropogenic characteristics, can be regionally divided into three tourist macro regions (Bilen & Bučar, 2004:114-115):

1. **Adriatic tourist region** (Mediterranean or litoral) that covers the area of 17,850 km^2 or 31.6% of the total Croatian area and is inhabited by 1.46 million inhabitants or 30.6% of all Croatian population.
2. **Mountain tourist region** that covers 7,913 km^2 or 14% of the total Croatian area with approximately 144,000 inhabitants or mere 3% of all Croatian population.

3. **Panonian tourist region** that covers 30,776 km^2 or 54.4% of the total Croatian area with approximately 3.17 million inhabitants or 66.4% of all Croatian population.

Adriatic region is the area of islands, coastline and sub-Mediterranean hinterland that stretches from Savudrija in the north to Prevlaka in the south. The total length of the Croatian coast is 5,790 km and this is due to its very indented coastline. After Norway Croatia has the most indented coast in Europe and the indented coast coefficient of 10.2. The Croatian part of Adriatic has 1,185 islands (66 permanently inhabited), 3,389 islets and 78 reefs. The Adriatic is a warm sea. In winter the temperature ranges from 9 to 12º C and in summer months it goes up to 27º C. As temperature for swimming is 19º C, the season lasts full four months. As the northern Adriatic is shallow, it warms up faster and the season starts earlier. On the other hand the season lasts longer in the south (see Bilen & Bučar, 2003).

Warm currents coming from the Aegean Sea affect the temperature of the Adriatic. The currents flow north at the speed of 7.2 km per day and return to the south along the Italian side of the Adriatic coast.

Salinity of the Adriatic is relatively high (38.3‰) and transparency of the water varies from 18 m in the north to 33 m in the south. The colour goes from greenish to blue. Special attraction is a rich and diverse flora and fauna not only of the sea but also of the islands and littoral.

The climate of the Adriatic tourist macro region is Mediterranean (Šegota & Filipčić, 1996:382-383). Precipitations are more frequent during winter months while summers are mainly dry with clear skies. Humidity is relatively low due to constant circulation of air. In winter northerly and southerly winds blow while in summer we have the westerly wind *maestral* that refreshes, clears the atmosphere and alleviates the heat. Winter sea waves are no higher than 2 metres and in summer they are around half a meter high. Due to *karst* relief and climate, specific flora and fauna have developed and the macro-region has six national parks (Mljet, Kornati, Paklenica, Sjeverni Velebit, Krka, Brijuni) plus several nature parks and reserves.

Based on its characteristics and natural features (but antropogenic values of high level of attraction) this macro-region is the most important tourist destination in Croatia (according to Pirjevec (1998) it accounts for approximately 75% of Croatia's tourism turnover). Relaxation on the sea, sport, recreation and fitness are no doubt the main reasons why foreign and domestic tourists visit destinations in this region (see TOMAS survey).

Overall and on the basis of its natural resources this macro region offers good conditions for water activities: swimming, water skiing, surfing, diving, and sailing of all kinds. In winter months the region offers good conditions for the development of health tourism and specific forms of sports and recreation activities. Due to the configuration of its terrain there are good conditions for walking, cycling, horseback riding, beach volleyball, tennis and golf. Most beaches are good for aerobic and aquarobic activities. A good portion of the coast is suitable for the development of water parks. Hinterland with its mountains and *karst* ecosystem offers excellent possibilities for development of sport and recreational activities like mountain hiking, paragliding, free climbing, rafting, and biking.

The location and natural characteristics of this region are also the cause of some limitations as regards the development of tourism in this region. Limitations primarily relate to accessibility and transport links between the region and the tourism generating countries. Mountain ranges in the region stretch longitudinally and form a natural barrier for the construction of modern motorways. One part of the problem has been solved by the construction of the motorways Zagreb – Rijeka and Zagreb – Split but access roads to destinations are still of poor quality and their traffic safety is of low level. Ferry and boat connection between islands and the mainland are far from efficient. Vessels serving these connections are very old, with small capacity and provide a low quality service. This is a particular obstacle for the development of weekend tourism as that form of tourism contains many aspects of sport and recreation.

A number of other problems hinder the development of tourism in the Adriatic region. Some of the most characteristic problems are water supply of islands and a number of small coastal places; complete absence or very old sewage system; very poor medical services (this is particularly true of islands); shortage of professional and trained staff. Finally, the absence of physical plans, expert approach and environmental concern when sports and recreational facilities are constructed in this environmentally very sensitive area.

Mountain tourist region stretches from the Slovenian border in the west to the border of Bosnia & Herzegovina in the southeast. The region encompasses mountain areas of Lika and Gorski kotar. Moderately high mountains, rivers, natural and artificial lakes, *karst* fields, caves, rich flora and fauna are the main natural and tourist resources of this region. By its characteristics the region could attract many visitors and develop many aspects of tourism. This is the narrowest part of Dinara mountains and therefore most suitable for connections between the Mediterranean and the hinterland. The most important road and railway communications pass through this region connecting the Adriatic not only with the central and the Panonian parts of Croatia but with the Central and Eastern Europe as well. The region is one of the most important European tourist routes to the Mediterranean and this provides good opportunities for the development of transit tourism.

Mountains are Gotrski kotar's main natural resource. On average they are between 700 to 900m above sea level and are rich in forests and wildlife. The whole region is interlaced with rivers that flow through picturesque valleys. The climate is typical for that type of region that is, with fresh summers and cold winters with plenty of snowfall. However,

due to the confluence of the continental and the Mediterranean climates snow in most areas of Gorski kotar (except the highest mountains) does not remain on the ground for very long. This is a major obstacle for the development of winter tourism.

Having analysed and carried out the stock taking of Gorski kotar's natural resources and their characteristics it can be concluded that this region has very attractive resources that might attract a significant segment of the domestic and even of the international market. This is particularly true for visitors looking for fishing and hunting but also for the visitor segment looking for health tourism. The region offers possibilities to visitors interested in winter sports, hiking, walking or visiting national parks. In summer months there are many possibilities for swimming in the rivers or lakes and for rafting or canoeing.

Lika has the same or very similar characteristics but it also has its own specific features deriving from its geomorphology. Valleys of Gacka and Lika rivers are not only the natural attractions but offer excellent opportunities for trout fishing and other water-related activities. The biggest attractions in Lika area are Plitvice National Park and mountains (Velebit, Velika i Mala Kapela, Pljesivica) that offer the possibilities for hunting, hiking, winter sports, speleological expeditions.

Panonian tourist region extends from the Slovenian border in the west to Vojvodina region in the east. It is mostly flat with scarce mountain ranges, large number of rivers and brooks, smaller lakes, thermal spas and significant areas covered in oak forests. Natural resources for the development of tourism are modest but there are some comparative advantages for the development of sports and recreational activities as well as for the general development of tourism. Many Croatian major cities are located in this region. They offer attractive antropogenic tourism resources. These cities are well connected with surrounding areas gravitating towards them. Mountains (Kalnik, Psunj, Papuk, Pljesevica, Samoborska gora), natural reserves (Kopacevski rit, Lonjsko polje), rivers (Sava, Drava, Dunav, Kupa, Mreznica, Dobra, Korana, Lonja) bear only regional importance and attract regional visitors and tourist excursions. Only thermal spas (health tourism), forests and areas rich in wildlife (hunting tourism) and natural reserves might have a wider national or international tourism bearing.

The region is very densely populated with a large number of urban dwellings. Several important traffic corridors pass through it providing links with countries in Eastern and Central Europe. The existing tourist and natural resources provide good conditions for sports and recreation in particular fishing, canoeing and rafting. Plenty of green areas combined with gentle geomorfology provide very good conditions for many sporting activities: football, volleyball, handball, rugby, golf, hiking, horseback riding or simply running through the picturesque nature.

Conclusion

In modern style of living sports and recreation are important parts of tourism offer and without doubt one of the key factors in the decision-making regarding the selection of a holiday destination. Thus sport and recreation do not only play an important role for people as regards their health-related benefits but also promote the tourist destinations in either direct or indirect way. Finally, they bring economic benefits both to the region and to the country. Croatia possesses a whole array of natural resources that provide basis for the development of many different aspects of sport tourism. However, that aspect of the Croatian tourism product has serious deficiencies. There is a lack of adequate sports facilities and a specific problem is the lack of instructors and trained staff for some sports and activities (Institute for tourism, 2002:40). We think this is mainly due to the lack of knowledge and creativity and not due to the lack of finances.

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NAUTICAL TOURISM FROM ORIGINS TO THE PHENOMENON AND CONTROVERSIES; CROATIAN EXPERIENCES AND PROCESSES

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Abstract

By applying a socioeconomic method of research, the author of this paper gives a systematic analysis of the origins, growth and development of nautical tourism in the world, Europe and Croatia in the context of its "origins, phenomenon and controversies". The paper recognises and pleads for this complex and significant form of tourism which has one of the fastest rates of growth. From its modest start, linked with the processes of continentalisation, littoralisation and globalisation, nautical tourism rapidly and thoroughly changes its features, from the selective to the large-scale one and this, in turn, along with the predominantly positive and useful effects, "burdens" it with damaging and negative consequences. In order to safeguard its predominantly positive features and, in the process, mitigate the unfavourable ones, the author advocates the concept and strategy of sustainable or selective development, exemplified in theory and practice by Croatian nautical tourism. Considering a broad range of topics, the material is presented in the form of systematization and syntheses.

Key words: *tourism, littoralisation, globalisation, sustainable or selective development, saturation.*

Introduction

In the developed West, nautical tourism has become a measure and symbol of the present-day tourism development and recognizability.

This is a phenomenon which on economic and social level most conveniently marks the world's tourism trends which ensued from the global process of littoralisation. Futurologists were right when some ten years ago they said "two out of three tourists will be at sea". On the other hand, on economic level, due to its polifunctionality and a large number of services, it has become of vital economic interest, which is the reason why many countries turn to this form of tourism.

In Croatia, this orientation was disputed and for no apparent reason neglected for a long time. Nevertheless, many sceptics were convinced they had been wrong to disregard it. Today, Croatian nautical tourism with its chain of marinas and organised recreational sailing has become the most representative product and symbol of the Croatian tourism industry.

The origin and development of nautical tourism in the world, Europe and Croatia

"Navigare necesse est, vivere non est necesse"
(It is necessary to sail, it is not necessary to live)

The sea, as a resort of restless civilisation, a metaphor of oblivion and the biggest and most significant biotropic factor on the Earth with an area of 361 million square kilometres or 70.8 percent of the Earth's total area and as such a rich source of various elements for sustaining life, has always attracted and fascinated people. The motives of this attraction and fascination have been diverse, ranging from lucrative, social, and cultural to emotional and poetic. People have been fascinated by its enormity, soothing beauty, elemental forces and its numerous surprises.

Due to these diverse attractive forces of the sea, the world turned to it in massive tourist migrations. Namely, after a 150-year process of continentalisation for a long time we witnessed the beginning and the strengthening of all levels of the littoralisation process which spread so quickly that today it has developed into a world's global process and one of the basic factors of globalisation. "The tourist gravitation to the sea is becoming ever stronger and more massive under the influence of the increase in recreational demand. More and more people, particularly those who live in a highly urbanised environment, crave the sun, clean air, peace, isolation, idleness and healthy sports activities and it is the sea and its coasts that can best satisfy these and other elements of recreational demand, either singly or in combination" (Alfier in Jadrešić, 1978:11).

Nautical tourism as a sector of tourism industry and an element of maritime industry is a relatively new phenomenon whose development dates back to the man's first river, lake and sea travels for pleasure, leisure, recreation and other numerous motives. And whereas tourism as a social-economic phenomenon emerged in the middle of the 19th century, nautical tourism had only begun to acquire the outlines and a relatively more important social significance when Thomas Cook organised the first travels in the 1940s. People started sailing "for pleasure". The Dutch term yachting came into use. Along with industrialisation and urbanisation, technological development of transport, an increase in people's wealth and their cultural awareness, population growth and the right for a holiday, there was also an increase in tourism, nautical tourism and recreational sailing on the sea and other water areas. It is important to point out that the first tourist travels were on the constant increase, especially in the more developed European countries, the USA, as well as other countries all over the world. This topic will be dealt with in the relevant literature suggested at the end of the study.

Nautical tourism, this complex and significant socio-economic phenomenon, is said to have first appeared in Great Britain, the USA and Scandinavian countries in the 1960s. Millions of people started buying boats, recreational craft, yachts and various other vessels. At first the sport of the rich, it soon became the "privilege" of the upper middle class and then of all classes and it simply was "recreational sailing" or "pleasure sailing" and boat owners and clients were "Sunday skippers". This form of tourism ceased to be a status symbol or a matter of social prestige; it began to assume mass character and became quite common and uniform. It was no longer a luxury but a specific need.

Table 1. The number and slip capacity of marinas in some Mediterranean countries in 1997

Country	Number of marinas	Number of berths
Italy	242	52,761
France	134	92,353
Spain	201	61,688
Greece	13	4,575
Slovenia	3	1,392
Turkey	13	4,845
Croatia	45	16,945

Source: The Institute of Tourism (1998): Competitiveness of Croatian Tourism, p. 101

Table 2. Overview of sports and tourism boats in major countries in 1994

	Number ('000)	Share in %
USA	11,000	55.00
Europe	4,170	20.85
France	1,530	7.65
Germany	840	4.20
Great Britain	650	3.25
Italy	590	2.95
The Netherlands	560	2.8
The rest of the world	4,830	24.15
World	20,000	100

Source: C. Smith and P. Janner; Tourism in the Mediterranean, EIU Travel & Tourism Analyst No 5/1994, according to the ICOMIA data

Table 3. World's sports and tourism boats production in 1993

Countries	Boats	Share in %
USA	400,000	53
Canada	100,000	13
France	40,000	6
Germany	39,000	5
Italy	35,000	4
Great Britain	34,000	4
Sweden	8,000	1
Other countries	44,000	14
Total	750,000	100

Source: C. Smith and P. Janner; Tourism in the Mediterranean, EIU Travel & Tourism Analyst No 5/1994

Thus in the developed world in the 1970s and 1980s, this phenomenon, due to its explosive growth, became highly controversial and a major problem particularly in destinations which experienced an enormous and uncontrolled growth. This spectacular growth in nautical tourism may be illustrated by indicators relating to different periods in Croatia and some other countries. Statistics show that the US national nautical park in 1913 consisted of 400.000 vessels; in 1930 this figure was 1.5 million and in 1950 it rose to 3.5 million; in 1966 it reached the total of 8 million and in 1986, 13.5 million vessels were used by 40-50 million boaters (Gomiscech, 1987:4). In the Mediterranean, over 150 thousands yachts and boats were registered in the 1970s. In 1970 France had about 310 vessels. In the last ten years 138 tourism ports have been built or adapted to accommodate 52 thousand vessels. In 1971, Italy had a fleet of about 250 thousand vessels and 12 independent tourist ports, as well as 215 little ports and moorings. The annual vessel production in 1972 was 50 thousand units. In 1972 Great Britain had 475 thousand registered vessels of the so called small or 4th fleet. There, 28 modern tourist ports (marinas) were built. At that time the annual value of built vessels exceeded 70 million pounds.

It is estimated that the 4th fleet in the countries of Western Europe generates tourism revenues of over 3 billion dollars and an estimate of the expenses of a common tourist ranges over about a hundred chandlery items, that of a motorized tourist is within a range of 1,300 items and a motorized boater purchases about 4,500 chandlery items (Bombardelli, 1970.).

In comparison, Croatia had the total of 10,000 registered vessels in 1969 and eight years later 35,000, while the number of the equipped ports was 4 or 5. Today the production of pleasure craft is mass production which in the USA is called "automobile industry number 2". These are only some data related to particular countries. The character of the study and the criteria applied do not allow for more appropriate analyses and socio-economic study of the phenomenon, for which reason only indications and certain standards are given. Further on, applying a similar procedure, the data from the period of the 1990s will be selected with the purpose to realistically present the development of one of the most powerful types of tourism and show the way of nautical tourism from "its origins to the phenomenon and controversies", i.e. some major problems which have arisen due to its exponential growth.

Controversies and negative features of nautical tourism

Tourism in general, nautical tourism including, as a multipurpose, "epi" phenomenon, as well as socio-economic controversies and "clash" of interest surrounding them bring about a great number of positive and negative elements. One-sided and forced growth and development of tourism in order to provide quick economic returns has negative effects on environmental, socio-cultural and economic level (For more information see Jadrešić, 2001.). The more tourism is mass and uniform, as a rule, the more negative and unfavourable elements are dominant. Each type and form of tourism, and there are more than a hundred of them, manifests its positive and negative features in its own specific way. In the case of nautical tourism and its enormous growth (processes of touristification and saturation), the negative consequences can be seen in the following:

- the negative effects characteristic of tourism in general also appear in nautical tourism
- nautical tourism is characterised as a seasonal activity
- the sea and the coast are invaded, various pressures and usurpations occur
- sea pollution by various waste and filth occurs
- bacterial contamination of the sea and other water areas (rivers, lakes, channels, etc.) by liquid waste and materials
- sea, river and lake natural resources are devastated
- oil pollution of the sea is frequent
- sea flora and fauna and fish stocks are destroyed
- recreational and economic fishing with banned tackle where no fishing is permitted takes place
- life safety at sea and on other water areas is reduced
- underwater "research", unauthorized appropriation of biological and archeological sea resources, privatisation of the coast, usurpation of beaches and other maritime goods, landscape devastation, etc. occur.

Croatian nautical tourism: beginnings, development, condition, experiences and processes

The first organised beginnings of nautical tourism in Croatia and on the east Adriatic coast started taking place in the mid 1960s, although it had appeared as a phenomenon and a form of tourist activity as early as the mid 19th century, in the form or organised tourist boat trips from Trieste via Istrian towns to Rijeka, and later, down to the South of the Adriatic all the way to Dubrovnik. However, unlike other receptive-tourism and maritime countries, it was not top priority in the former Yugoslavia until the 1980s. Thanks to the government programme of the Republic of Croatia (ACI marina system) nautical tourism experiences a strong impetus, which has become even stronger in the independent state of Croatia, especially after the Croatian War of Independence. Namely, the Croatian nautical tourism is especially developed in its coastal Adriatic area which stands out for its general comparative and market advantages: material basis, special and geographical setting, anthropogenic (socio-cultural) factors, gravitation to the sea, urban and rural communities, characteristics of the area: the total area of the Croatian Adriatic sea is 33,200 square kilometres; the mainland coastline is 1,778 km and the island coast is 4,078 km long. The coastline in straight line is 526 km long from the northwest promontory of Savudrija to the south east promontory of Oštro. The coastline indentness coefficient is 11.0 and the number of islands (according to the latest research of the Hydrographic Institute in Split) is 1,246 (79 islands, 525 small islands and 642 cliffs and reefs.) The biggest is the island of Cres (405.7 square km) and the smallest is the island of Galicia (0.01 square km). There are also many other landmarks such as seven national parks, 8 nature parks, cultivated land and diverse flora and fauna, etc.). So far this area has been considerably preserved, as well as the balance between natural and man-made goods. How long, though? And how to preserve it further? The answer should and can be found in the sustainable development and an active protection which presupposes balanced development, i.e. polycentric planning, reduced seasons, social responsibility, ecological awareness, cultural autochthony, market competitiveness and economic profitability.

The inventory and the material basis of Croatian nautical tourism, after many initial doubts, misunderstandings and shortcomings is nowdays experiencing a boom, and it can be considered to have definitely become the country's most well known and competitive tourism product on the sensitive and ever more demanding global tourism market.

Based on the principle of sustainable or selective development, the future policy should focus mainly on (in addition to long-term programmes for more modern and ecological marinas around 15,000 new berths) more rational revitalisation projects for small ports and similar facilities (public maritime areas, conversion of family houses with waterfront and adapted berths, as well as protected areas, bays and moorings which would make boating safer, more ambient and attractive). Therefore, the idea of building on the basis of the Argonaut would not be appropriate for the environment and cultural heritage, and it is also economically questionable. Building, adapting and revitalising should not be exaggerated and one should not be tricked by the market and global tourism challenges, as this may saturate and devastate the environment for future generations. Along with new marinas, investment programmes for building modern vessels (such as yachts, boats and dinghies, sailboats, etc.) should be drawn. Boat rentals, pleasure and recreational activities should be better organised, (especially sea and other water areas sports) and all the other services generating profit should be improved. This would lead to an increase in the daily expenses of a boating client from the present-day 79 US dollars to about 100 US dollars, which is the amount realised in more famous Mediterranean destinations.

Due to the existing and potential dangers entailed in nautical tourism ranging from the usurpation of public property, widespread devastation, illegal privatisation and large-scale environmental destruction, the future development should harmonise with the need and possibilities of the local community, as well as the overall national interests.

The next important factor, which will undoubtedly contribute to the development of nautical tourism is the construction of motorised nautical parks, eco-marinas, nautical clubs and collections, sailing and yachting events, retail outlets, chandlery items shops, rescue service, insurance and brokerage etc.

Current issues and market features of Croatian nautical tourism

With regard to the recent development of nautical tourism and its organisational, technical and market characteristics, in the future policy, due attention should be paid to the following factors:

- construction and reshaping of Croatian tourism identity, the redesigning of ports and the improvement of the overall tourist offer, the stimulation of its (home and foreign) demand, seeking for optional solutions in the privatisation and reconstruction of marinas and other entities in nautical tourism.

Plans should be drawn to liberalize the influx of foreign capital (especially by Croatians living abroad), to stimulate the construction of the home small or 4th fleet, in particular sports equipment for various water sports. The marketing conception, the management in nautical tourism, the categorization of tourist ports and the development of complementary tourism and economic activities should also be involved in the plans. Furthermore, the status of nautical tourism as a part of tourism industry must be recognized. Problems of coastal navigation, concessions, excursions, brokerage, the revival of small Adriatic and other inland villages, the future pricing strategy, upgrading hotels and extra services and staff training are certainly the factors which need attention and are crucial for the success of nautical tourism.

An important aspect concerns the clashes and controversies between the two main associations which bring together all the significant segments of nautical tourism: the Croatian Marinas Group and the ACI Marinas. If the disputes are not settled, this might have negative effects on the overall results of Croatian nautical tourism, as well as on the position it holds in Europe and worldwide. Also, greater sailing safety, the settlement of current disputes between the state and private boat owners, strict and consistent enforcement of the laws and regulations related to mooring of foreign-owned vessels are prerequisites for the success of this important sector of tourism industry.

Table 4. Slip capacity of marinas in the Republic of Croatia

	January – September 2002	January – September 2003
Number of marinas	49	48
Nautical tourism ports (moorings, dry-berths)	25	27
Area of maritime zone (m^2)	3,522,399	3,548,243
Number of sea berths	13,878	14,730
Total coastline for moorings (m)	52,395	57,008
Total mainland area (m^2)	1,001,618	1,057,500

Source: Croatian Tourism Today, p. 30

Table 5. The number of foreign and Croatian flagged vessels in Croatia

	number of vessels		structure in %	
	2002	2003	2002	2003
TOTAL	180,946	191,747	100.00	100.0
Italy	39,375	42,758	21.8	22.3
Austria	32,841	31,226	18.1	16.3
Germany	38,313	35,738	21.2	18.6
Croatia	30,322	37,561	16.8	19.6
Slovenia	7,951	8,051	4.4	4.2
Great Britain	6,267	7,196	3.5	3.8
France	6,371	7,174	3.5	3.7
Switzerland	1,227	1,187	0.7	0.6
Hungary	784	881	0.4	0.5
The Netherlands	2,133	1,521	1.2	0.8
Scandinavian countries	973	1,141	0.5	0.6
Other countries	10,547	12,266	5.8	6.4

Source: Croatian Tourism Today, p. 31

- further processes in the development of Croatian tourism and its effort to reach the standards of the best European and Mediterranean destinations should focus on the investment in and the organisation of specific forms of nautical tourism, especially sports and recreational activities, which may be called “lesser” nautical tourism and pleasure boating recreational navigation. These activities ought to comprise excursions and short cruises, boat rentals with or without a skipper, regattas, sports fishing, competitions, rowing, diving and scuba diving, sailing, rafting, white-water canoeing, windsurfing, beach activities, sailing school, swimming school, water polo and other traditional recreational sports which could be of interest to both tourists and local residents. They should also include projects of extra services related to cultural and entertainment programs, which would certainly make the tourism offer more attractive for foreign and home visitors to either Blue (Adriatic) or Green (continental) Croatia.

Conclusion

After a crisis and stagnant period, on the "wings" of the 1980s and 1990s, the Croatian nautical tourism has entered a phase of intensive development. It has become a trademark and "Mount Olympus" of Croatian tourism, its top-quality product and a genuine brand.

Therefore, we should give of our best to preserve it and encourage its development for the sake of future generations, following the concept of sustainable development despite all controversies and conflicts surrounding it.

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SIMULATION MODEL OF MANAGING THE DEVELOPMENT OF BUSINESS SYSTEM OF A NAUTICAL AND TOURIST PORT

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Abstract

A nautical and tourist port (NTP) has all the characteristics of a complex organisation and a business system, for which dynamic modelling of business and development sophisticated methods of simulation techniques have to be used. System dynamics (MIT, Forrester) is one of the most well-known sophisticated types of continuous simulation of complex realities (Forrester, 1975). Besides, it represents a complex methodology of scientific research, modelling, simulation, and optimisation of complex dynamics systems (Senge, 1994) to which the modelled business system of NTP, presented in this paper, also belongs.

The methodology of system dynamics is based on the basic concepts of system approach and cybernetics, especially the concept of feed-back loops, and cause-consequences link, using at the same time fast and precise digital computers (Coyle, 1996).

In this paper, the business system of NTP will be presented through mental and verbal model and structural model of the system. For this business system the authors have developed integral quality (mental and verbal model, structural model and structural flow-diagram) and quantity (mathematical and computerised) models. Integral simulation models provide the possibility of efficient analysis of the observed business system dynamics and quality business decision-making which will ensure its existence, growth and development (Munitić, 1989).

Key words: *system dynamics, simulation modelling, business system of nautical and tourist port, computer simulation, dynamic models*

System dynamics quality simulation models of a business system of NTP

In order to determine the global system dynamics simulation model of NTP, it is necessary to determine the following relevant subsystems: subsystem of berthing capacity (the main nautical and tourist service); subsystem of land berthing capacity; subsystem of servicing vessels; subsystem of trade capacities, subsystem of catering capacities; subsystem of sport and recreational capacities; information subsystem; subsystem of the liquid assets state on the account (cash-flow); subsystem of credits for performed services (value of the collected debts); subsystem of debts; subsystem of income; subsystem of marketing and sales; subsystem of long-term and short-term loans; subsystem of total capacities engagement; subsystem of new investments (Dulčić, 2003).

In relation to great oscillations in business conditions during a year, that is the obviously seasonal character of NTP business performance, it is necessary to determine the time schedule of the realisation of services. What follows in this paper is the description of the time schedule of NTP business performance, in relation to the realisation of berthing service as the basis for the simulation and development of the scenario of all business operations (Dulčić, 2001).

Time schedule of business operations of the NTP system

Simulation of possible business operations of NTP begins on the first day of April of the observed business year (TIME=120th day). The first season finishes at the beginning of October of the same year (TIME=300th day). The next period of off-season business begins in October of the same year (TIME=300th day) and lasts to the beginning of the new season in the second observed business year (TIME=485th days). The new tourist season begins in April of the second observed business year (TIME=485th day) and lasts to October of the second business year (TIME=665th day). New off-season business begins in October of the second business year (TIME= 665th day) and ends in April of the third business year (TIME=850th day). In accordance to the described time cycle which is continually repeated, it is possible to prepare further simulations of business operations depending on the needs of the modeller.

Mental and verbal simulation model of NTP business system

System dynamics simulation quality methodology determines the performance dynamics of a business system, or performance dynamics of cause-consequences links (UVP) and feed-back loops (FBL) within the system (Forrester, 1980). During one business system cycle each variable may be only causative, consequent or simultaneously both causative and consequent. Dynamic influence of two variables of the system is called cause-consequence link (CCL), and dynamic

relation between as the minimum two cause-consequences links (CCL) of the system is called feed-back loop (FBL). Depending on the performance dynamics of the system variables, cause-consequences links (CCL) and feed-back loops (FBL) may be of a positive (+) or a negative (-) value (Forrester, 1980).

If the increase of the cause variable causes the increase of the consequence variable, it is then a positive cause-consequence link (+)CCL. The corresponding sign (+) also refers to the situation when the decrease or drop of the cause variable causes the drop of the consequence variable. In case the increase of the cause variable causes the decrease of the consequence variable then it is called a negative cause-consequences link (-)CCL. The corresponding sign (-) also refers to the situation when the decrease of the cause variable causes the increase of the consequence variable. We may say that cause-consequences link is positive (+) if both cause and consequence variable have the same performance dynamics. Accordingly, a cause-consequences link CCL is negative (-) if cause and consequence variable do not have the same performance dynamics (Munitić, 1989).

If the sum of the negative signs in a feed-back loop (FBL) is an odd number (1, 3, 5, 7…), then its total sign is negative (-). A negative feed-back loop (-)FBL is self governing regulator, decreasing the oscillation amplitudes of certain variables of the system. If the sum of the negative signs in a feed-back loop (FBL) is an even number (2, 4, 6, 8…), then its total sign is positive (+). A positive feed-back loop (+)FBL causes exponential growth of the oscillation amplitudes of variables, which may lead to a crisis and the breakdown of the system. It is well-known that the negative feed-back loop (-)FBL enables the regulation of performance dynamics of the whole system. In the situation when the system does not have any or not sufficient number of feed-back loops, then the management has to develop them intentionally (Munitić, 1989).

In accordance to the system dynamics simulation quality methodology, it is possible to present the mental and verbal model of NTP in the following way:

"If the variable ***generator of the vessel arrival*** **GDP** increases, ***the number of vessel registration a day*** **BPPD** will also increase, which shows a positive cause-consequences link **(+)CCL",** i.e., as abbreviated**:**

GDP(+)à**(+)BPPD**

"If the ***number of vessel registration a day*** **BPPD** ***increases, the total number of registered vessels*** **UBPP** will also increase, which shows a positive cause-consequences link (+)**CCL"** i.e., as abbreviated**:**

BPPD(+)à**(+)UBPP**

"If the ***total number of registered vessels*** **UBPP** increases, the ***number of vessel checkouts a day*** **BOPD** will also increase, which shows a positive cause-consequences link (+) CCL.", i.e., as abbreviated**:**

UBPP(+)à **(+)BOPD**

"If the ***number of vessel checkouts a day*** **BOPD** increases, the ***total number of registered vessels*** **UBPP** will decrease, which shows a negative cause-consequences link (-)**CCL**", i.e., as abbreviated**:**

BOPD(+)à **(-)UBPP**

"If the ***average staying time of vessels*** **PVZP** increases, then the ***number of vessel checkouts a day*** **BOPD** decreases, which shows a negative cause-consequences link (-)**CCL**", i.e., as abbreviated**:**

PVZP(+)à**(-)BOPD**

(-)FBL1: The variables **UBPP** and **BOPD** create the so called negative feed-back loop (FBL), or self-governing (-)**FBL1**", i.e., as abbreviated**:**

UBPP(+)à**(+)BOPD(+)**à**(-)UBPP**

"If the ***number of vessel checkouts a day*** **BOPD** increases**,** ***the total value of the issued invoices*** **VIRD** will also increase**,** which shows a positive cause-consequences link **(+)CCL**", i.e., as abbreviated**:**

BOPD(+)à**(+)VIRD**

"If the ***value of the issued invoices a day*** **VIRD** increases, ***the total value of the issued invoices*** **UVIR** will also increase, which shows a positive cause-consequences link **(+)CCL**", i.e., as abbreviated:

VIRD(+)à**(+)UVIR**

"If the ***average realised revenue per vessel per day*** **POPPD** increases, ***the value of the issued invoices a day*** **VIRD** will also increase, which shows a positive cause-consequences link (+)**CCL,** i.e., as abbreviated**:**

POPPD(+)à**(+)VIRD**

"If the ***total value of the issued invoices*** **UVIR** increases, the ***value of the collected debts a day*** **VNPD** will also increase, which shows a positive cause-consequences link **(+)CCL**", i.e., as abbreviated:

UVIR(+)à**(+)VNPD**

"If the ***average time of collecting debts*** **PVNP** increases, the ***value of collected debts a day*** **VNPD** will decrease, which shows a negative cause-consequences link **(-)CCL**", i.e., as abbreviated:

PVNP(+)à(-)VNPD

"If the ***value of collected debts a day*** **VNPD** increases, the ***total value of issued invoices*** **UVIR** will decrease, which shows a negative cause-consequences link (-)**CCL**", i.e., as abbreviated:

VNPD(+)à(-)UVIR

"(-)FBL2: The variables **VNPD** and **UVIR** create the so called negative feed-back loop (FBL), or self-governing (-)**FBL2**", i.e., as abbreviated:

UVIR(+)à(+)VNPD(+)à(-)UVIR

"If the ***value of collected debts a day*** **VNPD** increases, then the ***total realised revenues a day*** **UOPD** will also increase, which shows a positive cause-consequences link (+)**CCL**", i.e., as abbreviated:

VNPD(+)à(+)UOPD

"If the ***total realised revenues a day*** **UOPD** increase, the **INCOME** will also increase, which shows a positive cause-consequences link **(+)CCL**", i.e., as abbreviated:

UOPD(+)à(+)INCOME

"If the ***value of collected debts a day*** **VNPD** increases, the ***value of paid assets to the cash-flow a day*** **VUSZRD** will also increase, which shows a positive cause-consequences link **(+)CCL**", i.e., as abbreviated:

VNPD(+)à(+)VUSZRD

"If the ***value of paid liquid assets to the account (cash-flow) a day*** **VUSZRD** increases, the ***state of the total liquid assets on the account (cash-flow)*** **SUSZR**, will also increase, which shows a positive cause-consequences link **(+)CCL**", i.e., as abbreviated:

VUSZRD(+)à(+)SUSZR

"If the ***state of the total liquid assets on the account (cash-flow)*** **SUSZR**, increases, then the ***value of the disbursements from the cash-flow a day*** **VISZRD** will also increase, which shows a positive cause-consequences link **(+)CCL**", i.e., as abbreviated:

SUSZR(+)à(+)VISZRD

"If the ***value of disbursements from the cash-flow a day*** **VISZRD** increases, then the ***state of the total assets in the cash-flow*** **SUSZR** will decrease, which shows a negative cause-consequences link **(-)CCL**", i.e., as abbreviated:

VISZRD(+)à(-)SUSZR

"(-)FBL3: The variables **SUSZR** and **VISZRD** create the so called negative feed-back loop (FBL), or self-governing (-)**FBL3**", i.e., as abbreviated:

SUSZR(+)à(+)VISZRD(+)à(-)SUSZR

"If the number of ***registered vessels a day*** **BPPD** increases, then the ***total operating costs*** **UTP** will also increase, which shows a positive cause-consequences link (+)**CCL**", i.e., as abbreviated:

BPPD(+)à(+)UTP

"If the variable ***average costs per vessel per day*** **PTPD** increases, then the ***total operating costs*** **UTP** will also increase, which shows a positive cause-consequences link (+)**CCL**", i.e., as abbreviated:

BPPD(+)à(+)UTP

"If the ***total operating costs*** **UTP** increase, then the ***value of the liabilities a day*** **VDOPD** will also increase, which shows a positive cause-consequences link (+)**CCL**", i.e., as abbreviated:

UTP(+)à(+)VDOPD

"If the ***value of liabilities a day*** **VDOPD** increases, then the **INCOME** will decrease, which shows a negative cause-consequences link **(-)CCL**", i.e., as abbreviated:

VDOPD(+)à(-)INCOME

"If the ***value of liabilities a day*** **VDOPD** increases, then the ***value of the total debts*** **VUD** will also increase, which shows a positive cause-consequences link (+)**CCL**", i.e., as abbreviated:

VDOPD(+)à(+)VUD

"If the ***value of the total debts*** **VUD** increases, then the ***value of debt settlement a day*** **VIOPD** will also increase, which shows a positive (+) cause-consequences link **CCL**", i.e., as abbreviated:

VUD(+)à(+)VIOPD

"If the ***average time of debt settlement*** **PVIOP** increases, then the ***value of debt settlement a day*** **VIOPD** will decrease, which shows a negative (-) cause-consequences link **CCL**", i.e., as abbreviated:

PVIOP(+)à(-)VIOPD

"If the ***value of debt settlement a day*** **VIOPD** increases, the ***value of total debts*** **VUD** will decrease, which shows a negative cause-consequences link (-)**CCL**", i.e., as abbreviated:

VIOPD(+)à(-)VUD

"(-)FBL4: The variables **VUD** and **VIOPD** create the so called negative feed-back loop (FBL), or self-governing (-)**FBL4**", i.e., as abbreviated:

VUD(+)à(+)VIOPD(+)à(-)VUD

"If the ***value of debt settlement a day*** **VIOPD** increases, the ***value of paid assets from the cash-flow a day*** **VISZRD** will also increase, which shows a positive cause-consequences link (+)**CCL**", i.e., as abbreviated:

VIOPD(+)à(+)VISZRD

Remark: If the state of the total liquid assets on the account (cash-flow) is higher than zero, then NTP business system is solvent, and if it is zero or less than zero, then it is financially insolvent and in order to be capable to pay its liabilities it has to ensure extra cash assets.

Structural model of the NTP business system

In accordance to the determined mental and verbal simulation model of NTP business system, it is possible to develop the system dynamics simulation structural model (Senge, 1994) (Figure 1):

Analysing the structural model as shown in Figure 1 it is noticeable that its dynamic performance is dominated by the influence of four feed-back loops (FBL): (-)FBL1; (-)FBL2; (-)FBL3; and (-)FBL4. Dynamic performance of the noticed feed-back loops "reduces" the possible oscillations of other determined variables of the NTP business system. It is known that the positive feed-back loops (+)FBL will result in a dramatic increase of the value of other variables of business systems, while negative feed-back loops (-) will reduce the oscillations of the same variables, or stabilise the business system.

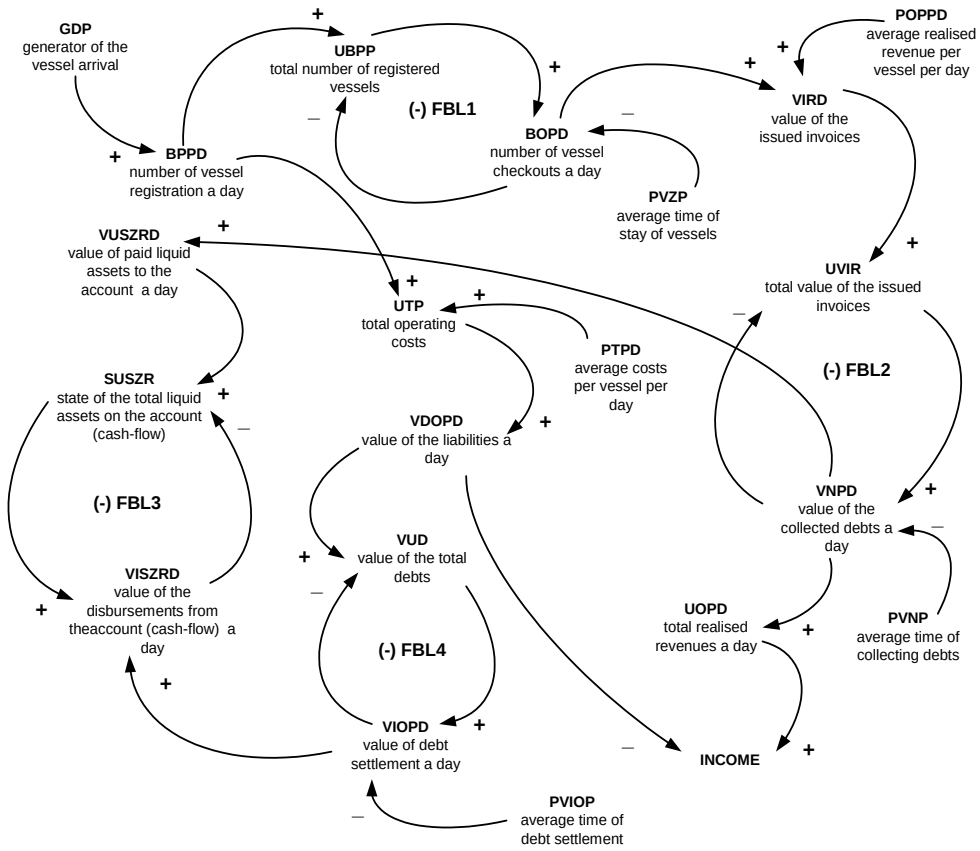

Figure 1. Structural model of the NTP business system

Other developed simulation models (structural flow-diagram and mathematical and computerised models) which jointly make a total dynamic simulation of NTP business operations and development of the desired scenario, have not been presented in this paper. Since the authors, besides the basic model, have also developed other models and possible

scenarios of NTP business operations, graphic presentations and commentary of the simulations based on the investments of business system into sports and recreational objects have been presented (Figure 2, Figure 3). Investments in such objects are parts of a plan to improve the complete quality of NTP business operations, to increase the level of satisfaction and consumption of the consumers – nautical tourists, to prolong the season, to have the opportunity to realise income during the whole year, and to increase the revenues (Kotler, 1994).

Global increase of demand for sports and recreational facilities and an increasing number of individuals who plan to spend actively their leisure time set to the managers of tourist business organisations the needs to prepare a more integral offer which will ensure full satisfaction of a guest and additional income. Besides, there is an increasing awareness of the influence of sports and recreation to physical and mental health of a modern man, "fleeing from everyday life" in search of new experiences and attractive programmes. Nowadays it is almost inconceivable to plan a quality tourist offer, especially for demanding guests such as nautical tourists, without ensuring the corresponding sports and recreation facilities (Dulčić, 2001).

In the presented simulation model of a hypothetic business system of NTP, a new investment has been planned into construction of certain sports facilities for which the authors think will satisfy the needs and desires of several target groups of consumers – boaters, or that they may provide additional revenues from the resident citizens throughout the whole year.

The results of the simulation of the NTP basic scenario

On the basis of the authorised simulation models the authors made a dynamic research of a hypothetic *ad hoc* NTP business system performance. The authors applied several scenarios of possible business operations for the same simulation, and presented the results of performance dynamics of the so called basic scenario which is based on the appropriate new investments in sports and recreation facilities (four open-door and two enclosed tennis courts, one beach volley ground, and one 50 m^2 swimming pool, including the ancillary objects: dressing rooms, sauna, bathrooms, sports massage, medical doctor service, etc.). Graphic results of the simulation are:

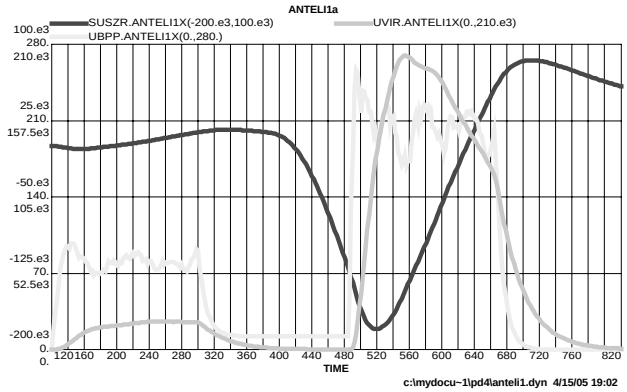

Figure 2: Graphic presentation of the base scenario simulation results – variables SUSZR, UVIR and UBPP

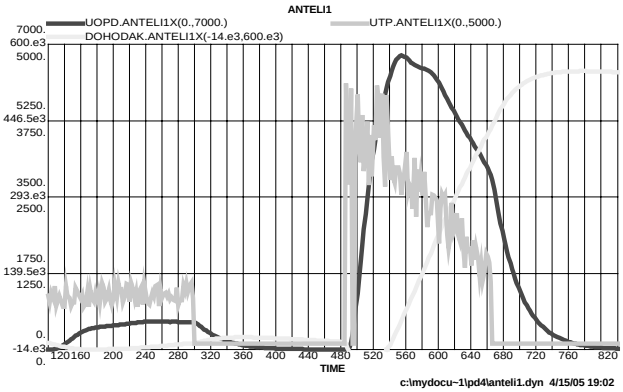

Figure 3: Graphic presentation of the base scenario simulation results – variables UOPD, INCOME and UTP

Comments of the base scenario simulation results

Managing non-linear business systems, which also include NTP system, is, in present business conditions, an extremely complex process which requires from the managers special expertise and skills with the aim of reaching quality business results and ensuring growth and development of the system (Warren, 2002).

Although men created business systems, they are not capable to control efficiently their extreme complexity and performance dynamics, and especially to plan the future development on the basis of classic intuition and experience methods which is most common in practice (Stacey, 1997), including managing NTP business system. By applying the system dynamics (SD) continuous simulation modelling we may observe that the NTP business system variables change, which is in accordance to the expected results of a scenario based on business decision-making about a new investment into sports and recreation capacities.

Analysing the obtained graphic results of the simulation of the basic scenario relating to a new investment, it may be observed that performance dynamics of certain variables of the NTP business system, within the relevant surroundings, is in accordance to economic laws. The presented figures show the positive expected changes of six variables which were chosen by the authors: 1. Total number of registered vessels – UBPP; 2. Total realised revenues a day – UOPD; 3. INCOME; 4. Total operating costs – UTP; 5. State of the total liquid assets on the account (cash-flow) – SUSZR; and 6. Total value of the issued invoices – UVIR.

On the basis of the results of NTP business simulation comments, and in view of the two observed tourist seasons and the considerable investment with the aim of improving business as a whole, it may be concluded that the observed NTP business system for such a scenario of the observed development period is stable and it gives positive financial results (revenues, income, solvency etc.) and total positive results in the observed period.

Conclusions

On the basis of the system dynamics research of the performance of a complex NTP business system, with the aid of a fast digital computer on which the performance simulation was done, it is possible to bring forward a number of relevant conclusions:

1. A direct application of system dynamics simulation complex models in the field of scientific research of performance of nonlinear management systems has full rationalization, because it ensures to the manager - model constructor quality and precise insight into continuous performance dynamics of NTP business system (Sterman, 2000).
2. System dynamics, by its nature, has all the characteristics of intelligent modelling of business systems, since in its models it combines continuous simulation technique and heuristic optimisation, with skills, expertise, experience and intuition of a good manager (Pidd, 1998).
3. System dynamics uses special methodology and special software packages, the most outstanding being: DYNAMO; Powersim, Stella, Vensim, and Think (Sterman, 2000).
4. System dynamics is especially convenient for the study of performance dynamics of business systems in which a great number of non-linear feed-back loops operate, and stochastic influences of the relevant surroundings, or for managing non-linear systems where at operating the system the use of manager's intuition alone fails (Forrester, 1980).
5. A special importance and quality of applying system dynamics is in the area of manager education and training, and designing and exploitation of complex business management systems (Pidd, 1997).

On the basis of the previous presentation, the authors of this paper recommend to the NTP managers and other business system managers the implementation of system dynamics methodology tool. Applying the SD enables better comprehension of performance dynamics of complex systems with which it cannot be experimented in real world without a risk for their existence, growth and development.

The possible scientific contribution of this paper is primarily in authorised determining of general multiple simulation models which allow for acquiring new knowledge about dynamic performance of real nautical and tourist business systems, but also sports organisation systems.

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RESEARCH WORK ON SPORTS TOURISM

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Abstract

The literature from the field of research in sport and tourism and their mutual connections is not rare. Various authors approach the research on these two phenomena differently and results of their investigations can be found in numerous papers around the world. Primarily they were oriented on identifying the connection between sport and tourism. Then the research work on the consequences, that is, the effects of their relationship follow (mainly the quantification of these effects). Contemporary studies move towards new contents and relations that can improve the quality of rest, and those that deal with the relation of policy makers towards sport tourism. For a better understanding it is necessary to point out various approaches to defining and explaining the concept of sports tourism. This is done in the paper and a more detailed overview of the works of Croatian authors is given. Special attention is paid to the development of sports tourism, that is, physical-recreation-related tourism in Croatia. An insight in the significance of this form of tourism on the development of tourism in general is given. The paper is a result of a comprehensive study of literature on the subject of sports tourism and its development in the world and Croatia.

Key words: *research, sports tourism, development, physical recreation*

Introduction

The motive of sport, that is to say, the attendance at sport events is one of the oldest motives which have influenced the travel (let us just remember the ancient Greeks and their trips to the Olympic Games). However, we had to wait for a while for the systematic research on the subject of the link between sport and tourism to appear. We begin the historical overview of such research with the year 1942 and the famous authors Hunziker and Krapf. Even at that time they noticed that sport affects the development of tourism. The studies that follow are connected with defining the ways in which sport and tourism interconnect and possibly interact. All this is presented under one unique term - *sports tourism.* The effects of sports tourism are systematized and quantified (in economic terms). Contemporary research put the cooperation among various organisations from the field of sport and tourism in the centre of interest for the purpose of a more qualitative development of this phenomenon. In order to explain the term *sports tourism* and physical-recreation-related tourism it was necessary to conduct a comprehensive desk research, i.e. to study literature that pursues this topic from various points of view. The definitions and explanations of sports tourism developed by experts from this field will be presented and briefly analysed (e.g. the definitions by Standeven and De Knop, Weed & Bull, Gibson, Bartoluci). A more detailed overview of the course of development of this form of tourism in Croatia will be given.

Historical overview of the studies of links between tourism and sport

As far as 1942 in their work *Grundrisse der allgemeinen Fremdenverkehrslehre* authors Hunziker and Krapf pointed to the link between tourism and sport. They wrote that the development of sport in all countries has great influence on national health and that sport has evolved to be that *crucial factor in tourism* because some types of sports, especially winter sports, are almost exclusively to be regarded as a part of tourism. A lot of time had to pass since then for us to see the first written papers and studies on this topic. Weed & Bull (2004:xi) as one of the earliest works on links between sport and tourism in that sense mention Don Anthony's paper *Sport and tourism* from 1966. After that more and more scientists had become interested in this topic so that consequently a bigger number of papers appeared. However, it is the 1982 study of S.A. Glyptis carried out in five European countries that marks the beginning of a growth of literature on the links between tourism and sport (Weed & Bull, 2004:xii). According to Gibson (2003:205), "beginning in the 1980s, primarily in Europe, Glyptis (1982, 1991) and De Knop (1987, 1990) began to investigate and write about the role of sport in vacations, primarily from the perspective of the tourist as an active sports participant." In the last few years we have witnessed the publishing of a great number of books like the one by Standeven and De Knop (1999) called *Sport Tourism*, then Turco, Riley and Swart's *Sports Tourism* (2002), and Weed & Bull's (2004) *Sports Tourism – participants, policy and providers.* This topic has been the subject of various research studies and papers but was also the motive for organising various conferences (see De Knop and Van Hoecke, 2003:65). Croatia did not fall behind all this development. In 1972 in the Croatian town Poreč an international symposium "Ekonomske vrijednosti sportske rekreacije u turizmu" (Economic values of physical recreation in tourism) was held. A number of domestic and foreign experts were involved in its work. From the very title of the conference one can see that the main area of interest were the economic effects of

physical recreation in tourism, which partially determined the course of later research studies on the topic of sport and physical recreation in Croatian tourism. Therefore, papers and research studies that mainly deal with economic effects of sport and physical recreation will be presented in this paper. In 1987 Relac and Bartoluci published a book *Turizam i sportska rekreacija / Tourism and physical recreation.* In it they emphasized the organisational and economic aspects of physical-recreation-related contents in tourism. In 1998 the cooperation of eminent scientists from the field of economics and management, kinesiology and sociology resulted in publishing of the book *Turizam i sport / Tourism and sport* whose editors were M. Bartoluci and N. Čavlek. The book elaborates the topics of links between tourism and sport, the role of physical recreation and health as a function of improving tourism, the development of some kinds of sports in tourism as well as the Croatian tourism in an international environment, in a detailed and comprehensive manner. Special attention is paid to the evaluation of "economic affects of tourism, sport, physical recreation and other activities in contemporary tourism" (Bartoluci & Čavlek, 1998:271). One year later, as a project of the scientific conference "Kinesiology for the 21st century", the special edition *Ekonomski aspekti sporta i turizma / Economic aspects of sport and tourism* was published. In its first part the authors wrote about the economic aspects of sport on the macro and micro levels, while in the second part of the book the articles written by tourism experts from Croatia are present. Economic aspects are accentuated which can be seen from the title due to the fact that "the development of tourism and sport is based on the same market aspects. The quality demanded by the customers (users of the services) has the dominant role for their development, and it is from that, that the economic effects of tourism and sport arise". (Bartoluci, 1999). The year 2004 in Croatia is marked by the book edited by M. Bartoluci, *Menedžment u sportu i turizmu / Management in Sport and Tourism,* the book written in two languages. It "contains some of the most important studies made both in Croatia and in the world. However, as for its topicality, this book is to be regarded as new since it deals with MANAGEMENT in sport and tourism and it is the first written work of its kind in Croatia". (Bartoluci, 2004:7).

According to Weed and Bull (2004) it is in general possible to identify three strands of literature that explains the links between sport and tourism. The first and "by far the largest" (Weed & Bull, 2004:16) focuses on expanding the idea that such a link exists. The authors of this strand simply tried to establish this connection and make the field in question worth researching, which they succeeded. There are numerous papers on this topic which are considered to be extremely useful in the preliminary development of work in this area. On the other hand, in the sense of empirically confirmed research studies they have lower contribution to the development of this science. Except maybe only in the form of some isolated research studies. The authors of the second strand direct their work towards trying to quantify the links between tourism and sport by means of defining the quantity and value of sports tourism and habits in expenditure, as well as the different profiles of sport tourists. The biggest problem of these studies lies in the fact that the data collected in them are not easily comparable with other countries. And finally, the third strand of literature deals with the response of policy-makers to sports tourism. There is a very limited number of this kind of papers and studies, because the organisations that make decisions and directives in the area of sport and tourism fail to see mutual benefits in connecting their activities with sports tourism. However, using the words of Weed and Bull "the continued and predicted future growth of sports tourism means that such links cannot be ignored by these organizations for very much longer". (2004:202, 203).

Finally, we cannot move on without mentioning the other side of the coin of involvement in sport and recreational activities, i.e. their influence on one's health. Working conditions today in which a sedentary way of living without enough movement prevails leads as a consequence to the development of various illnesses in contemporary society. Numerous research studies have confirmed the thesis that sport and recreation participation help in the prevention of these diseases (see more in Vuori, 2004:123-153). This health function of sport and tourism for that matter is very strongly expressed. Some authors even emphasize the important "influence of outings and recreation in the countryside, which positively affects the mental and physical recovery of a person and which can, in ideal circumstances, literally mean the re-creation of a person both from a physical and from a mental point of view" (Alfier, 1977:27-28). In their everyday lives more and more people begin to participate in some form of a sport activity. Sport becomes a lifestyle which is then transferred to tourist movements. As Bartoluci said "it is well known that various sport and recreation programmes have a positive impact on preservation and betterment of people's lives or in these cases the tourist's" (2003:69) so the intensive development of these contents in tourism does not come as a surprise.

And at the end of this brief historical overview, we wish to accentuate that only some of the research studies and papers on the topic of the development of sports tourism have been mentioned. The purpose of this paper was to simply point to the meaning of this phenomenon through history and the strands of the development of literature. In a more detailed way the papers on economic effects of sport and physical recreation in Croatia are presented and explained because we believe they are of a great value for directing the future research on this topic. Namely, it is these economic effects that can raise the interest of all participants that can appear in the process of development of this kind of tourism because in it they find their interest for involvement in its development.

The term *physical-recreation-related tourism*

It would be necessary to start this chapter with the explanation of the terms *sport* and *tourism*, but due to the limited space of this paper, only some approaches to defining the terms ***sports*** or ***physical-recreation-related tourism*** will be

presented. The rule *the number of definitions equals the number of authors* applies also in this case. This is due to various approaches used for the explanation of the same problem. When talking about sports tourism, mainly three approaches are present –from the point of view of activities, organisation of sports tourism and motivation.

The overview of definitions will begin with Standeven and De Knop. They defined sports tourism as "all forms of active and passive involvement in sporting activity, participated in casually or in an organized way for non-commercial or business/commercial reasons, that necessitate travel away from home and work locality" (quoted in Weed & Bull, 2004:44). The authors did not offer any systematization of sporting activities mentioned in the definition. They are merely regarded as either active or passive. When mentioning the active ones the authors imply the participation in sport activities, and the passive ones would imply the attendance as observers at sporting events.

A somewhat detailed overview of activities was given by Turco, Riley and Swart in their book *Sports tourism*. They used the explanation of the Texas Department of Economic Development and presented a general description of sports tourism saying that "sports tourism includes travel to and participation in or attendance at a predetermined sport activity. The sport activity can include competition and travel for recreation, entertainment, business, education and/or socializing. The sport can be competitive and/or recreational" (2002:3). Activities are again presented from the aspect of active or passive involvement. Certain attention is paid to the motives for the trip which can be undertaken, according to the definition, for the reasons of recreation, fun, business, education and/or socializing. Therefore, sport and sport activities in this case are not regarded as the primary motives for travel.

Based on the instructions of WTO, the World Tourism Organisation, sports tourism can be defined as "activities of athletes, recreants, spectators and travellers undertaken in places outside their usual environment for not more than one consecutive year for participation in sport, watching sport and other sport motivated leisure and business purposes" (quoted in Studzieniecki, 2003:250). In this case explanation is given from the purely 'tourist point of view'. The activities of people who participate in this kind of travel are in the focus of attention, the length of the stay is accurately determined, and business reasons for travel are added to the ones of sport-related activities.

For the purpose of defining sports tourism H. Gibson considered the behavioural sets of *sports tourists*. She finds that sports tourism is characterised by three behavioural sets and that it can be defined as "leisure-based travel that takes individuals temporarily outside of their home communities to participate in physical activities, to watch physical activities, or to venerate attractions associated with physical activities" (quoted in Gibson, 2003:207). The author suggested three types of sports tourism: active (travel for taking part in sport), event sport tourism (travel to watch sport) and nostalgia sport tourism (travel for visiting sports-related attractions such as famous stadiums, etc.). For the first time the visits to sports attractions, like stadiums of famous clubs, for example the one in Barcelona opened for visits, sport museums, etc., are mentioned.

Weed and Bull understand this term in a wider sense and offer a comprehensive explanation (not a definition) of the conceptualisation of sports tourism as a "social, economic and cultural phenomenon arising from the unique interaction of activity, people and place" (2004:37). According to the same authors sport tourism as an area of study "produces a range of issues that cannot be analysed and addressed via a simple amalgamation of approaches previously applied to the individual sectors of sport and tourism" (2004:xiv). That is to say, they find that sports tourism "is not simply derived from sport or from tourism, nor from some simple aggregation of the two" (Weed & Bull, 2004:204).

Croatia does not lack theoretical denotations of the concept of sports or physical-recreation-related tourism. As a basic criterion for the distinction of specific types of tourism Relac and Bartoluci used the motive for travel and stay (Relac & Bartoluci, 1987:40). In that sense Bartoluci says that "tourism in which sport is the main motive for travelling and for staying in a certain destination is termed SPORTS TOURISM" (Bartoluci, 2004:21). According to the same author sports tourism appears in several forms such as:

1. competitive sports tourism,
2. winter sports-recreational tourism,
3. summer sports-recreational tourism, etc. (Bartoluci, 2004:21).

It can be noticed that the author mentions sports and sports-recreational tourism. A difference will be explained further on. The term *competitive sports tourism* encompasses "all journeys that are initiated by the motive of participating in certain sporting events, from national to international competitions" (Bartoluci, 2003:71). The basic motive for travel is a sporting event even if one travels for active (athletes) or passive participation motives (fans). Standeven and De Knop present this as passive involvement in a sporting activity, and H. Gibson defines this form as *event tourism*. On the other hand, sports-recreational tourism includes involvement in those activities in the form of playing sport. Namely, "in contemporary tourism physical recreation as activity tourists engage in actively during their vacation appears more and more as motive for tourist travel. Physical recreation as a rule is not of competing or observing character. It is a sporting activity of the tourists chosen by their own free will and for the purpose of satisfying the need for movement, play, active rest and entertainment" (Relac & Bartoluci, 1987:40). We distinguish between winter and summer physical-recreation-related tourism depending on activities that one can practice during each season and the place where they are practiced. Having that in mind, we can say that *winter* physical-recreation-related tourism is conducted in mountain winter resorts,

but also in spas, on the see, while *summer* physical-recreation-related tourism is characteristic for the seaside, in the mountains, on the rivers, lakes, etc. There are also physical recreation activities specific for each season. Activities that people can participate in during winter are skiing, cross-country skiing, ice-skating, team sports on snow and ice, etc., and during summer, walking, running, mountaineering, water sports, team sports, golf, tennis, horseback riding, etc. (Bartoluci, 2004:23).

The development of physical recreation in Croatian tourism

For the development of physical recreation in Croatian tourism special significance is awarded to the Department of physical recreation on the *Visoka škola za fizičku kulturu / Physical Education Polytechnics* in Zagreb founded in 1959. Among the first experts to note the need for integrating the physical recreation contents in the tourist offer for the purpose of qualitative and eventful tourist stay was the founder of the Department M. Relac (Relac & Andrijašević, 1998:125). The first project was realised in 1966 in Baška on the island of Krk and in Crikvenica. This is the time when the first facilities for the physical recreation contents in tourism were built. These were a miniature golf course, one table for table tennis, darts and swing bowls. Numerous projects followed such as those of the building of two experimental physical recreation centres in tourism (Pula, Makarska), 9 more centres with physical recreation contents have been opened along the Croatian coastline (Pula, Rovinj, Umag, Omiš, Bol on the island of Brač, Lopar and Rab). Monitoring of the work of these centres served for "further development and quality enhancement of the tourist offer" (Relac & Andrijašević, 1998: 126). One year later, research studies in Šibenik and Poreč have been conducted, and from 1970 till 1990 the Department for physical recreation created more than 50 developmental tourism studies along our coastline. The offer of physical recreation was introduced in numerous treatment centres because they started to direct their activities towards prevention and not only rehabilitation. "Research studies conducted in experimental centres on a continuous basis, have confirmed the assumptions on the importance of physical recreation contents for the selection of a tourism destination, on their influence on prolonging the stay of tourists in hotels, as well as the tourists' satisfaction with their stay. All this affected the quality of the tourist offer in a positive way" (Relac & Andrijašević, 1998:126).

Since then many authors and researchers have contributed to the theory of development of sport and physical recreation in tourism with regards to changes on the tourist demand market.

The importance of sport in the development of tourism

Considering everything mentioned previously it can be concluded that sport and physical recreation contents become an unavoidable part of tourist offer. This can be said for passive involvement of tourists in sport competitions as well as for the programmes in which they are involved actively (physical recreation activities). In order for this to be possible it is necessary to create the conditions for the enforcement of these programmes and activities. Thus, some of the basic elements of physical recreation contents (buildings, programmes, etc.) become a part of tourism development plans for a certain area. For example, Vukonić and Keča (2001:105-106) explained the typology of tourist places where in the case of a group of cities or capital cities and the development of the specific form of tourism (*mega events*) they say how "towns that have based their tourism future on those bases build appropriate infrastructure: big congress halls, sport stadiums and halls as well as multifunctional halls". The same principle applies to other tourist places that tourists do not visit because of some sporting event but for participation in sport and physical recreation activities. The arguments for this lie also in numerous examples of facility classifications for hotels. McIntosh and Goeldner (1986:200) find that tourist offer must be composed of the following elements: natural resources, infrastructure, superstructure, transportation and hospitality and culture. As an integral part of the last component listed they included sport offer as well. A reverse influence is also possible. That is to say, developed sport in some area can be a reason for the development of that area as a tourist area. Jackson and Glyptis in this case distinguish between two types of tourism connected to sport: in the first one the destinations knowingly use sport for the development of their tourist profile, and in the second tourism has evolved more or less spontaneously as a result of sport activities (1992 quoted in Weed & Bull, 2004:15). Here we mostly talk about skiing centres especially on altitudes where development of tourism would be difficult to imagine if there were no sport competitions.

Conclusion

One of the aims of this paper was to present the development of sports tourism in the world and Croatia. The papers and research studies on the topic of the links between sport and tourism differed throughout history and were shown in a chronological order. At the beginning it was necessary to establish the links between these two activities so that specific characteristics of those links and the effects of their mutual performance can be researched into. A tendency not to do this by merely summing up the characteristics of both activities is present. Sports tourism is observed as a separate phenomenon. Depending on the starting positions from which sports tourism is viewed, the authors define and explain it in different ways. We have pointed to the approaches of some authors regarded to be the leading experts in research on this topic. Special attention was paid to the development of tourism and research studies in this field in Croatia in

comparison to research studies in other countries. We have tried to point to the economic but also to other effects of sport and recreation in general and in tourism. On the basis of the number of papers and studies on this topic it can be concluded that sport and physical recreation are of a great significance for the development of tourism. This can be seen from the fact that certain elements of physical recreation contents (buildings, programmes, etc.) are integrated in the tourism development plans.

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CRUISES WITH VINTAGE SAILING SHIPS THE CASE OF CROATIA

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Abstract

In Croatia, the tourist resources of the islands and the mainland can be used well for the development of cruises using vintage sailing ships. Today, Turkey and Greece are the two major countries in the market. However, the expanding market allows new countries an entry into the competition. Croatia has to differentiate its products and target the identified market niches more accurately in order to exploit all the market opportunities. The wealth of historical-cultural sights, the rich tradition and history, the unspoiled nature and natural phenomena offered by the islands are an excellent combination for the development of adventurous and thematic cruise programs. Small capacity cruises (as compared to mega-ship capacities of 1,500 – 2,000 passengers, which are turning towards mass tourism daily) with adventure and thematic programs are an excellent combination for the success of this type of supply. These are cruises consisting of 30-40 people who want to spend their holiday far away from the overcrowded tourist centers, enjoying the sea and discovering new experiences. The new programs would simultaneously complete and diversify the already existing supply.

Key words: *vintage sailing ships, adventurous cruise, theme cruises, Croatia*

Introduction

The exceptionally indented coastline, numerous islands, calm sea, multitude of natural havens and the beauty of the landscape and natural ambience are enormous potentials for the development of nautical tourism and cruises with sailing ships in Croatia. The interest in cruise travel is growing and there is huge potential for growth in this dynamic industry. The main objective of this paper is an analysis of the existing supply of cruises with vintage sailing ships, progress trends in the cruise industry, as well as the development of a new cruise program, which is lacking in the present tourist supply. The paper will present new tourist cruise programs – thematic and adventure cruises along the Croatian islands using vintage sailing ships – as the best way of visiting and experiencing the Croatian islands and coastline.

The main features of the cruising sector using vintage sailing ships

Croatia is known as a destination for a relaxing summer holiday. Sun and sea vacations are still its main tourist product. More than 90% of tourist arrivals are realized in seaside resorts. According to the survey, the primary motives for coming to Croatia are rest and relaxation at the seaside, followed by pleasure and fun and the visiting of natural attractions (TOMAS, 2004). Its main advantages are natural beauty and scenery. Croatia did not include itself in the competitive race by differentiating its supply. A noticeable contribution to the diversification of the tourist product was given only by the nautical tourist product, which began to show intensive development in the early 1980s. This sector offers the most business opportunities for the future, together with sun and beaches, touring and cultural tourism. For the growth of this sector, Croatia has a suitable coastline with a rich system of islands, good sailing conditions and good infrastructures.

Cruising with vintage sailing ships is a part of the tourist supply, and is relatively new in Croatia. Over the past few years in Croatia vintage sailing ship cruises are being offered along the Adriatic Coast. Agencies that deal with the organization of such cruises offer either tailor-made programs or simple ship charters where customers are allowed the freedom of creating their own itinerary with the help of the captain. There are over 50 ships in the supply of only two agencies. Alongside this, there are a number of other agencies that offer similar cruises, but their supply consists of a small number of sailing ships.

Croatia has great potential for the development of cruises using vintage sailing ships along the Adriatic coastline and islands. Alongside Greece, the Croatian archipelago is the richest archipelago in the Mediterranean with 66 islands, 652 islets, 389 cliffs and 78 reefs (Statistical Yearbook, 2004). The islands are especially pleasant, and the rhythm of life on them is different from life on the mainland. The tenseness of city life has not arrived there yet. The abundance of natural harbors along the Croatian coastline is expressed by the coefficient 10.2.

Cruising with vintage sailing ships represents a niche within the cruising sector. It is expected that the demand for this kind of product will grow in the future due to the attractiveness of the product in the Mediterranean and the constant increase in quality. It is gaining in popularity as it offers a unique experience in an authentic ambience, relaxation and the discovery of the natural and cultural sights of the Adriatic, in one word great value to the clients.

A niche market in smaller yacht-like vessels is developing. Niche cruisers are seeking an experience very different from the traditional cruise. Special interest cruises offer travelers the opportunity to expand their knowledge through special programs and activities. Different types of cruises are gaining in their importance and popularity. These types of cruises make up for only a small percentage of the total cruises, but with an increasing rate of growth (Peisley, 2002). Due to the increasing popularity of such cruises, most companies that generally offer mainstream cruises are turning more and more towards thematic cruises. In 2002, 119 ships were included in expedition and niche market cruises, realizing 2.8 million pax-nights (Lloyd's Cruise International, 2003). A variety of niche cruises offer: cultural, sailing, coastal, river, mini, and the most numerous are expedition cruises.

Today, Turkey is the most popular destination for these kinds of cruises, with its traditional yacht - goulette. The only other country besides Turkey that develops and promotes this kind of tourism is Greece, but to a lesser extent. These two countries have successfully positioned themselves on the main generating markets. Turkey offers cruises on traditional Turkish yachts called "goulettes", a relic from the days of Christopher Columbus. It is an all-wooden motor sailing yacht built for cruising the coasts in the calm warm waters of the Mediterranean. Modern goulettes are comfortably equipped and encourage an environment in which clients are expected to do nothing but enjoy themselves - a relaxed and enjoyable atmosphere for all the passengers with a friendly relationship with the crew. As in Croatia, the emphasis is on swimming, resting in the sun and visiting charming and deserted bays. Ships dock in bigger places where visitors are encouraged to shop for leather products and traditional Turkish products, and also to visit cultural historic monuments and archaeological sites. Also, there are very high-category ship cruises that offer de luxe all-inclusive programs (www.aegeanyacht.com). The so-called simple and casual programs are offered at a lower price. Archeological cruises target a specialized market segment.

Croatia should take advantage of the situation, taking into consideration the small number of competitors, and should position itself on the world tourist market as the main destination for cruising with vintage sailing ships before other competitors. Up to now, this kind of cruising in Croatia was rather ignored in terms of inadequate promotion and diversification of the existing supply. If the superiority of a single company and the lack of adequate ships are considered, then the limited present supply is not surprising. The existing supply is based exclusively on the enjoyment of the sea and sun, relaxation and swimming. There is hardly any other additional activity.

The potentials of developing a new product

Croatia has excellent credentials for creating the image of a cruise destination for vintage sailing ships. It possesses a unique system of islands (concentration and diversity of islands), beauty of the sea (cleanliness and clarity of the water), attractiveness of the coastline, authenticity of the land and its people, hospitality of the local population, healthy and good quality natural food and drinks. With its calm sea and closely connected islands, Croatia offers good cruising conditions. According to THR and Horvath Consulting, (2001), the vintage sailing ship cruising sector is very attractive for future investments in Croatia for the following reasons:

- the vintage sailing ship cruise sector has high growth rates (it is expected to reach 15% per year in Croatia);
- the product is experiencing a rise in popularity in major emissive markets;
- the threat of new entrants and the threat of substitutes are medium to low;
- the bargaining power of buyers is low;
- the existing volume of business is low, but rapidly growing;
- the rivalry between the competitors is low;
- the cost of building new ships is higher than in competitive countries.

In order to compete successfully, Croatia has to offer more value than its direct competitors. Also, to exploit all the opportunities in the market, Croatia has to differentiate its products and target the identified market niches more accurately. Its calm sea, unique system of islands, local hospitality, and cultural heritage give Croatia an excellent opportunity for developing a product that could be both successful and recognizable in the market as being something unique and worth paying for. These are thematic and adventurous cruises on vintage sailing ships that are directed towards market niches that have been either hidden or ignored up to now.

Low-capacity ships are involved (mainly up to 40 passengers), so there is an excellent opportunity for customer segmentation and for targeting market niches. As there are small groups of people that spend from 7 to 10 days together, it is best to attract customers that share the same features. For example, cruises can be organized for people who are single, for women, for certain professions or for young couples. There is also the possibility of organizing special cruises for certain professions, for example workshops, because they offer the opportunity for people of the same profession from various countries to exchange experiences – a musician workshop or various lectures. The potential exists for a combination of cruise-land excursions, i.e. 7-day cruises combined with a 7-day stay in either a hotel or apartment.

The Croatian islands and coastline, by their uniqueness and rich cultural-historical monuments and tradition, offer countless opportunities for the development of special programs, as well as cruises that revolve around certain themes, such

as culture, history, mythology, tradition, gastronomy, music, sports, nature, etc. Each cruising area must offer particular experiences suited to different groups of clients. Various themed cruises and specific itineraries can be developed:

- The Cradle of Marco Polo – legends about the island and Marco Polo
- Robinson Crusoe Adventure - cruising deserted islands and lighthouses
- Pearls of the Adriatic – visits to Zadar, Šibenik, Trogir, Primošten, Split, Dubrovnik
- Croatian wine – visits to wine cellars, tasting the best Croatian wines on Pelješac, Korčula, Vis, Lastovo, Hvar and Brač
- National parks and nature parks – visits to National park Brijuni, NP Paklenica, NP Plitvice, Nature Park Telašćica, NP Kornati, NP Krka, and NP Mljet
- Croatian UNESCO World Heritage Sites: Old Town of Dubrovnik, Diocletian Palace in Split, Euphrasian Basilica in Poreč, Old City of Trogir, Šibenik Cathedral
- Greek colonies along the Adriatic – Vis (first Greek colony in Dalmatia), Palagruža (archaeological findings that prove that Palagruža is the island of the Greek hero Diomedes).

The Croatian coast and its islands are an endless source of themes. Some of the themes that could be used for organizing theme cruises are the following: Sacral Adriatic Art, Roman Colonies Along the Adriatic, Adriatic Gastronomic Supply (restaurants), The Most Beautiful Adriatic Beaches, Cruise and Fishing, Cruise and Clubbing (the most popular nightclubs on the coast), Cruise and Romance for couples, Cruise and Learn (history, geography, culture of the Croatian Adriatic basin), The Most Attractive Coastal and Island Historic Villages, The Most Picturesque Old Fisherman Villages, Best-Secluded Bays, Summer Festivals on the Adriatic, etc.

Special attention should be given to the development of adventure cruises. Among the existing adventure programs in Croatia, the most usual ones are rafting and free-climbing. Other programs are jeep safaris in Konavle near Dubrovnik, different walking tours all over the country, biking and mountain biking programs, sea and river kayaking, horseback riding, sailing, diving, flying (by parachute, kite or balloon), visiting caves, and as the greatest attraction, adventure races for endurance athletes and explorers. There is an association of agencies for adventure tourism in Croatia that aims to develop and control the quality of adventure programs. Also known as Robinson Tourism, there are trips to the uninhabited island of Mrčara, the southern coast of the island of Brač and the uninhabited islands in the archipelago of Kornati. An especially interesting vacation is a trip to the lighthouses on Croatian islands and reefs. These programs include a certain dose of adventure, as lighthouses are places for a special and different kind of vacation away from the noise and speed of big cities. There are 11 lighthouses in different locations, either close to tourist centers or far off the coast. Lighthouse capacities are small. There are usually two or three 3-star apartments per lighthouse (www.adriatica.net).

The existing offer of adventure programs in Croatia is insufficiently developed and the islands are not enough included. Taking into consideration the popularity of the cruise industry world-wide, and Croatia's potential for the development of nautical tourism, the idea of adventure cruises occurs by itself. There is no doubt that the features of the Adriatic islands with its untouched nature are an excellent background for the development of adventure tourism. The slogan of the Croatian Tourist Association that presents *Croatia as the Mediterranean* used to be supports this conclusion. Croatia as a tourist destination is not known enough to a wider public, especially to the youth and potential clients from large emissive markets in west Europe and the world. It is a country yet to be discovered. An excellent way to do this is through adventure cruises that offer a unique experience of the Croatian islands as its most striking feature, experience of the sea, nature and culture with attractive and interesting onshore programs.

Adventure programs are intended for the customers aged from 25 - 45 years who have a youthful spirit, experience in adventure holidays, a desire to enjoy the sea and nature, travel with the intention of discovering and experiencing something new and exciting, travel with a partner or friend, and have middle or higher spending power.

Adventure cruises along the Adriatic islands should be created for groups of cca. 30 pax, and they should include mainland programs in cooperation with local agencies and communities (treasure hunts, sea sports, survival tests, jeep safaris, hand-gliding, etc.). The island programs are not dangerous, and they do not require good physical fitness. They should be adapted to people seeking an experience of something new and exciting during their holiday. They offer the opportunity of active vacation with good fun and the development of a competitive spirit. Another possibility is the development of the combination of adventure cruises and land holidays, with the possibility of participating in similar programs on land. The objective of this package is the experience and better introduction of the unique Adriatic coastline, with active participation in different adventure programs. It should be emphasized that this includes soft adventure tourism, which is acceptable to a wider public.

The quality and equipment of ships should be improved in order to add value to cruising in the vintage ship sector. Also, a ship's capacity should be increased to cca 50 passengers, including comfort. The crew must be from the Adriatic region (personality-wise), with a sound knowledge of local customs and the attractions of the places visited, and should be dressed in navy-styled uniforms. The crew should consist of a captain, a sailor, a cook, a cleaning lady, a waiter and an animator qualified to give necessary information to the passengers and at the same time to prepare onshore programs. Their task would also be to create a relaxing and familiar atmosphere without formalities (no formal dinners, etc.).

Promotion and distribution

To attract customers to the new product, a competitive advantage has to be offered - something new or different that competitors do not have. There are two basic ways to obtain competitive advantage (Middleton, 2002.):

- offer a similar product to your competitor, but offer it cheaper - cost
- offer a different product – differentiation.

In the case of adventure and theme cruises along Croatian islands, it is a matter of differentiation i.e. the offer of a new product. Competitive advantage has to be identified in order to achieve a successful market position, and the best competitive advantage has to be selected for the promotion that will target the consumer of the segment chosen. Some of the competitive advantages are:

- Croatia is the only remaining preserved and protected area of the Mediterranean;
- friendly atmosphere during cruising and intimate ambience;
- close contact with nature;
- richness of experience;
- soft adventure programs on land;
- opportunity to enjoy the sea and sun and learn about your favorite subject at the same time.

Western European countries are potential markets (especially Germany, United Kingdom and France), but certain central European countries should not be overlooked. These are countries that have already been traditionally oriented towards the Adriatic, and where there is a high interest for cruising with vintage sailing ships. The product could be positioned as a high experience satisfaction type of product that guarantees market success.

The promotion of a previously presented product should be based on the differentiation of the newly created product, and the already tested traditional cruises. This product should be promoted as a different cruise that involves a relaxed atmosphere without formalities, far from the overcrowded and large tourist centers, and with exciting mainland programs. It would be a specific call to potential customers to forget the traditional cruise concept, and to surrender themselves to the experiences of a different kind of cruise, full of adventure and surprises, of sensing and enjoying the pleasures of the sea, and of visiting the most secluded corners of the Adriatic Sea. The aim is to inform a targeted market of the new program and to promote the specific features that differentiate this product from similar competitive products.

The purpose of advertisement is to reach the potential and existing consumers of such products and other tourist products through the well-chosen media. The message that we would like to send out with this product is:

- you will enjoy the cruise in a relaxed atmosphere, you will experience the sea and discover one of the most attractive archipelagos of the world, while at the same time learning and experiencing something new;
- you will have an active vacation in a relaxed atmosphere;
- you will forget the traditional concept of cruises and gala evenings; this cruise offers you a chance to get in touch with the sea and nature.

Communication tools should be chosen in accordance to communication objectives identified for each targeted market segment. Potential communication tools are: web sites, editorials, public relations, articles in travel magazines and travel sections of newspapers, advertising in special media, CD-ROMs, videos, posters, face-to-face promotions: presentations to travel agents and tour operators, personal contacts, etc., displays in travel agencies. Further, brochures with pictures and detailed information must be published: ships, various cabin categories and all the amenities that the ship offers; itineraries; transfer to the port of embarkation; supply onboard; ports and island visited; onshore programs; prices; reservations; general conditions; information on the country, islands, customs, and places visited; pre- and post-cruise hotel deals and possibilities of participating in some adventure programs on the mainland (rafting, jeep safari, mountain climbing etc.). One of the ways to conquer the market successfully is to publish jumbo advertisements with attractive photographs of one of the ships in the supply, using a picture of one or more picturesque coves, harbors or Adriatic islands along with the slogan. A possible slogan could be - *Experience something new and discover the Croatian islands.*

Indirect and direct sales systems have to be developed in order to market adventure cruises on Croatian islands. Indirect sale systems through: travel agents that promote Croatia; Croatia specialists travel agents; general travel agents; travel agents that sell cruise holidays; special interest tour operators (cruising and sailing, but also culture, adventure, diving, wine, etc.) and direct sale systems through telephone sales offices, Internet sales facilities, web sites with detailed information and possibilities of on-line reservation. The web address should be advertised on the web pages of the Croatian Tourist Board, Ministry of Tourism, and it should be included in all listings of Croatian sites connected to the tourist offer in the country.

With the already mentioned activity for improving the sale of certain thematic cruises, agencies specialized for the sale of such programs would contact specific market segments. The second possibility for sales is a direct contact with different institutions, associations, clubs connected with a certain theme offered and also universities, art academies, wine grower associations, etc.

Conclusion

A calm sea, a unique system of islands, local hospitality, and cultural heritage give Croatia an excellent opportunity for developing the cruises with vintage sailing ships that could be both successful and recognizable on the market as being something unique and worth paying for. These are thematic and adventurous cruises on vintage sailing ships that are directed towards market niches that have been either hidden or ignored up to now. Special attention has to be paid to adventure cruises. They offer a potential for an active holiday, with the chance of discovering new and relatively unknown sea regions, as well as participation in various adventurous programs. The island programs should be adapted to people seeking an experience of something new during their holiday. This product should be promoted as a cruise that is different and a one that involves a relaxed atmosphere without formalities, far away from the overcrowded mainland, but with exciting mainland programs as well. It would be a specific call to potential customers to forget the traditional cruise concept, and to surrender themselves to the experiences of a different kind of cruise, full of adventure and surprises, of sensing and enjoying the pleasures of the sea, and of visiting the most secluded corners of the Adriatic Sea. The product could be positioned as a high experience and high satisfaction type of product that guarantees market success.

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A CONTEMPORARY CONCEPT OF THE DEVELOPMENT OF PHYSICAL RECREATION IN TOURISM

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Introduction

Recreation is an integral part of the concept of contemporary tourism. It encompasses numerous activities that a tourist selects according to his/her own wishes and preferences. The activities and the types of recreation change and adapt to the cultural and social needs of people, and are realized in the domicile as well as during the holidays in tourism. In accordance with the needs of a contemporary tourist physical recreation is one of the expanding activities dominant in the last decades as the important contents of stay in a certain tourist destination, and thus also an important motive for selecting a particular tourist destination for spending the holidays. Active rest is a synonym of rest in tourism and implies sporting activities as well as numerous other activities in an attractive natural environment. In this context and by investigating the needs of the contemporary man who lacks physical activity and contact with nature, who lives too fast and too stressfully, we reach the conclusion that tourism should realize numerous goals that will ultimately lead to the recovery and satisfaction. The contents of physical recreation have a dominant role in fulfilling the need for movement and the appropriate physical activity, which is nowadays an imperative of a quality rest. It is, therefore, not surprising that sport and tourism develop rapidly owing to the increased interest, but also owing to the needs of the increasing number of tourists.

The development of physical recreation in tourism in Croatia originated from health tourism based on extremely beneficial natural resources of the Adriatic coast. The tradition of health tourism is more than 130 years old and its beginnings can be traced to spas that are visited primarily with the reason of improving health, of rehabilitation, but also of treatment by means of natural factors. Continental health tourism was based on geothermal springs, whereas the coastal tourism was based on the well known characteristics of the Mediterranean climate and thalassotherapy (Razović, 1998). Although health tourism points to treatment and prevention, the bases of such supply modelled on the kinds and contents connected with the improvement and preservation of health by means of natural agents and methods. Activities within thalassotherapy are known that encompass, among other things, movement and exercise near the sea. Numerous walking paths along the Croatian coast (the best known is the 14km-long path in Opatija) were built so that the tourists could enjoy in the unique beauty of the countryside, but also affect their health. The motives of the first tourists to visit Hvar, Opatija, Crikvenica, Veli Lošinj and other places were connected with the optimal natural conditions for the improvement of health. The Romans built most of the spas on the territory of Croatia, and there are many proofs that Diocletian (around 300 AD) built his palace in Split precisely because of the mineral water springs and the healing sea mud. Although Croatia is exceptionally rich in geothermal waters, the health tourism supply in comparison with other European countries such as Slovenia, Hungary, the Czech Republic, Austria, etc. is extremely poor. Croatia has big potentials and comparative advantages for the development of the most interesting kinds of tourism supply connected with the improvement of health of the contemporary, urban man. In Croatia the maritime activities and contents are dominant that encompass almost all types of activities and contents connected with the sea (Vukonić & Čavlek, 2001), however, those activities are mostly offered in the summer tourist season.

The new concept of physical recreation in tourism

Contemporary tourism demands new, sophisticated techniques of creating the optimal models of tourism supply. One of the basic characteristics of the tourism market is its fluctuation due to which it is necessary to permanently follow all elements that lead to the needs of tourists and ultimately to the tourism demand (Bartoluci, 2002). The expansion of tourism in the world is the result of a whole series of dynamic socio-economic relationships in the developed countries as regards the needs, the rights, the economic power, habits, culture, education and the trends in the interaction with the supplier of services. The relationships between the demand for and the supply of products and services are interwoven with numerous mutual functional links. The accelerated flow of information enables the contemporary man to make the decisions connected with travelling and the selection of a tourist destination faster and more easily. The changes that tourism has gone through are the most expressed in the increased number of trips, which is closely connected with the increase of profit, increase of free time and its distribution, with the organization of transport (charter, roads, etc.), as well as with other factors.

The large-scale types of tourist traffic (in Europe and thus also in Croatia) began in the 1970s, which led to the changes as regards the basic characteristics of tourism, namely, that people mostly go to a certain destination to relax, to spend

quality rest directed towards meeting one's needs and health (Andrijašević, 2004). The excessive commercialization decreased the values of the tourist product that was primarily recognizable by its profile. The technological achievements and the unification of the tourist product for wide use found themselves in tourism neglecting the objective needs of tourists. Under the motto *escape* from the urban centres into the kind of large-scale tourist 'asylum', the need of tourists are only partially met. The tourist frequently came home more tired than before he/she went to the vacation. The new, contemporary tourism started to form a new concept of supply of tourism-specific contents - the supply that takes into account primarily the needs of tourists, which implies the quality rest and the quality stay. Apart from numerous factors the contents of stay influence to a greater extent the selection of a tourist destination, and they are sometimes decisive for making a decision to go on a trip. Sport and recreation have always been present in tourism, however, their role was, until about two decades ago, dominantly of the accompanying character. Since the tourists have started to appear in all tourism-related activities as active participants in various programmes, the then passive observers – tourists – obtained a new role as active tourists. In this way the tourist destination together with its facilities and natural resources was changed – it became alive. The physical recreation contents are the basis of modern tourism supply in that they affect the needs and satisfaction of the tourists.

The role of physical recreation in active rest

The trend of the development of contemporary tourism includes a big number of various contents among which are the sporting activities that provide active rest but also the amusement that ultimately offer satisfaction throughout a longer period of time. According to Macmillan (2002:1181), recreation implies doing something out of pleasure, with a positive effect on the restoration of the capacities of a person. A deeper meaning of this definition is the reflection of the complexity of human personality - during the evolution and the technological development it has opened a whole series of needs that tourism should fulfil. Therefore, several professions systematically analyse the subjective and objective needs of tourists, both in the domicile and in a tourist destination - each profession from its own point of view. Sport and recreation have an important compensatory role, namely, their role is to fulfil the primary needs of people to move and to be active in natural conditions. The higher the level of technological development of the society, the more expressed the needs of people. Mental strain and stress on the one hand, and hypokinesis and insufficient relaxation on the other are typical characteristics of the working and living environment of the contemporary person. The consequences of everyday pressure and everyday living conditions are continuously analysed by numerous scientists who have identified a high correlation between negative factors and the occurrence of many diseases (In the book, Spencer A. Rathus, 2000; Kaner et al., 1981; Smith et al., 1990; Simons et al., 1993; Stewart et al., 1994). Stress that encompasses a whole series of various stressors significantly increases the risk of diseases (Holmes & Rahe in Spenser A. Rathus, 2000). Tourism has the opportunity, but also the task, to encourage, recover, to revitalize the tourist who has come to a certain destination to rest. Sport and recreation represent the active component of tourism that, through the tourism environment and under the beneficial influence of the environment relieves the organism of everyday strain thus giving a new dimension to the quality of stay by introducing new experience and perception.

The supply of sport and recreation in tourism is realized through three basic types – activities:

1. free utilization of natural resources (attractions) and sports facilities,
2. organizational forms of sport and recreational activities, and
3. programmed types of sport and recreational activities.

The forms of sport and recreation programmes in tourism are usually divided with regard to age, namely, from the youngest age, to the young and adult persons, to the elderly, to the persons with a disability and to the groups of persons, family and individual consumers. The condition and the contents of the stay of tourists are defined by the category of tourist centres. In Croatia the complementary types of accommodation facilities are still dominant whose supply is oriented towards the main season (households, camps, etc.). The number of facilities and of high-category hotels that can provide the quality services throughout the whole year is still insufficient. The time distribution of the stay of the tourists is still dominant in the peak of the tourist season, regardless whether the trends of tourist trips change their character and whether they are subject to the new rules of tourism demand. The Croatian tourist offer has recognizable advantages through attractive natural resources, and the disadvantages, defined by the tourists, are visible in the poor supply of contents, particularly those related to sport (Institute for tourism, 2005).

The offer of sport and recreation in tourism is more and more frequently the primary factor of visiting a certain destination, which implies the need to permanently analyse the wishes and interests of tourists in order to conform the supply to the demand. Croatian tourism has numerous comparative advantages that must not lose their specific characteristics and unique value. The versatility and the richness of the basic conditions for the development of tourism represents the basis of the development of various programmes in which sport and recreational activities have a significant role. They are present in all types of tourist destinations and they relate to various types of movement, activities, etc. Tourist destinations in Croatia may be divided according to the basic profile and the contents of tourism supply in the following way:

Table 1. Types of natural attractions according to the contents and possibilities of active rest in various conditions and with various aims.

Selective tourism	Centres, locations, regions	Contents and goals
Wellness	Hotels and centres of a high quality	Protection and improvement of health, relaxation, natural agents
Thermal health resorts	Spas and health resorts	Therapies, diagnostics, treatment, prevention of diseases
Health tourism	Spas, centres at the seaside and in the mountains	Thalassotherapy, diagnostics, treatment, therapy, prevention
Sport tourism	In all centres where sports facilities may be found	All sports on the land and on the sea
Eco-tourism	10 nature parks	Tours, bird watching, walking, orienteering, mountaineering.
National parks (visiting natural attractions tourism)	8 national parks	Eco-tourism, tours, bird watching, park tours, walking, etc.
Recreational-competitions-specific tourism	In all centres	Sporting games, regattas, triathlon, old sports, village Olympic Games, tennis, etc.
Agro-tourism	Villages, Adriatic hinterland, inland	Activities in the village, countryside, bird watching, learning
Extreme tourism	At the seaside and in the mountains	Diving, speleology, sky diving, mountaineering, etc.
Religious tourism	Religious centres	Pilgrimages, visiting religious monuments
Hunting tourism, fishing	Hunting areas	Spear-fishing, fishing, hunting

Source: classification by the author.

The systematisation of the supply model in whose basis are the sport- and recreation-specific contents is the more and more required type of selective tourism demand on the tourism market. The contents of physical recreation in tourism are closely connected with the conditions and the way of life in the domicile, particularly, of the urban person. As for its protected natural areas, Croatia has two nature reserves, eight national parks, 10 nature parks, as well as the areas with other types of protection, namely, 69 special reserves, 24 park-forests, 28 landscapes, 114 horticultural monuments, the exceptionally rich flora and fauna, the ecologically preserved area, clean water and the sea. This phenomenon of an ecological oasis is the basis for the development of selective kinds of tourism (Vidaković, 1997 in Geić, 2004).

The trends of the development of physical recreation in contemporary tourism

Apart from the family character of trips to Croatia, the results of the TOMAS research (2004) showed that in Europe the number of people who travel alone as well as the number of the elderly is increasing, which is reflected in the type of demand for a certain tourism product, and it relates to:

- a higher quality,
- appropriate sporting activities,
- a higher demand outside the main season,
- a higher demand for the activities adapted to individual needs,
- the accessibility of the tourist destination, etc.

Most tourists seek an appropriate activity during the vacation that would be close to their needs, interests and wishes, with the emphasis on health. Free time significantly participates in creating the quality of life and it is more and more connected with the care for one's own health. The needs, the wishes and the possibilities are reflected and focused on the time of vacation in order to regenerate, refresh, restore the general capacities of those goals that are incorporated into the principles of physical recreation. What has become topical today is the search for the *real* rest that implies specific activities. The contemporary tourist has differentiated his/her needs taking into account his/her experience, education and the way of life. Those are the needs that encompass all the elements of human nature and characteristics, adapted and harmonized primarily with himself/herself and with his/her environment.

NEEDS OF TOURISTS						
Physical activity – to be fit	Psychological balance – to be content	Socialization – to be communicative	Spiritual wellness – to be fulfilled	Aesthetic perception – to be satisfied with one' s appearance	Education – to learn something new	Contact with nature – to perceive one's environment

Figure 1. Needs of tourists.

Physical recreation follows the dynamics of the needs of tourists and relies on the everyday living conditions that are realized particularly during the period of rest in tourism. The listed need of tourists (Figure 1) encompass the basic components of the balanced functioning of the man (Corbin, 2002), and they are the basis for the analysis of tourists' needs and of the programmes of supply. Wellness supply has become the closest to the needs of a modern tourist and

it represents the high-quality tourism with a wide range of supply. Wellness tourism is based on the philosophy of the comprehensive fulfilment of the complex and topical human needs. It is directed towards health, it affects the increase of human capacities in order to improve health to the largest possible extent and for the longest possible period of time. Wellness implies the whole concept of health and it encompasses healthy movement, physical exercise, nutrition, relaxation and stress management until the feeling of both physical and mental satisfaction is reached (Andrijašević & Bartoluci, 2004). The techniques and the methods of applying the wellness supply are adapted in detail to the needs of tourists, to their possibilities and capacities. Thus wellness consciously enters the zone of satisfying the physical and mental needs. The result of such an approach is the satisfaction in accepting the knowledge and the care for one's own health. In this context, the contemporary concept of physical recreation acquired the dimension of the primary content in tourism that has the role of fulfilling the most important factors of the tourism demand and the driving forces for travelling, and that is health.

Potentials for the development of physical recreation supply in Croatian tourism

Croatia has the primary tourist resources that meet the highly differentiated needs of tourists. Physical recreation has contributed to the development of sport tourism whose form is recognizable, diverse, and thus also unique with regard to other tourist destinations and supply. Although Croatian tourism has so far been oriented mostly towards the Adriatic area (more than 90% of tourist traffic) and towards the main tourist season (summer) (more than 95% of tourist traffic) (Central Bureau of Statistics, 2005), big potentials for the development of tourism lie in other areas in Croatia. Their development will depend on the socio-economic strategy of Croatian tourism that recognizes the advantages and the quality of numerous destinations for the development of special kinds of tourism.

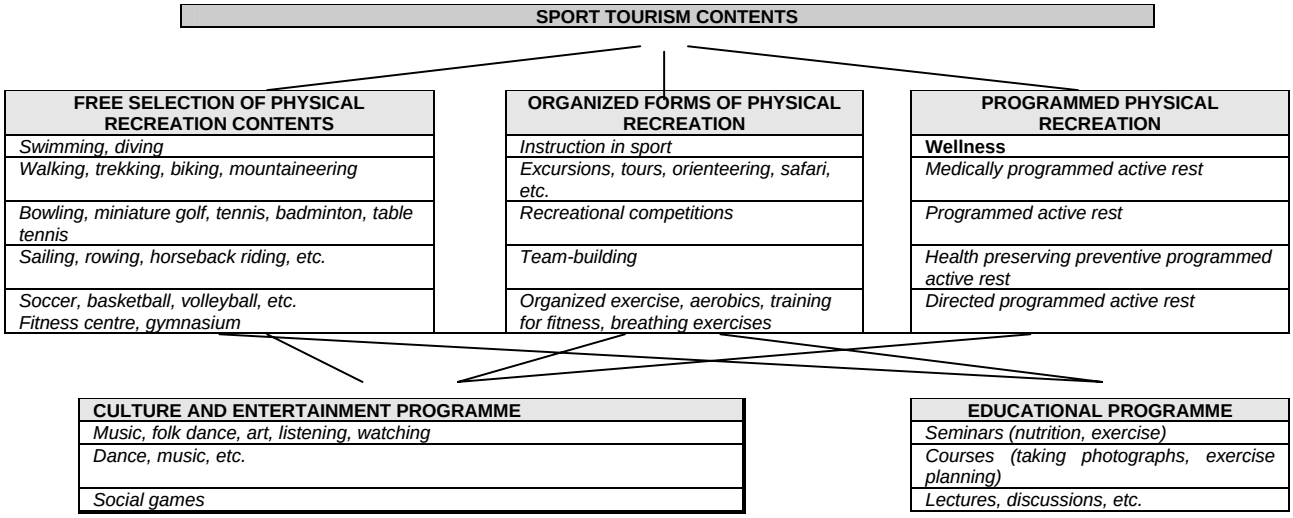

Figure 2. Contents of physical recreation for the purpose of devising the concept of sport tourism.

Sport and recreation contents and activities are an integral part of the comprehensive programme of tourism supply whose goal is to improve the quality of stay and the quality of rest for tourists. As regards their topic, they can be devised according to the interests of tourists, and thus fulfil their wishes and needs during the stay in a certain tourist destination. Taking into account numerous elements that are integrated into comprehensive programmes a new model of sport tourism is obtained that takes into account various needs and capacities of tourists. The input information represent the basis of structuring the physical recreation activities in tourism. Figure 2 shows the possibilities of developing various kinds of selective tourism that are based on physical recreation programmes. Simultaneously, the level of certain groups of programmes is recognizable, which requires that the criteria for their implementation be regarded with respect to the material and professional preconditions. The physical recreation supply is not static – it is subject to new needs and possibilities/capacities of prospective consumers.

Conclusion

Croatian tourism has so far been focused on the Adriatic coast in the summer season. The contents of physical recreation have followed, more by inertia than due to objective reasons, the tourism-specific needs that could primarily be described to have been at the level of renting, for example, the tennis courts, sports grounds, boats, etc. or to have been at the level of free utilization of natural resources through walks, swimming, etc. These contents were mostly conducted

by seasonal workers who could not provide a complete and a quality supply, either because of their lack of professional knowledge, experience or because of the low level of motivation. The facilities intended for the recreation of tourists were not appropriately maintained, so that they deteriorated quickly, thus making their utilization not profitable. The tourist sports centres should follow the changes on the market, simultaneously preserving the specific characteristics of the tourist environment. The quality physical recreation programmes can be used to go beyond the limits of the seasonal kind of tourism. The issue of expert personnel is the key question of quality, which implies the professionalism and the responsibility in all segments of spending in tourism. Sport and recreation have, for a long time now, not been only the reflection of spontaneous needs of tourists, but the carefully planned contents based on research and scientific perceptions of developed countries from the whole world. Sport and recreation in tourism represent the richness of life and stay in tourism, which provides satisfaction and good time, but also the benefits for each tourist through improved health.

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THE ROLE OF PROMOTION IN THE DEVELOPMENT OF TOURISM

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Abstract

Promotion and promotional activities in tourism are part of the joint framework of marketing efforts aimed at satisfying tourists' needs. The role of promotion in tourism development is to adequately inform tourists about a specific area and to attract them to it. This papers highlights different forms of promotion and promotional activities by which agents in tourism system participate in communication processes on the tourism market. The role of sports and activity is very important in the creation of the overall tourism product. The paper stresses the importance that promotional activities are coordinated by all those involved in tourism sector and on all levels so that, based on mutual interest and marketing concept, the tourism product is successfully presented and business targets are achieved. Promotion therefore bears particular significance in the activities of agents in tourism system and is also very important for the development of tourism.

Key words: *promotion, development of tourism, agents in tourism system, sports and activity*

The basics of the marketing concept in tourism

When stressing the role and importance of promotion in tourism development we undoubtedly have to consider the fundamentals of the marketing concept where promotion and promotional activities play a significant role. From the theoretical and practical point of view marketing basics in tourism do not differ from those in any other business. In other words, all activities are eventually concentrated on the final user, i.e., the tourist. Tourism marketing has its own specific features that should be respected by entities active in tourism. However, they will act in accordance with general principles of marketing and adjust them to the specifics of tourism marketing. Marketing as a business concept considers particular characteristics of a business activity and adjusts to them accordingly. It is necessary to respect the characteristics of a business activity as they differ in areas such as: service features, types of distribution and sales channels, business strategy, pricing, markets and market segments, use of natural resources and their availability, business environment, various external factors, etc. Let us not forget that tourism product, as an amalgam of different products and services, is a good traded on the tourism market.

The majority of tourism services follow general principles of service industry marketing. But in some aspects the implementation of these principles is different from other services. The differences that exist arise from the specific nature of tourism and tourism market and also because in tourism we sell things that do not bear features of goods and services but nevertheless have significant influence on the sales of goods and services that satisfy the needs of tourist. We primarily have in mind various benefits that a tourist area offers. Frequently, this is the main reason why tourists come and spend time and money in that area. We have already stressed that marketing concept in tourism directs the offer towards satisfying the already determined needs of tourists. But in order to achieve this and a certain level of income it is necessary to research relevant aspects of tourism market beforehand. It is particularly important to research different motivations and behaviours of tourists, as they are the ones who create needs and demand. The structure of offer in the market should be surveyed with equal importance. By identifying and getting to know different motivations we are able to tailor the offer so that it adequately responds and ultimately satisfies these motivations. Tourism offer and demand are formed on the market under the influence of many factors. Tourism offer is static and inelastic while tourism demand is characterized by mobility and elasticity. Dispersion and a physical separation of both ends of tourism market is a common and very important feature for the functioning of tourism market.

Marketing concept is not only essential for tourism development of a country, specific tourist destination, region and tourist resort but also for companies active in tourism sector. Due to many different activities that directly or indirectly partake in creation of a tourism product of a region or a country this represents a complex system within national economy. The complexity of tourism product and equally important economic effects from tourism necessitate the creation of a specific tourism policy. This is particularly true of the receiving tourism countries.

Physical separation of tourism product can be viewed in two ways, from the geographical and from immobility of providers of tourism product aspect. As a rule, the tourist generating areas are geographically separated from the receiving areas regardless of the real distance that exists between the two. A clear feature of the physical distance between tourism offer and tourism demand is that tourism product can be consumed by travelling and arrival of tourists from the generating to receiving areas. This feature makes the application of marketing in tourism somewhat specific. Due to the

characteristics of tourism to which we need to adjust the marketing activities many theoreticians link tourism marketing and country tourism policy as two parallel activities that must be coordinated. Senečić emphasizes that marketing in tourism is the implementation of the marketing concept in tourism companies and other providers of tourism products but not limited to them only as the implementation is coordinated on different levels where interests of providers of tourism products and aims of tourism policy of a country, region or local community are agreed. However, tourism companies must also create their own marketing policy and management system. They should and must build their own business concept based on marketing and taking into consideration common interests that link the entire system of tourism offer and enable its functioning (Senečić, 1998).

In the context of what has already been mentioned, the link between agents in tourism system and implementation of tourism policy on the level of a country and particular regions is clearly evident. Hence, marketing in tourism has its specifics that need to be respected by agents in the tourism system although they behave in accordance with general principles of marketing adjusting their activities to the specifics of tourism marketing. Specific relations on the tourism market, complexity of tourism product, characteristics and behaviour of tourist on the market are fundamentally important for the implementation of marketing in tourism.

The importance of sport and activity in the promotion of tourism

According to the findings of a recent research (TOMAS 2004) sports and sports-related activities are among the key reasons why people travel and stay in a destination. Active participation in a sporting event or simply watching professional or amateur event is becoming one of the key factors in attracting the tourists. Bartoluci clearly indicates the links between sport and tourism and stresses that sport in contemporary tourism does not only imply stay in a certain destination but is frequently the main reason for travel to a destination. The relationship between sport and tourism leads to the development of a new type of tourism: sports and activity tourism. The same author emphasizes that interdependence between sport and tourism rests on the factors that lead to the development of tourism and sport and of functions that generate tourism and sport (Bartoluci, 1998). It is evident that development of sports and possibilities for sporting activities leads to the development of tourism. The complementary nature of these two phenomena is evident in promotional activities. Unique interaction between sport and tourism stems from one common feature, and that is free time. The possibility to use free time for sporting activities is an indispensable part of contemporary tourism offer and messages communicated to tourists. Of course, this is only possible where infrastructure, sporting facilities and conditions for such activities exist.

The promotion of different sporting events in a destination is also the promotion of the destination. By creating the conditions for sports and activities in a destination we enhance the tourism offer that directly and indirectly influences the development of tourism in that area. The effects can be measured through visitor numbers and revenues but also through increased employment, construction and improvement of local infrastructure, increased possibilities for tourism consumption. Promotional activities aim to present overall tourist potentials of a destination. Sports and activities should be considered an essential element of tourism offer. They attract tourists and contribute to the development of tourism.

The importance of promotional activities in tourism

As one of the controllable marketing variables the role of promotion in tourism and its development is particularly stressed in this paper. Without ignoring other aspects of marketing mix, promotion on tourism market is the key link between tourism offer and demand. Let us define tourism promotion as a group of planned and continuous activities that form the communication process on the tourism market between suppliers and customers with the aim to create positive attitude towards a tourism product. The opinion to which potential tourist arrives in the course of communication process, from opinion, via emotion to behaviour, ultimately results in the selection of a destination. We can hence talk about a model of opinion influencing the behaviour that works in the following pattern. Firstly, a potential tourist via communication within his or her environment acquires knowledge and perception of a destination or a few of them. Then he looks for additional information (again via communication) and firms up his/her opinion about a destination and its abilities to satisfy his/her needs and expectations. These opinions are integrated and valued and emotions towards destination are formed. Based on the opinion and emotions a tourist ultimately expresses the intention, or lack of it, to travel. It is clear that this model of opinion formation is based on the communication process (Grgona, 2003).

Tourism promotion implies activities aimed at attracting a tourist/customer to a destination and at persuading tourists to buy products and services when travelling and when in a destination (Senečić, 1998). Therefore, promotion plays a significant role in marketing policy and activities of agents in the tourism system. It is important to note that in tourism promotional activities are not implemented only on the level of tourist companies but also on the level of state institutions, tourist destinations, regions and towns.

Let us mention the main tourism promotional activities that are almost the same as in other business activities although they are slightly different in their application. In the first place, advertising is the most widely spread form of promotion, followed by direct marketing, sales promotion, public relations plus other forms of promotional activities characteristic

for tourism such as trade fairs, exhibitions and events where different elements of tourist offer are presented. According to *Rječnik turizma [Dictionary of Tourism]* the importance of advertising in tourism as a form of promotion stems from the fact that advertising in tourism carries several critical communicational functions: information, persuasion, reminding, increasing the value of product (service), support for other marketing efforts (Vukonić & Čavlek, 2001:110). For tourism advertising to be successful a unique set of instruments is used, primarily advertisement slogans, media and other advertising means.

Advertising is generically an impersonal form of communication. It allows the possibility for potential tourists to get the information that will help them in the decision-making process regarding their holiday plans, the visit and stay in a destination exclusively through messages conveyed to them via media by using the advertising techniques.

When talking about advertising of tourist countries we must single out a feature that different to advertising in other sectors has a common activity on all levels. Namely, advertising acts as general tourism advertising, on country, region or destination level with the aim of presenting these areas and attracting tourist. Mainly it is the different state institutions that initiate such promotional activities and provide financing. The primary target group, although not the only one, are foreign tourists. The promotion of specific products and services is the task of business tourism advertising and its aim is to inform potential tourists what hotel companies, travel agents, transport companies and others have on offer. The aforementioned types of advertising are distinguished primarily according to where the initiative comes from but it needs to be stressed that every general tourism advertising has elements of business advertising and vice versa. General and business tourism advertising in contemporary tourism practice are closely connected. All agents in the tourism system of the respective country have a common interest to co-ordinate promotional activities and efforts in presenting an area that contains global tourism product. Due to a specific way of advertising in tourism it is necessary to promote the country as a whole and irrelevant of distinctions among different tourist attractions and sites. This type of promotion results in a more favourable and positive behaviour of tourists abroad. Naturally, this does not exclude the need for individual advertising campaigns of specific places and of tourist agents. On the contrary, the co-ordination of individual and country campaigns is very much welcome.

Direct marketing in tourism is a form of promotion where direct communication with tourists is established and through personal contact we get to know better the tourist's preferences, wishes and demands. That is the main advantage of this form of promotion. With direct communication it is easier to adjust to different tourists' needs and at the same time we receive an adequate level of feedback. The other advantage is the possibility to approach target groups more directly and with greater intensity. Very frequently the outcome of such activities is the sale, one of the most important aims of promotional activities. Shortcomings are mainly related to relatively high costs and difficulties in selecting appropriate employees for this type of communication. Hence people working in tourism and in particular those in direct contact with tourists must be adequately educated and trained to carry out such tasks.

When nicely fitted into the complete marketing mix, adequately timed and coordinated with other promotional activities sales promotions in tourism yield best results. They are primarily directed at intensifying the relations between providers of tourist offer and tourist demand with the aim to stimulate sales. In practice sales promotions use different promotional vehicles directed at stimulating the direct reaction of the market. They are aimed at final customers via special offers, awards, free gifts, etc. and towards agents via various forms of co-operation like advising on marketing activities, furnishing and design of sales points, education and training of sales staff. Finally, sales promotions in tourism can be directed at own sales personnel via permanent or sporadic education, advising, training and various incentives aimed at increasing the level of expertise, competencies, initiative and general efficiency.

Key efforts to realize these activities are primarily focused on creating an adequate programme to improve the sales. It is also necessary to establish the intensity of measures, select promotional activities and the distribution of the programme and finally to determine the budget. We stress the importance of the timing of activities because if the timeframe is too short, an expected participation of all those interested shall not be achieved. In other words those tasked with sales promotion are expected to establish precise timeframe for the realization of all activities, their coordination, duration and persons responsible.

As a part of marketing mix in tourism let us also mention public relations that compared to the forms of promotion mentioned earlier has some advantages. The first advantage is a high level of credibility. Namely, most of public relations activities are based on social responsibility and creation of positive image in the market. As a rule, public relations reach a good number of message recipients that are not very receptive to advertising and direct marketing. A systematic activity aimed at forming positive public image creates a level of trust, understanding and empathy for tourists, suppliers, own employees, banks, sub-contractors, businesses and experts.

The aim is to create a positive image in the public and to integrate with it, so as to build a long-term trust and empathy. In their efforts public relations agents have commitments towards the public (Schneider & Pflaum, 1994). One of them is the social obligation requiring the explanation of activities to all relevant people and social groups so as to avoid any potential conflict situations. Obligation to inform is also very important. In order to fulfil our social obligation we need to create a communication system that will provide the public with all the necessary information. We also have an obligation

to follow the reactions of the public relating to the behaviour of a company or some other entity in tourism. There is also an obligation to correct our actions in accordance with public expectations. These obligations form content, aims and functions of public relations in tourism.

Tourism trade fairs are places where the tourism supply and demand meet and they serve as a means for advertising, sales promotion and direct marketing. They provide a venue for marketing experts to achieve direct contact with customers, tourists and agents and hence offer series of benefits to all those working in tourism market. Fairs can serve for various purposes; to channel promotion to selected markets, to provide possibility for detailed presentation of the tourist offer, to establish direct contact with existing and potential tourists, they negotiate the venue and the chance to view the complete tourism offer, asses and compare essential elements of the offer of every exhibitor.

From the tourists' perspective fairs are a competent source of information in the decision-making process. By selecting the information about the prices, payment conditions, access to the destination, benefits that a country, destination or hotel offers during the stay, tourists form a perception of a destination they shall accept or reject as a potential destination for their future travel and holidays. In direct communication with the personnel tourists can ask for additional information important to them and that cannot be found in catalogues, brochures or other advertising material. The role of direct marketing is particularly important at tourism fairs and requires respectable knowledge of one's own tourist offer, good communication skills (verbal and non-verbal communication, knowledge of foreign languages, dress code). The shortcomings of trade fairs are high costs and inability to direct promotional efforts to the required market segment.

Conclusion

Tourism and its development should be studied in the context of general development of a society, region or country. Explanations of tourism phenomenon can be found in the works of many theoreticians. All of them and without exception stress that development of tourism in an area is primarily triggered by economic reasons that presume the overall economic development in that area. We can only guess whether these arguments are justified and what possible consequence tourism development might have on the economy of a place or a country. However, there should not be any dilemma as to the role marketing and marketing communication via promotional activity play in the development of tourism.

When talking about the role of promotion in tourism development we again must stress the importance of the systematic and consistent communication on the tourist market aimed at attracting tourists and creating positive attitude towards tourism product, company and destination. Promotion and promotional activities in tourism as a part of marketing mix are a relevant source of information that aids the existing and potential tourists in decision-making process and selection of a holiday destination. Through this communication process tourists firm up their attitudes, opinions and convictions about destinations they know or have already visited. They also discover new destinations about which they know little or nothing at all.

Messages that via promotional activities are directed at tourists represent a significant input in the creation of an image of the tourism product and of tourism in general. Sports and activities are definitely an additional attribute that should be used in the creation of the tourist offer and messages about a destination. In some destinations complementary aspects of sport and tourism have led to interdependent development of both social phenomena.

If we measure the effects of tourism on the economy of a region or a country through economic indicators we realistically assess the possibilities for the development of other sectors. In other words, development of tourism can instigate or improve development of other sectors.

By creating the conditions for tourism consumption we indirectly stimulate the development of tourism in an area. Promotion plays a crucial role here. Tourists need to be acquainted with a tourist destination and its product and they must be provided with timely information. They need to get a realistic and a clear image of all positive attributes that will represent the factors of attraction for a destination. As this is all about communication on the tourism market it is important to co-ordinate the activities on different levels, from agents of tourism system to relevant state institutions tasked with the implementation of tourism policy.

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PROMOTION IN THE WINNING TOURISM MARKET

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Abstract

Promotion has a significant role in connecting tourism supply and demand. It informs the potential tourists about the tourism product trying to persuade them that it is more advantageous than the competitors' one. Convincing promotion of high quality tourist product presented at the right time attracts tourists and it also expands the market.

Key words: *tourism, market, promotion, demand, supply*

Introduction

By travelling and changing the place of permanent residence the tourists endeavour to satisfy their needs as much as possible, namely, to have a good time and to relax to the maximum. They travel either individually or in groups, they form the tourism demand in certain places and in a certain time. Before making a decision, potential tourists gather information about the facilities for travelling and for spending their vacations. Then they choose the destination and the hotel facility where they want to go. The role of promotion is to inform tourists about the supply and to invite them to a destination and to the facilities that are promoted.

On the following pages the characteristics of the tourism market are analysed, the goals of tourist travel and the methods of promotion in winning the market are defined.

Characteristics of tourism market

Besides the similarities with other goods markets the tourism market has many individual characteristics. They can be mainly explained through the behaviour of the tourism supply and demand on the market.

On the tourism market, as a special form of goods market, the law of supply and demand is functioning but its effects are different in manifestation than on the other markets.

The tourism demand is very heterogeneous in its requests. They are permanently growing in quality and in their diversity. The supply is less heterogeneous, but it tends to become more complete in order to enable the most possible rationalization of business operations to its organizers.

The demand is mainly concentrated in places and in time while the supply is constantly drawn towards deconcentration in order to use the natural and material resources to the maximum.

Subjective factors are very important for tourism demand which is not the case with the tourism supply. The demand for natural goods that are used in tourism is numerous and flexible while their supply is not flexible. The goods on the tourism market behave the same as on other markets.

The supply of tourism services is strictly connected to tourism facilities. The services are prepared and used in them at the same time. The supply and demand are very often regionally distant from one another and therefore they meet on the market through intermediaries in tourism.

On the tourism market several organizers offer their services to a tourist who seeks for a tourism product, which is not the case with other markets. From such particularities as well as from the relationship between the non-flexible supply and a flexible demand the prices of services are created.

The tourism market undergoes continuous changes. These changes come from the demand as well as from supply.

The demand becomes more and more challenging and more selective forms of supply and destination with attractive natural and cultural values and recreational issues are appreciated. Confronted with such requirements of tourism demand and at the same time with growing competition tourism supply also comes to evident changes. The supply becomes more specialized and better in quality. The hotel accommodation becomes more comfortable, gastronomy supply richer, the supply of short excursions, entertainment and physical recreation diverse.

Promotion in defining the goals of tourist travel

The organizers of tourism supply communicate with the market of tourism demand not only to inform about their supply but also to place it to the potential tourists. The purpose of promotion is "to influence and encourage the buyers

to accept and adopt the goods, services and ideas." (Dibb, Simkin, Pride & Ferrell, 1995:406). It is certain that "the ultimate efficiency of promotion is determined by the level up to which it creates the inclination for acceptance of the product with the potential buyers and increases the number of sales with the existing buyers." (Dibb, Simkin, Pride & Ferrelll, 1995:406).

In winning the market the greater results can not be expected after the first promotional action. This is the process that is performed in tourism and it has at least five phases:

- defining the travelling goals,
- information about the conditions for the realization of travelling goals,
- making inquiries before the last choice,
- selecting the destination and booking a hotel,
- experience of travel and vacation.

The phase of defining the travelling goals lasts a bit longer. This is the phase where the wishes and means are adjusted. People who are single do it easier, but with the families this is a more complex.

What could the travelling goals be?

People join in tourism for different motives. Therefore the travelling goals can be:

- travelling for visiting natural beauties,
- travelling for visiting cultural values and customs,
- travelling for religious reasons,
- travelling for vacation and entertainment,
- travelling for participation at expert and scientific conferences,
- travelling for following up cultural and sport events, and
- travelling that combines several motives.

The financial aspect is the limiting factor of tourist travel.

Information about the conditions for the realization of travelling goals

Information about the conditions of travel is a shorter phase in time. Upon receiving the general information about possible a tourist journey through mass media, the potential tourists visit the nearest agency to seek for detailed conditions for the realization of the target journey. The agencies regularly receive promotional material from tourist destinations, i.e. hotel facilities about tourist attractions and conditions of stay. This particularly refers to such tourism facilities that have made the contracts with the agency.

The potential tourists can inquire about and receive information from the respective hotel facility through the Internet.

Making inquires before making the choice is possible if the potential tourists know some friends or acquaintances who have already been in this destination, or a hotel that is the goal of the travel. Such information can be precious in the preparation of a journey.

Significance of promotion in selecting the destination and the hotel

The term destination is more and more frequent in tourism media and even in literature. The scientists, particularly American scientists have also shown an interest for national determination and characteristics of tourist destination.

According to them "destinations are places with some form of actual or perceived boundary, such as the physical boundary of an island, political boundaries, or even market-created boundaries such as those of a travel wholesaler who defines a South Pacific tour solely as Australia and New Zeland." (Kotler, Bowen & Makens, 1996:636).

In tourism promotion and in tourist travel the market boundaries and the administrative boundaries of destination are usually the same, particularly in the recreation supply. This, of course, does not refer to longer journey in whose programmes not only several destinations but also several countries are included.

Before choosing a destination the potential tourists must analyse the factors that this destination has to offer regarding vacation, entertainment, excursions, congresses and business contacts.

Here we include natural resources, infrastructure, transport and suprastructure.

The base of tourist destination that enables the receipt and the stay of the tourists are hotels. They are mainly of various size, type and category.

Upon gathering the required information the potential tourists come to a final decision. They have chosen the destination and made a booking either directly with the hotel or through the tourist agency. In their reservation they have specified the segments of the tourism product that they want to use in a certain time.

The experience of the tourism product used is the last phase of the stay in a tourism facility and in a destination. It is usually the last phase of the journey too.

The tourists estimate the value of the tourism product which they have used. They communicate their judgement directly to the staff in the hotel object and destination, they register it in the book of impressions and what is even more important they recommend it, if they have been satisfied, to their friends and acquaintances. Sometimes, their voices could be heard or read in the media. For hotels and destination it is a promotional business success if the tourists are satisfied and if they speak affirmatively about the product.

The role of promotion is important in all phases of winning the market, namely, purchasing of the tourist product.

Methods of promotion in winning the tourism market

Several promotional methods can be used for marketing communication of hotels and destinations with the potential tourists and agencies. When the combination of several elements is made for the promotion of the tourism product it represents the promotional mix of this product (Dibb, Simkin, Pride & Ferrell, 1995:410).

There are six possible elements of the promotional mix and they are:

- tourism advertising,
- personal promotion and sale of the tourist product,
- promotion of the product sale,
- presentation of the tourism product,
- introducing the product through media and
- creating public image of the product.

Tourism advertising is the most open element of the promotional mix in communication and winning of the tourism market. This is a public presentation of the tourism product to the wide auditorium of potential tourists. Tourism advertising is a powerful medium of penetration on the market. It permits manifold repetition of an advertising message.

This medium enables the potential tourists to receive and compare the advertising messages of various suppliers of the tourism product that are mutual competitors.

Advertising makes it possible to focus the attention on the tourism product by using well calculated treatment of "press, sound and colour" (Kotler, Bowen & Makens, 1996:747).

Tourism advertising is not a too decisive medium. The receivers of the advertising message are not required to answer the message. Advertising leads a monologue with the potential tourists that may or may not lead to the desired results. Tourism advertising uses various means in its realization.

These means can be divided into visual and auditive. Visual means of tourism advertising use press and pictures. Auditive means of tourism advertising use sound (speech, music, singing). It is best to combine appropriate visual and auditive means in tourism advertising.

The means of tourism advertising are usually divided according to their technical characteristics. They are (Kobašić & Senečić, 1989:118): graphic, advertisements, projections and the other.

Which advertising means are used and in which advertising situation depends on the promotional goals and available financial resources.

Personal promotion and sale of the tourism product is a very efficient promotional channel. Personal promotion and sale are an active and direct relationship between the organizer of the tourist product and the potential tourists. Each promotion and sale enables the presentation of the tourism product on the spot. It is also possible to agree all the details of its usage.

The participants in personal promotion and sale of the product usually feel some obligation. Personal promotion and sale of the tourism product are performed in hotels, agencies, tourist fairs.

Promotion of sale of the tourism product can be encouraged and increased by carrying out certain promotional activities such as: issuing the coupons, advertisement of vacanties, giving gifts at occasions, giving discounts for usage of the product. This way of sale attracts attention, gives certain advantages and can, in reality, encourage the decision about the purchase of the tourism product.

Presentation of the tourism product can be performed on tourist fairs. This includes photographs of natural and cultural importance, excursion programs and price lists of services. The treasures of destination and of hotel supply can be presented by promotional films.

Introducing the tourism product through media is performed through public media and through public lectures of experts and scientists.

This way of promotion makes it possible for the tourism products and the terms of its use to become well known to the whole public.

Creating the public image of a product is obtained by intended actions for establishing understanding, trust and image between a hotel from one hand and tourists, suppliers, investors, media and public on the other.

"The hotel enterprise must make efforts to insure that the representatives of media are very well informed about the enterprise. At all significant events of changes in the enterprise the representatives of media should be invited but they should be also invited in the ordinary periods so that they can have the impression about the atmosphere in the enterprise during its everyday routine." (Senečić, 1998:117).

Conclusion

Promotion has a decisive role in connecting tourism supply and demand. They meet on the tourism market that is characterized by a very flexible tourism demand and a relatively rigid tourism supply. These relations form prices of tourism services, i.e. products. People engage tourism for various motives, but the most dominant are vacations and entertainment. In preparing for the selection of a tourist destination and a hotel the potential tourists have a big help in promotion. By its specific methods it informs, motivates and attracts tourists and therefore wins the market for its employers.

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THE RECREATION OFFER IN HOTEL INDUSTRY

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Abstract

The task of hotel industry, as the major bearer of tourist offer, is to fulfil, as best as possible, not only the materialistic needs of people in their accommodation and food but also other social, cultural and health needs of modern man.

The modern life style and the need of people to experience the natural environment are the motives for travelling to places which differ from everyday life. Tourists often need services, like physical activities, physical and emotional relaxation, healthy nourishment and other things, beyond good food and luxury accommodation, especially for business people. Greater value is placed on health, good mood, life filled with various positive experiences, and similar facets of the human experience. Recreation becomes a more and more significant factor in satisfying human needs.

Key words: *hotel industry, recreation offer, tourists*

Introduction

Hotel industry is a tourist activity that offers accommodation and other services required in the tourist market. The objectives of hotel industry are to entertain tourists, to provide their temporary accommodation, and to offer recreational and sport activities in tourist destinations.

Modern tourist trends are characterized by a heterogeneous demand for offer. The total offer presented in a certain area is preferred over individual services. That area, with the totality of its offer elements, becomes the destination, the travel target, where its size and formation are determined by tourists and their demands. Recreation offer becomes the overwhelming consideration for tourist travels.

The recreational offer

A tourist offer is a quantity of products and services presented to tourists at certain times and at certain prices. It is an institutional form and it encompasses all services renders and their organization. The recreation offer, as a part of the tourist offer, implies the personal services which fulfil the needs and wishes of tourists looking for active or passive vacation and fun. It is often a motive for the choice of a tourist destination and a hotel facility, the factor of tourists' pleasure and of the longer stay in the tourist destination and the hotel facility.

The recreation offer can be defined as: travel for non-commercial (holidays) or for commercial (non-holidays/business) reasons to participate in or observe sporting activities (Thwaits, 1999). The recreation offer encompasses recreational programmes in a hotel (fitness exercises, massages) and outside the hotel, in its immediate vicinity (golf, tennis, water sports, skiing, wandering, biking, etc.).

The following characteristics of recreation offer should be recognized:

- dislocation from demand for recreational services
- heterogeneous offer (complexity/variety)
- fixed recreational offer (embedded into a certain area)
- inflexibility.

The terms of recreation offer itself consist of:

- attractive elements of the offer – attractive characteristics of a tourist destination, hotel facilities, recreational contents and sport-related events,
- communicative elements of the offer – traffic infrastructure that provides better connection between a tourist destination and hotel facilities, and the tourist market,
- receptive elements – facilities for accommodation that provide certain recreational contents.

On the other hand, demand is the sum of individual requests of tourists for natural resources and services. "Tourist demand represents a group of potential tourists – consumers which, through their perspectives, habits, wishes and potentials, determines quantities, quality and prices of particular goods and services on the tourist market" (Pirjevec, Kesar, 2002). The tourist demand of modern tourists is directed towards active forms of vacation relating to sport and recreation.

Tourists became more demanding, more experienced and, therefore, selective. The choice of a vacation destination depends on a complex package of motives and expectations. Besides the main motives (rest, sun and the sea), there are some new motives for taking a trip: intensive pleasure, activities in nature, recreation and health.

Recreation increasingly gains the attention of tourists in accordance with an increasing demand for this form of offer. Recreation should become a part of every tourist package and every hotel offer.

Receptive elements of recreation offer

Receptive elements of recreation offers encompass all facilities for accommodation and food of guests. These elements add some recreational contents to their stay. Although the demand for a particular tourist destination depends primarily on attractive factors, the economic function of that destination would be insignificant without the receptive elements. The receptive elements are the benchmark of the tourist destination development.

Receptive elements can be divided into receptive elements in broader and narrower sense. In their broadest sense, receptive elements encompass all facilities and services that the tourists indirectly use (communal infrastructure, shops, servicing stations, and similar facilities). Receptive elements in the narrower sense encompass catering establishments providing accommodation, food and beverages.

More than two thirds of foreign overnight stays in countries where tourism is developed were realized in hotel industry, which shows the need and the importance of developing the basic accommodation capacities. The structure of accommodation facilities is one of the key elements that create attractive tourist destinations since it provides offer that has a certain quality.

Table 1: Tourist accommodation capacities in Croatia 1987 – 2004

Types of accommodation establishments	1987	1989	1994	1997	2001	2004	Index 04/87	Index 04/01
Hotels	125,985	128,925	123,077	121,385	94,543	101,422	80.5	107
Private tourist accommodations	257,495	271,342	121,765	206,281	273,734	332,240	129	121
Campsites	280,307	299,411	263,552	223,349	202,197	215,772	77	106.7
Holiday dwellings	50,756	51,254	56,677	53,517	62,959	54,201	106.8	86.1
Other tourist establishments	112,078	110,284	18,769	34,582	49,288	47,737	42.6	96.9
Total	826,621	861,216	583,840	639,114	682,721	751,372	91	110.1

Source: Tomas 2004. (2005). Attitudes and Expenditures of Tourists in Croatia. Zagreb: Institute for Tourism

Croatia had 751,000 registered regular beds (without the ports of nautical tourism) in 2004. During the last three years, the number of regular beds increased by ten percent. However, that number is still smaller than the total number of beds recorded in 1989 (Table 1).

Accommodation facilities are grouped, i.e. categorized, in a specific number of groups according to their quality levels and based on fixed standards. A category helps tourists to determine the offer's quality and to decide if the price fits the quality. In the past three years, the quality of accommodation capacities in Croatia has improved. Consequently, the number of hotels with 4 and 5 stars tripled, whilst some of the hotels were included in international hotel brands. Yet, the special concentration of accommodation offers is fairly unfavourable. The coastal part of Croatia contains 97% of available capacities whilst the continental part offers only 3% of accommodation capacities. The highest hotel category (five stars) contains only 12 hotels (5 hotels in Dubrovnik-Neretva County, 3 hotels in the city of Zagreb, 3 hotels in Primorje-Gorski Kotar County and 1 hotel in Krapina-Zagorje County (Table 2).

New regulations on classification and categorization, special standards and the special qualities of accommodation facilities from the group "hotels" (NN 48/2002) which were accepted on May 2002, brought some changes in types and categories of accommodation facilities from the group "hotels". According to the provisions of the above mentioned regulation, hotels are classified into four categories and marked with (at least) two to (at most) five stars.

Wellness as one of the new forms of offer in hotel industry

Wellness takes up an extremely important place in modern hotel offer because it is harmonized with the needs and demands of modern tourists. The wellness offer contains a range of programmes for the preservation and improvement of health. Most programmes boost regeneration and the creation of energy which the human body should produce on its own and exchange with the environment.

Wellness is the trend which promotes progressive and healthy habits of individuals towards the achievement of physical and psychological health. Wellness encompasses many methods and techniques which affect the human physical condition, his/her health and shape. It represents the broad offer of conditions and procedures for the achievement of optimal physical and psychological well-being of an individual.

Table 2: Survey of hotel by counties and categorization in 2004 (as at 03rd December 2004)

COUNTY	NUMBER OF HOTELS					NUMBER OF BEDS					TOTAL	
	*	**	***	****	*****	*	**	***	****	*****	Number of hotels	Number of beds
ISTRIA	8	24	52	9		1,315	7,644	17,676	3,258		93	29,893
PRIMORJE - GORSKI KOTAR	4	38	41	8	3	537	6,034	10,436	895	236	94	18,138
LIKA-SENJ	3	6	5			197	1,273	901			14	2,371
ŠIBENIK- KNIN	2	9	15			112	739	5,298			26	6,149
ZADAR	4	15	13	3		595	2,457	2,238	459		35	5,749
SPLITSKO-DALMATINSKA	5	34	44	8		288	4,341	8,946	729		91	14,304
DUBROVNIK-NERETVA	2	22	33	4	5	130	4,611	7,320	1,043	1,497	66	14,601
TOWN ZAGREB	1	8	11	4	3	946	737	1,377	1,020	1,648	27	5,728
CONTINENTAL COUNTIES	7	32	21	3	1	290	16,235	1,525	119	52	64	18,221
TOTAL	36	188	235	39	12	4,410	44,071	55,717	7,523	3,433	510	115,154

Source: www.mmtpr.hr 21st April 2005.

The newest discoveries of the usefulness of water as a means of the fastest and the fullest relaxation came at the right moment for hoteliers. The times when hotels offered only overnight accommodation, good food and natural surroundings are behind us. Only those hotels which also offer "that something" that would attract the guests, can count on the realization of greater tourist consumption.

The solution for improving business activities of hotels was found in various forms of "water" usage; pool recreation, hydro massage, warm baths and other. More entrepreneurial hoteliers became familiar with the possibilities provided by wellness, and, in spite of the high risk and the need for large investments, created wellness centres within their hotels.

The wellness offer is characterized by assorted services. Services within the wellness offer include: wellness programmes, internal and external pools, hydro massage, various baths, cosmetic treatments, massages, aromatherapy, thalassotherapy, fitness, assorted sports and other.

A wellness centre in a hotel enables:

- an enhanced offer,
- better occupancy rates,
- the possibility of increasing the price of stay in a hotel,
- the extension of the business season
- the arrival of guests who can financially afford more
- hotel recognition and image
- increases in tourist consumption.

The opening of wellness centres in hotels brings surprising results. For the economic aspect of the wellness centre, it is very important to introduce the right services, i.e. those which are useful to a large number of potential consumers, which maximize the space and which cover incurred expenses with their price and realize the necessary profit.

Conclusion

Insufficient physical activity, irregular eating habits and stressful situations are the problems of modern man. A large part of the urban population as well as people exposed to hard work and stress feel the need for qualitative recreation, wishing to recover in the shortest possible time and refuel with new energy.

From this need for more qualitative and active recreation the requirement for hoteliers to introduce changes and new services into their offer arises. A pleasant stay in a hotel and qualitative food are not sufficient for modern tourists who want to recover from hard work of their everyday lives. Recreation becomes a more and more significant factor in satisfying human needs.

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SPORT TOURISM PROMOTION – SOME EXAMPLES FROM CROATIA

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Abstract

Sport tourism encompasses all aspects of sport-related visits to a certain tourist destination – from visiting a sporting event, to tourism-sport participation. The sport-specific offer in tourism may be considered either as independent of the rest of the tourism offer and promoted as such or it may be considered within the entire offer related to a particular destination. Examples of advertising materials described in this article show that tourism providers consider both varieties. The today's tourist catalogues, brochures, leaflets and other advertising material dedicate significant space to sport and recreation. The basic reasoning behind such conceptualisation both of the actual supply on the field and of the advertising material is to respond to the requirements of the modern man who seeks a healthy life style and the concept of well-being.

Key words: *history, advertising, sport, recreation*

Introduction

The reciprocal development of sport and tourism may be observed from the times of the ancient Olympic Games till today. However, the promotion of sport was rather limited throughout history due to the almost complete absence of the means of communication - apart from the by word of mouth communication, various written manuscripts, documents, later in history also newspapers, etc. - before their skyrocketing development in the 19th and 20th centuries, from the invention of the telephone, to the invention of radio and television, fax machines, and global computer networks. Tourism, as an industry that renders services to people who travel for various purposes, as well as an industry that sells tourism-specific products found its ways of presenting those services and products to prospective consumers.

Some examples of the development of tourism and sport in Croatia

Simultaneously with tourism, sport and various sporting activities developed in the world, as well as in Croatia. How much this development of sport affects the contemporary tourism supply on the Croatian coast will be illustrated by several examples. In 1929 the citizens of Supetar, a small town situated on the northern part of the island of Brač, started to build the first tennis court on the island. The construction of the tennis court was completed in the year 1931. Nowadays, tennis is one of the sports included in the sport-tourism offer in Supetar. In the year 1936 a road was built on the island of Brač to Vidova gora (Marović, 1999, pp. 102-103), the mountain peak (778m) that is the highest island mountain peak on the whole Croatian coast. Since then, Vidova gora has been visited by many tourists, particularly, mountaineers. Simultaneously, biking also developed on the island of Brač. The development of biking and mountain tourism is nowadays reflected in the tourism supply on this island, and consequently in the contents of the advertising material, which will be discussed further in the text.

Sport-participation and travel motives

The aspects of motivation for sport participation range from social, to psychological, to philosophical (Weed & Bull, 2004, p. 49). The motives for sport participation relate to interests, needs, goals and personality (Weinberg & Gould, 1995). During the twentieth century, as the result of global development and consequently due to the development of mass media, many sports have become increasingly commercialised. Owing to the skyrocketing increase in the number of television sets in the second half of the twentieth century, television has become "a major global business" (Weed & Bull, 2004, p. 12) and sport "one of many phenomena that can be commodified and sold to an ever-growing audience" (Weed & Bull, 2004, p. 12-13). Broadcasting rights and television commercials are nowadays regarded to go hand in hand. Travel is nowadays motivated by various reasons, among which McIntosh and Goeldner (1986) list physical motivators, they use the term *motivators*, such as refreshment of body and mind, health, pleasure and the like, interpersonal motivators, namely, desire to meet people, to visit friends or relatives, to seek new experiences and to escape from routine experiences, status motivators and prestige motivators. Out of these four groups of motives "three have immediate relevance to sport" (Weed & Bull, 2004, p. 49). Sport is becoming a more and more frequent motive for travel to a certain tourist destination. However, the range of sport-related reasons for travel are many – from direct participation in a sporting event, such as various championships, to spectating, to business reasons, such as marketing strategies, to tourism-sports participation during the holidays. Quite a few holiday-makers seek active rest and it is for this reason that activities that can be conceptualized under the term *active rest* are therefore on demand.

Promotion as a way of communication

The decision of a consumer to return to a tourist destination, which is the goal of any tourism offer, implies the creating of loyalty (Park & Kim, 2000) of consumers to a certain product, or, in case of tourism, a certain destination. The development of the loyalty of consumers depends primarily on the satisfaction of consumers with what is offered to them. What makes some place a better one, or more special, or, simply, more preferable than the other (Crouch, 2000), and what is ultimately decisive for making a decision to visit a certain place is a part of creating an image of each destination. The pricing of sport and leisure (Berrett, Slack, & Whitskon, 1993) and consequently visitor spending (Vaughan, Farr, & Slee, 2000) and other topics are the subjects of many analyses and discussions that all tend to extend the body of knowledge on tourism in general, but subsequently also on sport tourism.

Since promotion uses various activities and various media for the purpose of presenting products that should become and remain known to the general public on the one hand, an on the other, for the purpose of increasing the selling and provide the constant demand for a particular product (Bartoluci, 2003, p. 255), it is obvious that this can be only done through communication. Therefore, communication is the basic element of any promotion, because it is the way in which the message is transmitted from the sender to the recipient. The essential elements of promotion must take into account the essential elements of supply that answer the following questions (Avelini Holjevac, 2002): *for whom* (consumers), *where* (in which places), *who* (the expert personnel), *why* (the purpose) and *what are the expenses and income* (economic effects). Following these questions, that is, answering them and combining appropriately the available elements, it is possible to design a high-quality supply that will be able to fulfil all the requirements of consumers, thus eventually warranting the realisation of the economic goal, namely, the profit.

For the successful transfer of a message a communication channel is necessary that represents the path of the transmission of the message. Each communication channel consists of a sender, the medium through which the message is transmitted and the recipient. Since any message is a coded system of signs understood by all who are in the know of the same system of signs and the concepts denoted by those signs, for a successful understanding of a message both the sender and the recipient must operate with the same coded system of signs. Promotion of tourist destinations is no exception to this rule. The sender, a tourist agency, or any other provider of a sport tourism product must be aware of the demand – of the wishes of prospective consumers of tourism-supply-specific products. When creating the advertising material (a message) the sender must know what the prospective tourists want, what their expectations as regards the quality, the versatility and the price of the supply are, etc. Above all, the sender must know who (what group of prospective tourist) he is addressing – ordinary holiday-makers whose goal is to rest, to sun-bathe, to swim in the sea, or also to be able to participate in a certain kind of a sporting activity, to visit cultural attractions, etc. The advertising material should subsequently be designed in such a way as to correspond to those requirements. Naturally, the high-quality of material is preferable, a quality layout, informativeness, etc.

Since tourist destinations are, in this context, regarded as products (for example, Ashworth & Voogd, 1990), creating the image of a tourist destination and its promotion on the market are elements of a successful promotional strategy of any provider.

Therefore, tourism promotion is defined as the "sum total of activities aimed at attracting the tourists – buyers to a certain region (country) and talking them into buying certain products and services in the tourist destination and during the travel (Vukonić & Čavlek, 2001, p. 394).

Examples from the history of promoting sport and physical recreation in Croatian tourism

Promotion in marketing is realised through four basic forms. These forms are advertising, personal selling, sales promotion and public relations. For the purpose of this article let us consider the first one, namely, advertising. It is a type of indirect communication in which the advertising material plays an important role. The advertising material developed together with the development of tourism and sport.

As for tourism, picture postcards were one of the first advertising materials in the world. In Europe the picture postcards appeared in the second half of the 19th century. By the turn of the 19th to 20th century postcards became a big business. In France alone about eight million postcards were published around the year 1900, and in the year 1920 as many as 123 million (Seferović, 2003, p. 70). The first postcards in the world were decorated with an illustration that took up one third of the left upper corner of the postcard on the side on which the message was written. Such postcards were also printed in Croatia. However, this layout of postcards was not the only one. There were also postcards in which illustrations took up one whole side even in the year 1900. The first picture postcards were two-colour postcards, but very soon the full-colour postcards appeared. Simultaneously with postcards the other types of advertising material appeared in Croatia, from tourist guidebooks, to leaflets and brochures. In the feuilleton *135 godina organiziranog turizma u Hvaru* (*135 years of organised tourism on the island of Hvar*) written by Marinko Petrić, the feuilleton that appeared in serial form in the daily newspaper *Slobodna Dalmacija* in the year 2003, the author described the beginnings of tourism on the island of Hvar, an island on the Croatian coast. In the first part of this feuilleton, *Od "higijeničkog" do "Sunčanog Hvara"* (*From the "hygienic" to "Sunny Hvar"*) Petrić (2003a, p. 54) described how in the year 1868 a group of eminent citizens of Hvar,

led by the then bishop Juraj Duboković, founded *Higijeničko društvo* (*Hygienic society*) whose goal was to promote the development of hospitality supply in the city of Hvar. They emphasised the beneficial and healthy Mediterranean climate of Hvar, thus establishing, according to Petrić, the model of health tourism on the island. In the fifth part, *Rađanje "hvarske Madeire"* (*The generation of "Hvar Madeira"*), of the feuilleton Petrić (2003b, p. 46) described how the first tourist guidebook of Hvar was published, in German, in Trieste in the year 1899, and another one in 1903, also in German. In the tourist guidebook published in 1903 the mild climate of the island of Hvar and the possibility of winter tourism were emphasised. It is in this guide that the first traces of sport and recreation supply may be noticed – according to Petrić, the book lists, among other things, the possibility of fishing at night, of sport shooting in the shooting alley, and bowling. Another example of combining sport and tourism in advertising material comes from the island of Brač, the island on the Croatian coast. In the 1930s, Antun Vidošević, who is considered to be the initiator of organised tourism on that island and who also led a pension for tourists (Pension Vidošević) at Bol, published, in German, the advertising material for his pension. Among other things such as geographical details, cultural attractions, description of the climate, and the possibility of excursions, the material emphasised the possibility of recreation in the sense of recovery (*Erhohlung*), and the possibility of bowling and doing water sports (Todorović, 1998, p. 87). Recreation, implied within the concept of wellness offered in today's hotels at Bol, bowling and water sport (see for example, www.bol.hr) are still, apart from many additional activities, a significant part of tourism supply in this village on the island of Brač.

Contemporary Croatian tourism and the contents of advertising material

Let us first raise the question whether the sport-specific and recreation-specific contents should be advertised within the general tourism supply, that is, together with other contents such as cultural attractions, beneficial climate, etc., or should they be advertised separately as a unique segment?

The development of tourism in Croatia resulted in the fact that tourism today represents the most profitable industry in Croatia. The successes of Croatian athletes have contributed to the promotion of Croatia more than any other promotional mix elements. According to some research results (Marušić & Weber, 1999; 2002) sporting activity participation is advancing on the list of motives of tourists to visit Croatia. Since it is well known that promotion is inevitable for success in presenting the tourism-specific products and services both to general public and to specific profile of prospective consumers, research was conducted into various topics - style of advertising material, for example, the style of brochures of tour-operators advertising ski resorts (e.g., Goodall & Bergsma, 1990), the quality of published advertising material in Croatian tourism (for example, Weber, Vrdoljak-Šalamon, & Boranić, 1994; Weber, Vrdoljak-Šalamon, Tarlow, & Boranić, 1996), promotion as a marketing mix element in sport tourism in Croatia (Bartoluci & Omrčen, 2003), etc.

The present status of the contents of advertising material reflects the trends in the development of tourism. As already described in previous parts of the text, sport and tourism developed in Croatia, particularly as a part of the tourism offer on the Croatian coast. As an example, let us analyse the advertising material relating to the island of Brač in which sport-related contents specific for this location are presented. Biking, apart from many other sports that the tourists can do or play in various places on the island, has an important place. This is evidenced by the quality of advertising material available. An example of such advertising material is *Dalmatia by Bike* (Split & Dalmatia County Tourist Board, 2004). This material contains the following information: the small map of Europe, the small map of Croatia on which the island of Brač is pointed up, the map of the island of Brač on which all biking routes are drawn and containing the legend of symbols that denote some important points on the island, descriptions of bike routes in six languages (Croatian, English, Italian, German, Czech and Slovenian) and the diagrams of biking routes depicting the length of the road, time necessary to cover the distance, altitude, trail description (difficult, easy), photographs of several towns and villages on the island and phone numbers of important services, as well as phone numbers and Email addresses of tourist offices on the island. The material is of outstanding quality in all aspects – it is informative, comprehensive, colourful, and printed on high-quality paper. Biking is frequently used to promote a certain tourist destination and this is evidenced by numerous other examples, for instance, the advertising material of bike routes and walking tours in the Municipality of Fužine (Turistička zajednica Općine Fužine, 2004), bike route in the National park Plitvička jezera (Nacionalni park Plitvička jezera, 2004), cyclo-tourism in Karlovac county (Karlovac County Tourist Board, 2004, p. 115) and trekking and mountain biking in Zadar county (Zadar County Tourist Board, 2004, p. 109). Similar pieces of information can also be found on web sites of these municipalities and counties.

The variety of sporting activities included into the tourism supply in tourist destinations is substantial, however, some of the capacities of certain destinations are still unexploited, at least at the moment, either due to the lack of money or due to the disproportion between the necessary investments and the expected profit. This is the case, for example, with the skiing capacities in the town of Delnice that has, due to the convenient climate, excellent preconditions for winter sports, however, not much has been done as regards the investment into the building of new capacities – hotels, ski courses, ski lifts, cross-country skiing routes, etc. – which would help the overall development of the area. Still, the number of tourists in the town of Delnice and its surrounding area is surprisingly large. The fact remains that with more investments the area could provide more opportunities for active rest (vacations) then at the moment. As for the tourist brochure published

by the Tourist Board of the Town Delnice (2004), it contains valuable pieces of information as regards the possibility of sporting activity participation in this town and its surrounding area.

Naturally, each region has its own attractions that help comprise the tourism-specific offer – from the Croatian part of the Adriatic coast, where sport-specific offer contains all the activities connected with water sports, for example, windsurfing, apnea and scuba diving, sailing, water-skiing and the like, to biking, walking, tennis, golf, etc., to the continental part of Croatia in which significant effort is being made to either build new facilities or to restore the old ones in such a way as to fit the demands of contemporary tourists. Naturally, the contents of offer in those places are structured in accordance with the latest research results as regards, for example, the motives of tourists to visit certain places (destinations). The opportunity of training for fitness is included in almost all advertisements of tourist destinations – be it places such as towns or villages, or hotels and camps - along the coast, although some evidence, as the result of research conducted, suggests (Weed & Bull, 2004, p. 23 quoting Keynote, 2001 and Reeves, 2000) "that sports facilities (particularly those in hotels), while playing an important role in the marketing mix, are actually used by surprisingly few guests".

The Internet has nowadays become one of the most widespread means of communication. It is, therefore, not surprising that tourism-specific products are advertised on the Internet. Information about various Croatian tourist places, activities, attractions, etc. may be found on web sites of tourist agencies, county tourist boards in Croatia, municipality tourist boards, town tourist boards, on the web sites of many hotels and also on the web pages of the Croatian National Tourist Board (www.croatia.hr). The web sites are usually in at least two languages, Croatian and English, but sometimes also in German, Italian, French, Czech, Slovenian, etc. Information on sport and recreation, and active rest are to be found on those pages. The body of information is sometimes rather comprehensive and provides the reader with detailed descriptions of, for example, biking routes, walking paths, mountaineering routes, etc. The web sites are usually colourful and attractive, the photographs are selected carefully and according to their quality, special attention is paid to the layout and the design of the web page, and the result is frequently a web page that has a high artistic quality and that attempts to be as informative as possible.

Apart from the web sites on the Internet and the brochures and leaflets described previously, tourist catalogues published by travel agencies are also one of the many means of promoting the tourism offer. These catalogues also try to present, in a concise way, the places, or hotels, advertised. Sport-related offer is an almost inevitable part of that offer.

All the advertising means described include in their offer a new concept that developed in the 1970s, and that is *wellness*. This part of the offer is sometimes advertised together with the sport-related offer, and sometimes separately. In the former case, sporting activity participation on recreational basis is associated with the concept of well-being. This is in accordance with the contemporary concept of a healthy life style that considers physical activity to be of crucial importance both for the physical and for the mental fitness of the modern man. However, it is not only the places on the Croatian coast that are advertised on the Internet. For example, the Tourist Board of the Vukovarsko-Srijemska County (continental Croatia) has its web pages on the Internet and is among many other locations in the continental part of Croatia that pay significant attention to tourism and the possibilities of its development, thus including sport and recreation into tourism supply (www.hinet.hr/tzvsz/rekreacija.htm). Although coastal tourism makes up almost 90% of Croatia's income from tourism, tourism supply in the continental part of Croatia is on constant rise. Spas, ski resorts, sport centres in the mountains such as the Olympic centre Bjelolasica, etc. start to pay much more attention than before to what they can offer to a prospective consumer. Sport and recreation in those places have an increasingly important role.

The previous example may be divided into two groups – the first group is comprised of such advertising materials that incorporate sport-specific offer into the general tourism supply/offer in a certain destination. The other group is comprised of materials that advertise exclusively sport activities. This second group can be supplemented by such examples as promoting sporting events, for example, the XVIth Women's World Handball Championship held in December 2003 in Croatia (http://www.wwhc2003.hr), etc. Such events are an opportunity not only for the promotion of Croatian tourism, but also for the promotion of the sponsors of those events.

In both groups the visual presentation is of extreme importance, and that is the reason why much attention is paid to the layout of the advertising material.

Conclusion

Tourism is Croatia's most promising industry. All tourism-related activities are focused on improving the tourism supply and on promoting the Croatian tourism in the best possible way. Sport tourism encompasses all aspects of sport-related visits to a certain tourist destination – from visiting a sporting event, to tourism-sport participation. A question is therefore rightly raised whether the sport-specific offer in tourism is independent of the rest of the tourism offer and whether it should be promoted as such, or whether it should and is considered within the entire offer related to a particular destination. Arguments in favour of either of the two varieties may be listed, however, this topic deserves much more attention as regards its elaboration, which would exceed the range of this paper, so that the question raised is to be found here for the purpose of further consideration. Examples of advertising materials described in this article

show that tourism providers use both varieties. Advertising material changes together with the trends in the development of tourism in general. Thus, the today's tourist catalogues, brochures, leaflets and other advertising materials dedicate significant space to the promotion of sport and recreation. The basic reasoning behind such conceptualisation both of the actual supply and of the advertising material is to respond to the requirements of the modern man who seeks a healthy life style and the concept of well-being.

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THE ROLE OF SPORTS ANIMATION IN TOURISM

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Abstract

Mutual connection of sport, recreation and tourism has created the conditions for the development of a selective kind of tourism determined by sport contents and shaped by animation creativity into a complete tourist product. The research in this study has shown that guests coming to our hotels, apartments and camps, regardless of their paths of life, have a particularly positive attitude towards sport as an integral part of the tourist offer. Their responses imply clearly their habit to do sport in their free time. The results indicate that guests take part in the programmes and use the sports and recreation facilities, but less then they enjoy swimming and sunbathing on the beaches during their holiday.

Sport contents, organization approaches, the personnel level of equipment and the shortage of attractive programmes for an active holiday are essential disadvantages of the hotel and camp product of "Arenaturist". On the basis of domestic and foreign guest's personal evaluation of the offered sport contents, the need has been defined for their development and modernization due to the demand of the modern tourist market.

Key words: *sport, recreation, active holiday, quality holiday, animation, tourist product*

Introduction

Animation has become the essential component of tourist services in modern tourism, an important factor in tourists' motivation in choosing the destination and accommodation.

Animation, as a constituent part of tourist services, marks their higher phase in regard to more meaningful tourist stay, better extra services, and the consciousness of people who work in tourism that it is not enough to offer to the tourist only the sun and the sea (Ravkin, 1989:7).

Tourist animation is essentially based on the personal animator's character mainly because the animator's communication with a guest is direct.

If a tourist product is a package of activities used to please the guest's wishes and needs, it has to be conceived in the way that the expected guest's perception should be entirely completed (Cerović, 1999:13).

In marketing terms, the demands of the tourist as a consumer and of the user of services are oriented towards the growing diversity and the seeking of potential wider spectrum of services.

If once the accommodation and food, the sun and the sea have been the synonyms for "recreational tourism", today all the services have remained only a prerequisite, not a tourist objective. A tourist nowadays looks for a destination which offers a change, a new sensation, events, exploration, adventure, the complete package of atmosphere in a destination.

The role of animation

In the relation between the tourist demand and supply, animation with its role acts as a mediator through informing and creating the atmosphere of comfort, it stimulates the biggest consumption of tourist programmes, improves and updates these programmes by accepting direct suggestions of guests in direct communication and interaction with the tourists. "*Animation, therefore, can be defined as a constituent part of a tourist offer, which represents the enrichment of the offer with various programmes and the stimulus for the tourists for a more meaningful tourist sojourn*." (Ravkin, 1999:23).

As one of the activities in the tourist offer, by organizing culturally valuable programmes, animation contributes to the development of the guests' fitness, their physical and psychological abilities, their pleasure and realization of values, and the general atmosphere in the tourist visits to a certain destination.

Animation increases the competitiveness of the tourist offer by realization of its various programmes, and it increases, indirectly or directly, the total tourist consumption.

It is indisputable that animation in modern tourism becomes an important component of the tourist offer and a more and more important factor and motivation for tourists when choosing their holiday destination. Additionally it should be stressed that animation cannot serve to conceal the deficiencies in the services quality, because then it ceases to be animation.

The analysis of the Croatian tourist offer (Institute for tourism, 2002:3-6) indicates insufficient care for the holiday programmes and the tourists' entertainment, inadequate tourist offer which fails to keep pace with our competitors in the Mediterranean – Italy and Spain.

The tourists' opinions about our tourist offer warn that the communication with the guest is inadequate. In personal contact with the guests many of their remarks and objections could be solved, so the task to compensate for and correct the oversights is imposed not only to the animators but to the complete team of the hotel service.

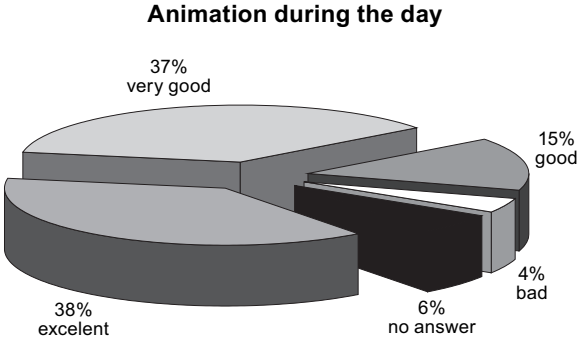
Defining the research problem

The scientific problem of this part of the paper was to establish the importance, the comfort and the possibility of application of sport and recreation programmes in the total tourist offer of hotels and campsites of "Arenaturist" d.d. Pula. The enrichment of the tourist offer would contribute to the promotion and development of the quality of tourist programmes. The establishment of interest for sport, recreation, entertainment and animation programmes, together with the programmes of sport recreation evaluated by the interviewed guests will provide concrete guidelines about the possibilities and contributions to the entire development of the tourist subject and destination.

The analysis of the current state

The survey of the guests' satisfaction, carried out by a *questionnaire***,** referred to the quality evaluation of all the programmes and departments in hotels, campsites and tourist complexes of "Arenaturist" in Pula and Medulin. The analysis of the quality evaluation per accommodation units and totally for "Arenaturist" d.d. will be presented.

The basic group to which the questionnaire was dedicated, consisted of the guests of hotels, campsites and tourist complexes. The evaluation of animation quality, based on the collected and analysed questionnaires, was done through the conducted survey, the animation during the day being separated from evening animation. 38.42% of the interviewed guests evaluated the *animation during the day* as excellent, 36.82% as very good, 14.79% as good, while 3.76% of guests evaluated the quality of animation as bad, and 6.22% of the interviewed guests did not give the answer to the question. The average quality rating of the *animation during the day* is 3.95, which in our opinion represents a solid, very good quality.



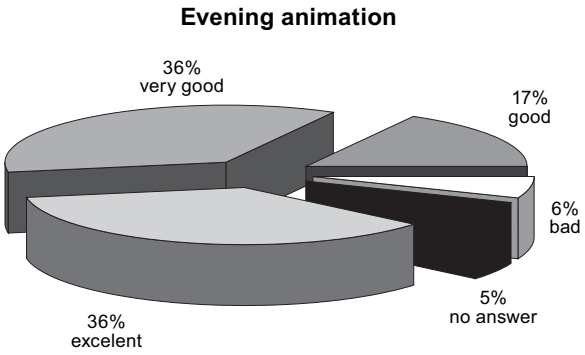
The source: According to the author's survey

Graph 1. The animation during the day quality rating

35.60% of the guests evaluated the *evening animation* as excellent, which is slightly lower rating than that of the animation during the day. 36.42% of the guests evaluated the evening animation quality as very good, 16.71% as good, and 6.06% evaluated it as bad, which is much worse than the rating of animation during the day. 5.20% of interviewed guests did not answer the question.

The average *evening animation* quality rating was 4.16. We consider this rating to be a convincingly good evening animation quality rating in "Arenaturist" d.d. The total average quality rating of animation during the day and evening animation for "Arenaturist" d.d. is 4.05, which in our opinion represents again a very good animation quality rating.

Comparing the animation quality rating in profit centres of the accommodation units, the apartment settlement "Punta Verudela" got the best animation quality evaluation, while the apartment settlement. Horizont – Zlatne Stijene got the worst quality evaluation.



The source: According to the author's survey

Graph 2. The evening animation quality rating

The results of the survey of the hotel guests' sport and recreation participation

Many questions were raised in order to estimate the interviewed guests' attitudes and opinions about sport, recreation and the choice of programmes, as well as habits, and from it the questions that gave an accurate insight in the structure of the interviewed guests were selected.

Active vacation has been an orientation of many guests for a long time. The variety of activities and sports in which the tourists are active during vacations, in places other than their permanent residence, truly confirm that. It can be seen in the results in *Table 1.*

Table 1. Hotel guests' sport activities rank list in %

RANK	SPORT ACTIVITIES	PARTICIPATION IN %
1	Swimming/Bathing	66.5
2	Tennis	29.2
3	Table tennis	21.0
4	Miniature golf	14.5
5	Water – skiing	7.7
6	Health – Recreational programme	7.7
7	Bowling	4.7
8	Football	3.7
9	Other	21.1

Note: This question offered the opportunity of maximum two answers
Source: According to the author's survey

As many as 22 sports and activities that can be practised were offered to the guests. 2.5 % of the total interviewed number of guests was not interested in any activity. Nevertheless the biggest number of guests who had the possibility of choosing two sports at most, chose mostly swimming (66.5%), which leads to the conclusion that many guests prefer resting and sunbathing, together with one relaxing sport, like the miniature golf, table tennis or the like. Tennis is next in the popularity rank. Almost one third of the guests, 29.2%, selected tennis. Miniature golf is popular as well (21%), and table tennis is slightly less popular (14.5%).

These four sports, with the participation rate of 74%, are the most popular among all sports, other sports are rather less represented, but our guests practise them as well. They are: water-skiing 7.7%, bowling 7.7%, horse-back riding 4.7%, health and recreation programmes 7%. Beside these, sports like body-building, squash, aerobics, windsurfing, football, spear-fishing, trim track running, cycling, golf, rowing, airgun shooting, basketball and darts are represented with less than 5%.

Such a poor participation rate in water sports is surprising and leads to the conclusion that not all marketing, organisational and animation aspects of contents and programmes promoted in a destination are put to use.

Great aberrations can be seen in the most favourite activities, especially the activities connected with the sea when comparing the Pula and Medulin survey results with the TOMAS 97 research (Institute for tourism, 1998) – Special reports: Recreational activities and TOMAS 2001 research (Institute for tourism, 2002) – Attitudes and tourist consumption in Croatia.

If we neglect the dominant swimming/bathing activity (over 90%), boating (48%), cycling (40.4%), diving (23.2%), fishing (21.4 %), sailing (8.9%), windsurfing (10.2%) and water-skiing (10.6%) show big differences as regards the survey in Pula and Medulin area.

The need for a stronger popularization of sport programmes held near the sea and in the sea is emphasized. This can be done by developing the trend of an entrepreneurial organizing of the tourist offer in Pula and Medulin.

The results of the survey of the campsite guests' sport and recreation participation

General impression, which derives from the survey results, is that our guests are not very interested in sport activities, that is to say, the interest in sport activity participation during vacation is smaller in the guests who are accommodated in campsites than in those who are accommodated in hotels and tourist complexes. However, the guests in campsites have a bigger spectrum of interests that they engage in and they are interested in as many as 30 various sport activities.

However, a considerate number of campsite guests (7%) are not interested in engaging in any sport activity *(Table 2).*

Table 2. The list of the campsite guests' preferable sport activities in %.

RANK	SPORT ACTIVITIES	PARTICIPATION IN %
1	Swimming/Bathing	62.0
2	Tennis	21.2
3	Miniature golf	14.0
4	Table tennis	12.2
5	Water-skiing	7.2
6	No activities	7.0
7	Bowling	3.0
8	Windsurfing	2.7
9	Health and recreation programme	2.0
10	Spear-fishing	1.7
11	Horse-back riding	1.5
12	Running trim track	1.5
13	Diving	1.5
14	Fishing	1.0
15	Basketball	1.0
16	Cycling	0.7
17	Rowing	0.7
18	Sailing	0.7
19	Motorized hang-gliding	0.7
20	Boating	0.5
21	Football	0.2
22	Body-building	0.2
23	Airgun shooting	0.2
24	Italian bowling	0.2
25	Badminton	0.2
26	Volleyball	0.2
27	Handball	0.2
28	Darts	0.2
29	Aerobics	0.1
30	Squash	0.1

Note: This question offered the opportunity of maximum two answers
Source: According to the author's survey

When we add to them the quests who were not interested and the guests who chose swimming/bathing (62%) as a form of recreation, it is obvious that the campsite guests are more inclined to relaxation and resting than to active participation in sport. The second sport activity in rank is tennis (21.2%), then miniature golf (14%), table tennis (12.2%) and water-skiing (7.2%). Much less interest is shown in other sports, which can be seen in *Table 2.*

The surprise and the result of a smaller interest in sport activities at sea, water sports like rowing, sailing, spear-fishing and diving, leads to the conclusion regarding either a poor promotion and poor advertising on the one hand, or inadequate tourist offer of private enterprise programmes and clubs on the other.

The evaluation of the quality of animation programmes in Croatia

According to the personal author's observation, the interview and the comparison with the several hotel-and-tourist companies in Croatia, a conclusion has been drawn about the quality of animation activities and the quality evaluation, so that several essential segments of improvement in the animation programmes in the further period of the tourist management will be specified.

According to the quality comparison of animation segments in eight Croatian hotel-and-tourism companies, it follows that:

A) *the most common critical quality evaluations are*:

1) the lack of infrastructure for animation (stages, equipment, scenes, etc.),
2) unadjusted space for animation,
3) uneducated workers,
4) frequent influence of the proprietor structure on the programmes' contents,
5) the lack of space in case of bad weather, and
6) unadapted animation contents for teenagers (ages 14 – 17);

B) *favourably judged animation activities are:*

1) good advertising and informing of the guests,
2) good choice of media for manifestation advertising,
3) proper animation school,
4) contracting of animation through professional agencies for the animation services, and
5) the guests' satisfaction with the animation activities (+3 average grade).

For the purpose of increasing the animation teams' work quality, the process of a continuous schooling is necessarily imposed, both for the employees in tourism and the management. They will initiate the processes of investment in the infrastructure for the animation programmes contents and will introduce innovations in the tourist offer and in the activities of programmes and services in the Croatian hotel – and – tourism industry with new knowledge about the quality of the whole tourist product and the animation as well.

Conclusion

Based on the subjective evaluation of domestic and foreign tourists of the offered sport programmes, the need of their development and modernisation was established, adequate to the demand of the modern tourist market. The construction of golf centres, wellness centres, fitness and other modern sport and recreation facilities will surely represent a bigger step forward of the tourist destination in the globalisation processes and in increasingly stronger Mediterranean tourism competition. Entrepreneurial projects in sport and recreation will partially moderate this drawback, but stagnation is felt both in relation to the demand trends in the tourism market and in relation to competition. Promotion of the tourist sport and recreation offer is imposed as an imperative in keeping and improving the status in the tourist market. By educating the personnel for professional and scientific work, Croatia has been trying to improve and promote the sphere of physical recreation for almost four centuries.

It is necessary to point out that physical recreation and tourism are significant integral spheres for a future development and a wider social interest of Croatia and for the possibility of progress and destinations promotion as well, both local and regional, and particularly of the Croatian tourist destination, not failing to keep pace with the most developed tourist destinations in the Mediterranean.

Animation, sport and recreation are connected multi-functionally with tourism and make a dynamic component of its development. These phenomena have acquired mass characteristics today and their expansion is continuing fast. In the relations between the tourist offer and the demand, animation represents a kind of mediation which is manifested in the promotion and improvement of the tourist offer in conformity with the demand requests, in the continuous informing of tourists about the offer contents and stimulating their interest for those contents.

The research in this study has shown that guests coming to our hotels, apartments and camps, regardless of their life paths, have a particularly positive attitude towards sport as an integral part of the tourist offer. Their responses imply clearly their habit to do sport in their spare time. The results indicate that guests take part in the programmes and use the sport and recreation facilities, but less than they enjoy their holiday swimming and sunbathing on the beaches in the main season.

Sport contents, organization, the number of personnel and the shortage of attractive programmes for an active holiday are essential disadvantages of the hotel and camp product of “Arenaturist”.

On the basis of domestic and foreign guest’s personal evaluations of the offered sport contents, the need has been defined for their further development and modernization according to the demand of the modern tourist market. The building of a golf centre, a wellness centre and a fitness area as well as other modern sport and recreation contents will certainly represent a bigger step forward of the tourist destination in the processes of enrichment of the overall tourist offer.

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THE LEGAL FRAMEWORK FOR THE ORGANIZATION AND IMPLEMENTATION OF SPORTS AND RECREATIONAL ACTIVITIES IN TOURISM IN CROATIA

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Abstract

The legal provisions regulating the field of tourism are dispersed through numerous general and special regulations governing specific administrative areas and the performance of various activities. Regulations governing the organization and implementation of sports and recreational activities in general, and in particular within the framework of tourism offer, are insufficient. Supply and demand for these kinds of services is constantly on the rise, while sports tourism, as a specific tourism form, occupies an increasingly significant place on the tourism market. Participation in sports and recreational activities presents an elevated danger to the life and health of the participants and in order to protect the users of these services it is necessary to intervene in this segment of tourism offers with legal measures as well. By creating an adequate legal framework, the safety level and the quality of these services would increase and therefore contribute to the development of tourism. The aim of this paper is to analyse the existing legal framework for the organization and implementation of sports and recreational activities in tourism in Croatia and to propose legal measures which need to be implemented/adopted.

Key words: *state intervention in tourism, legislative measures, client safety and protection.*

Introduction

The modern tourist is no longer satisfied with the classic 3S offer yet, seeks out activities to fill his/her free time on vacation and fulfil his/her various needs. Depending on his/her personal preferences, he/she will search for and participate in different cultural, entertainment, recreational and other attractions. For this reason more and more services are offered in tourism. The services offered and the conditions under which they are offered are governed by various special regulations governing the subjects, the manner and the conditions for performing the activities within the framework of which such services are offered. Accordingly, in order to be able to legally offer services, the tourism service providers and travel organizers must, in addition to being familiar with the regulations governing the provision of tourism services in the narrow sense, also have knowledge of and abide by numerous other regulations governing the performance of those activities. Similarly, in order to organize and carry out sports and recreational activities, the service providers must know and follow numerous regulations from the field of tourism, the hospitality industry, sports, protection of common goods (sea, environment, nature, cultural heritage and the like), contractual relations, etc.

Participation in sports activities also requires certain special psychological and physical abilities of the participants themselves – these being tourists. Organization and implementation of these activities demand specific professional training on the part of the persons implementing them. The more demanding the activities, the greater the necessity for training and preparation of clients and service providers alike in order to avoid possible injuries. Any sort of oversight which causes damages to the client leads to the obligation of compensation for damages but also leads to the dissatisfaction of the client and to all the consequences to the development of tourism related to that dissatisfaction. With that in mind, organizers and providers of sports and recreational services must provide these services with special care and train their staff for expert, safe and high-quality implementation of these activities. On the other hand, since the activities are carried out at the place of destination, it is of great significance that the receiving countries prescribe such a legal framework (determine the subjects, services, conditions for providing services, liability of service providers) which will prevent/reduce to a minimum the possibility of damages to the client, especially since consumer protection and safety are receiving more and more attention all over the world and are becoming an increasingly significant factor of competitiveness in tourism.

As stated by Čavlek (2004:79), in Europe more than 50% of travels abroad are related to sports, while active forms of vacationing (adventure travels) are the most rapidly increasing segment of tourism demand. The author distinguishes between sports-oriented vacations and vacations which include sports activities but not as the focal point of the vacation. These facts point to the connection between sports and tourism and to the role of sports and recreation in the development of tourism.

The aim of this paper is to explore and analyse the prescribed requirements for providing the services in sports tourism in Croatia and to propose the changes in regulations which would contribute to the successful development of sports tourism in Croatia. In view of the fact that this field has not been explored yet the paper contains a systematic overview of positive regulations governing that field. In consideration of the elevated risk to life and health of clients, special attention is given to the provision of services in the so-called hard and soft adventure tourism.

State intervention in tourism

Motivation for the involvement of the state in tourism is primarily of an economic character since the state has significant direct (tax revenues, standardization of payment balance, foreign currency earnings, etc.) and indirect (general economic growth through employment increase, increase in consumption of domestic goods and services otherwise difficult or impossible to market, etc.) benefits from tourism. Yet tourism also produces numerous non-economic (cultural, social) effects towards which the state has remained indifferent for a long time. It is only the development of mass tourism and finally the perception of its negative impacts, the devastation of the country's natural and cultural recourses, sudden and drastic social and cultural changes and a markedly negative attitude of a large part of the domestic population towards tourism and tourists, that prompted a more serious state intervention in tourism for the reason of its non-economic impacts.

The state's role in tourism has been constantly changing from its direct intervention to coordinated activities which may be followed through three phases:

1. the pioneer phase in which the state invests huge resources in the creation of the basic infrastructure and capacity of the offers;
2. the phase of strong legal regulation of the activity in which the government introduces special regulations governing the field of tourism
3. the coordination phase, which only economically highly developed countries have been able to reach, in which the protection of tourists and other service users are mainly regulated (Cockerell, 1997:5).

According to Raphael (1997:6), the most important competences of a state in the development of tourism in a country should be the following: adoption of a master plan, legislation, building of general and specific infrastructure for tourism, education of personnel, development of tourism products and promotion. The countries realize these goals by adopting and implementing certain intervention measures. State intervention measures may be: legislative, economic-financial, administrative and social-political. The legislative measures create preconditions and frameworks for performing the activities in tourism, establish mutual relations between the state and the subjects which appear in the field of tourism and govern business (and other) relations created in relation to tourist travel.

Legal framework for providing services in tourism in Croatia

Due to the number and diversity of tourism services and subjects as well as the mutual relations which come into being it is not possible to regulate in one place all the matters that relate to tourism. Thus, no country, including Croatia, has a single code regulating the field of tourism, but the provisions which relate to this field are dispersed through numerous regulations. Some of them exclusively or for the most part regulate the matters related to tourism (the Act on Tourism Activities, for example), some of them regulate the matters which are not solely related to tourism but are of importance to tourism development (the Sports Act, for example), while others are of a more general nature, in other words, they apply to everyone and therefore to tourists as well (the Health Insurance Act, for example). Besides, it is not possible to encompass by regulations the totality of matters relating to tourism so that interrelations between subjects in tourism are also governed by rules of autonomous law (business customs, usage, general business conditions, etc.) (see in more detail in Gorenc & Šmid, 1999: 1– 8).

Pursuant to the above, provisions of significance to the provision of sports and recreational services in tourism are also found in various regulations and autonomous law and may be divided into the following basic groups:

1. provisions binding upon the providers of tourism and hospitality services, found in:
   - Act on Tourist Activities (OG, No. 8/96, 19/96 and 76/98, hereinafter referred to as: AOTA) and its implementing regulations – Ordinance on the professional exam for tourist animators (OG, No. 95/96, 47/97 and 80/98), Ordinance on the types and categories of vessels in nautical tourism (OG, No. 11/97, 105/98, 38/99, 56/00 and 106/00),
   - Act on Hospitality Activities (OG, No. 49/03 – consolidated text and 117/03, hereinafter referred to as: ACA) and its implementing regulations – Ordinance on classification, categorization, special standards and special quality of accommodation facilities pertaining to hotels (OG, No. 48/02, 108/02, 132/03 and 73/04);
2. provisions regulating contractual relations between subjects in tourism and their liability:
   - provisions of the Civil Obligations Act (OG, 35/05, hereinafter referred to as: COA) governing tourism contracts,
   - provisions of Special usages in hospitality (OG, No. 16/95)
3. provisions of regulations governing the organization and implementation of sports and recreational activities:
   - provisions of the Sports Act (OG, No.111/97, hereinafter referred to as: SA) and its implementing regulations – Ordinance on professional training for performing expert activities in sports (OG, No. 47/93), Ordinance on the training of personnel for performing expert activities in sports (OG, No. 45/91),

- provisions of the Maritime Code (OG, No. 181/04) and its implementing regulations which govern: navigation, underwater activities and safety at sea, of which may be pointed out: the Ordinance on performing underwater activities (OG, No. 47/99), Ordinance on the procedure and manner of issuing permits for performing underwater activities in parts of interior and territorial waters of the Republic of Croatia which constitute protected cultural heritage (OG, No. 56/03), Ordinance on boats and yachts (OG, No. 27/05), Ordinance on navigation in interior waters (OG, No. 50/02), National plan for search and rescue at sea (OG, No. 146/98),
- provisions of the Air Transport Act (OG, No. 132/98 and 178/04) which regulates airsports activities;

4. provisions from other sources of law of significance to relations in tourism, the most important being:
   - provisions of the COA which regulate liability for damages and compensation for damages and which also apply to service providers in tourism and sports,
   - provisions of the Consumer Protection Act (OG, No. 96/03) which also relate to consumer protection in tourism,
   - provisions of regulations governing the use of common goods – Act on Protection and Conservation of Cultural Heritage, Nature Protection Act (OG, No. 162/03), Environmental Protection Act (OG, No. 82/94), Waters Act (OG, No. 107/95) and others,
   - provisions of regulations governing rights to health protection and health insurance in Croatia and abroad (Health Insurance Act - OG, No. 94/01., Health Protection Act - OG, No. 121/03),
   - provisions regulating insurance which are contained in the COA, Insurance Act (OG, No.46/97), Act on Mediation and Representation in Insurance (OG, No. 27/99), etc.

ad 1) The AOTA and its implementing regulations govern the conditions for providing tourism services, among others also conditions for providing services by travel agencies, tourist animators, providing services in nautical and sports tourism and providing other tourism services. Provision of services by travel agencies, tourist animators and provision of services in nautical tourism are regulated in detail (in nautical tourism relevant regulations of maritime law also apply). Under other tourism services the AOTA states the rental of beach canoes, sailing boats, surf boards, water bikes, equipment for bathing and water-skiing, parasols and chaise longue and the like, and in providing these services the provider must ensure the service user from injuries or death. The AOTA devotes only one article to the provision of services in sports tourism (and other specific forms) in which authorisation is granted to the minister competent for tourism to prescribe the minimal requirements and the manner in which they are to be provided. Till now this authority has not been used, meaning that these forms of tourism are not regulated by regulations governing the provision of services in tourism at all.

Regulations governing the hospitality industry, among other things, establish in detail the minimum of hospitality and other services which have to be provided in certain types of accommodation facilities, the minimal requirements (decoration, equipment and appliances, etc.), category requirements and special standard requirements. The special standard is a novelty introduced in 2002 which is interesting for the provision of sports and recreational services because it prescribes additional attractions, equipment, appliances and services for establishing the special standard of the Health & Fitness, Diving Club and Ski type.

ad 2) Mutual relations (rights, obligations, liabilities) which come into being during the provision of tourism services are governed by civil contracts regulated under the COA and under Special usages in catering (on contracts see Gorenc & Šmid, 1999). For the provision of sports and recreational services the manner in which the liability of the service providers in tourism which ensues from these contracts is especially important.

ad 3) Regulations from this third group govern, among other things, the conditions for performing sports and airsports activities and for organizing and implementing some sports and recreational activities. The requirements for diving tourism, for performing airsports activities, for boats and yachts, navigation and safety at sea are regulated in detail. The provisions regulating other sports and recreational activities are rather general and do not provide a real basis for providing the services in specific types of recreation for which tourism demand is increasing, and especially in adventure tourism.

It is clear from what has been said previously that the legal framework for organizing and implementing sports and recreational activities is insufficient and that mainly the requirements for providing the services which are of a lower risk to their users are prescribed. The manner and conditions for providing the services, facilities, equipment and professional training of activity leaders in adventure tourism (and especially in hard adventure tourism) are in this way practically left to the good conscience of the service providers. For now, this has not created greater problems in practice since all the above has an impact on the quality of services and the satisfaction of clients and their competitiveness on the market. That is the reason why a large part of service providers abide by the standards of the existing domestic and foreign sports associations and by the rules of the profession, and train their staff in the manner customary to countries in which the provision of these services is regulated in a more developed fashion.

The reasons for which these matters are not sufficiently legally regulated in Croatia for the most part lie in the fact that for the adoption of relevant regulations the cooperation of a large number of ministries, within the competence of which certain segments of the provision of these services belong, is needed. On the other hand, in drawing up relevant regulations there is a need for specific knowledge pertaining to various professions which in attempting to adopt adequate regulations often represent entirely opposite point of views. Due to the importance of regulating these matters for the development of tourism, the Ministry of Tourism (the now Ministry of the Sea, Tourism, Transport and Development) has, on numerous occasions, shown the initiative for the adoption of regulations. But, it did not succeed in its attempts because the ministries are independent and autonomous bodies and one ministry cannot influence the work of another. Therefore, it would be necessary for the Croatian Parliament, as the legislative body, to obligate all the ministries under the competence of which these matters fall, to cooperate and draw up the proposals of acts which would regulate these matters.

The safety and protection of participants in sports and recreational activities

The users of package holidays and excursions which include sports and recreational activities are protected under the provisions of the AOTA and COA which govern the provision of services by travel agencies and the package holiday contract. Namely, these provisions prescribe the liability of the travel organizer for all damages the client incurs in relation to the travel, which he did not cause himself and which was not caused by force majeure. The organizer is also liable when he does not himself provide the services from the package holiday but when they are provided by his business partners (from whom he might subsequently claim a refund for the compensation he paid to the client). This liability also includes the liability for the choice of business partners which directly provide the client with services. Accordingly, travel organizers will choose their business partners and their providers of sports and recreational services carefully.

According to the ACA and its implementing regulations as well as the Special usages in hospitality, hotel-managers are responsible for the person and property of their guests. In other words, if they provide their guests with special entertainment in the form of services of a sports and recreational character (for example, sports animation, fitness, swimming pool, trim cabinet, gym) they are liable for damages which might occur as a result of providing those services, that is, as a result of the improper functioning of the equipment or facilities. The liability of the hotel-manager is regulated in detail under the Special usages in catering for each type of agreement the client and the hotel-manager conclude.

The liability of legal and natural persons performing sports activities, providing services in nautical tourism or diving tourism is not specially established by regulations. But, the conditions, facilities and the manner of providing these services are prescribed so that service providers are liable for damages which result from the non-compliance of these regulations according to the rules on liability for damages from the performance of activities. Problems arise in determining the liability of providers of services which are not governed by regulations. As it is explained under the previous heading, these are precisely the services in hard adventure tourism, in other words, in the type of tourism in which there is the highest risk for damages to occur, especially injuries or death. Liabilities for damages which occur during the provision of these services should be established by applying by analogy the provisions on liability for injuries from hazardous objects or hazardous activities. This is because in the cases mentioned the liability cannot be eliminated or limited while in practice it is already customary that service providers conclude agreements with clients (or they have them sign statements) eliminating their liability for damages.

In establishing a legal framework for providing sports and recreational activities it would therefore be advisable to precisely establish the liability of the service provider according to the principle of presumed guilt, to prohibit the possibility of eliminating or limiting liability and bind them to insurance for liability in performing the activities.

One of the measures by which risk in providing these services is reduced, and which might be prescribed as a requirement for the provision thereof, is the obligation of clearly informing the users of the risks involved in those activities prior to concluding the agreement. This kind of measure, as stated by Page, Bently and Walker (2003:396) is applied in Australia based on the Adventure Activity Standards.

Conclusion

Croatian legislation has relatively sufficiently regulated some aspects of providing sports and recreational services in tourism including the safety and protection of tourists. As a rule this applies to regulations which fall within one administrative area (department), that is, under the competence of one ministry. For example, the legal framework is sufficient in the areas of organizing travels (package holidays and excursions), sports and recreational activities provided in accommodation facilities, providing services in nautical tourism, performing air – sports activities. Yet in the part which relates to the organization and implementation of sports and recreational activities for which a legal framework needs to be created by interdepartmental cooperation, regulations are insufficient. In this matter the insufficiency of legislative regulation is most accentuated in the area of providing the services in hard adventure tourism, in other words, in the one type of tourism which presents the highest level of risk for tourists. Rafting, kayaking, bungee jumping and

the like are not included either in regulations on the provision of tourism services or in regulations on the performance of sports activities. The liability of the providers of these services should be established by the appropriate application of the provisions of the COA on liability for injuries from hazardous objects or hazardous activities. Therefore it is necessary to as soon as possible draw up and adopt in an interdepartmental coordinated action the regulations which would create a satisfactory legal framework for the provision of these services as well as determine the competent bodies for its future improvement and supervision. In the meantime, service providers in their provision of these services and competent bodies in their approval and supervision of the performance of these activities, as well as in resolving disputes caused by the performance of these activities should follow the standards of the existing domestic and foreign sports associations, rules of the profession, business customs and consumer protection institutes.

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THE DEVELOPMENT OF SPORTS TOURISM IN CROATIA

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Abstract

Competition on tourism market becomes stronger and stronger every day, and the old formula *sun, sea and sand* does not suffice anymore to attract the tourists. Therefore, in the battle for attracting the tourists many tourist receiving countries try to improve their competitive position by developing the specific forms of tourism. This article focuses on sports tourism as a special, quality tourism. It is defined as a "special type of tourism in which sport-specific motives for travelling and for the stay in certain tourist places and centres prevail". It may be categorized either as winter or as summer sports tourism. This article tries to present the possibilities for the development of sports tourism in Croatia on the basis of this categorization. Croatia has numerous opportunities for the development of all types of sports tourism. Competition-oriented sports tourism is mostly characteristic for big towns in Croatia (Zagreb, Split, Rijeka, Osijek, etc.), but also for small towns (Umag, Bol, Makarska, Čakovec, etc.). Winter sports tourism can be successfully developed in the mountain part of Croatia, but also in spas and at the seaside, which is evidenced by certain opportunities. Special significance is attributed to the development of summer sports tourism since Croatia is an exceptionally season-oriented tourist country (as many as 40% of tourist arrivals are realized in July and in August). The TOMAS research (Institute for Tourism) speaks in favour of the development of sports tourism and its results point to the increased activity of tourists in Croatia.

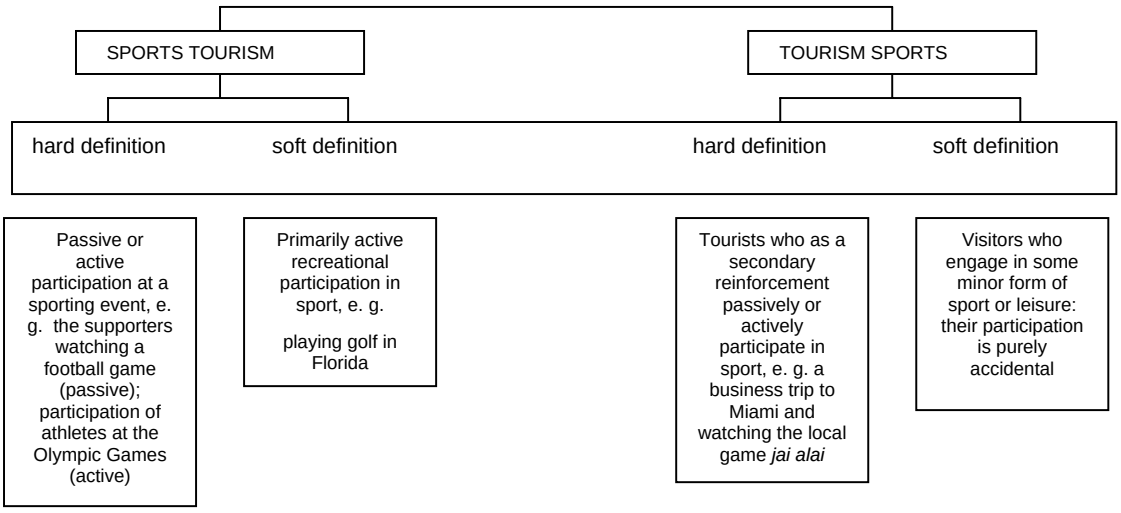
Key words: *sport, sports tourism, physical recreation, tourism development*

Introduction

The most developed tourist region in international tourism trends is Europe with 57.7% of share in international tourist arrivals in the year 2003 (WTO). However, this share gradually decreases, that is, "the tendency of dispersion of tourist traffic to a bigger number of tourist receiving destinations in the world becomes stronger" (Čavlek, 1998:161). This occurs primarily due to the development of traffic and the means of traffic that enable even the farthest destinations to be well connected with the rest of the tourism market. The competition on the tourism market becomes stronger and stronger every day, and the old formula *sun, sea and sand* does not suffice anymore to attract the tourists. Therefore, in the battle for attracting the tourists many tourist receiving countries try to improve their competitive position by developing the specific forms of tourism. The specific forms of tourism are hunting, fishing, nautical, adventure, ecology tourism and many others, among them, naturally, the sports tourism. Tourism and sport have always been two interconnected social phenomena. Whereas in ancient Rome and in ancient Greece sport was the driving force that made people travel to visit big sporting events, in contemporary tourism sport plays a much wider role. Nowadays sport is not only an object of observation, but becomes the more and more important contents of stay in a tourist destination where tourists become active participants in various sporting activities, like water sports, tennis, golf, skiing, team sports, etc. (Bartoluci, 2003: 65). This created a new relationship between sport and tourism from which sports tourism emerged. What is sports tourism and what are the possibilities for the development of sports tourism in Croatia are the two basic questions that this article will deal with.

The concept of sports tourism

The concept of sports tourism may be explained in various ways, starting from various viewpoints and depending on what is in the focus of our interest – activities of tourists, their motives for visiting a certain destination, the effects of sports tourism, etc. The goal of this paper was to point to the possibilities for the development of this type of tourism in Croatia. The activities that the tourists participate in in a certain destination are therefore the focus of this analysis, so that sports tourism will be explained from the point of view of sport and recreational activities. When explaining the concept of sports tourism Gammon and Robinson (according to Turco, Riley & Swart, 2002:7-9) present a model that consists of two parts – namely, the *sports tourism* and *tourism sports* (Figure 1).



* Modified according to Turco, D. M., Riley, R., & Swart, K. (2002). Sport tourism. (p. 8). Morgantown:Fitness Information Technology.; Turco, Riley & Swart according to Gannon & Robinson, 1997.

*Figure 1. Sport and tourism**

They classified the types of sports tourism by the description of the activities of tourists while they travel and during their stay, as well as their primary and secondary motivation for sport participation. As for sports tourism, the primary motive for travelling is either the active or passive participation in sporting activities, whereas in tourism sports the motive of sport participation is in the second place, and the primary motive is something else. Standeven and De Knopp (quoted in Weed and Bull, 2004:44) define sports tourism, again from the point of view of activity, as "all forms of active and passive involvement in a sporting activity, participated in casually or in an organized way for non-commercial or business/commercial reasons, that necessitate travel away from home and work locality".

The authors who deal with this topic in Croatia denote sports tourism as a "special type of tourism in which sport-specific motives for travelling and for the stay in certain tourist places and centres prevail" (Vukonić and Čavlek, 2001: 365). However, to analyse in more detail the possibilities for the development of sports tourism, the definition alone is not enough. What is necessary is the further systematization of sports tourism that would make the segmentation of the tourism market easier. For a certain area to optimally exploit its resources, in this case the resources for the development of sports tourism, it must be well acquainted with its supply, but it must also recognize the characteristics of demand in order to be able to direct its efforts towards the right market segment and to do this in an appropriate way. In this sense Bartoluci (2004:21) primarily distinguishes between *sport* and *physical recreation*, and he analyses sports tourism separately in summer and in winter season, and lists the following kinds of sports tourism:

1. competitive sports tourism,
2. winter sports tourism,
3. summer sports tourism, etc.

Under the term ***competitive sports tourism*** Bartoluci implies "all journeys that are initiated by the motive of participating in certain sporting events, from national to international competitions" (Bartoluci, 2003:71). The motive of being present at sporting events is one of the oldest motives that influenced the travelling. According to Bilen, "the range of motives for travelling in ancient Greece was relatively wide. However, the most attractive, the most widespread, and, according to the economic effects, the most profitable journeys were those undertaken to watch the Olympic Games" (Bilen and Bučar, 2001:4). This motive is still among the important ones. Namely, regardless of the presence and the possibilities of the media for the direct coverage of popular sporting events all over the world, still a large number of people travel to watch sporting events which gives them a special feeling of "being present". Čavlek is of the opinion that the connection between tourism and sport, that is, between competitive sport and tourism, is "the most emphasized and the most obvious" (2002) in big sporting events. The differentiation between ***winter and summer sports tourism*** relates primarily to the place where the activities are held. The former are carried out in winter mountain centres, and the latter at the seaside, in the mountains, on rivers, lakes, etc. The term *sports tourism* implies the type of tourism that is aimed at satisfying the need to move, play, rest actively and to be entertained, consequently affecting, by creating a habit to spend leisure time in a creative and meaningful way, the preservation of health and the prolongation of life expectations» (Relac & Bartoluci, quoted in Omrčen, 2004:412). On the basis of such systematisation the possibilities for the development of sports tourism in Croatia will be presented as well.

The assessment of possibilities for the development of sports tourism in Croatia

When talking about ***competitive sports tourism*** we must say that its development depends primarily on the entire development of competitive sport, particularly of the high-performance sports in which Croatian athletes participate at international competitions. This form of sports tourism is mostly realized in bigger towns in Croatia: Zagreb, Split, Rijeka, Osijek, but also in smaller towns at the seaside and in the hinterland, for example, tennis tournaments are held in Umag, Bol, Makarska, international sailing regattas in Split, Dubrovnik, Rovinj, Mošćenička Draga, etc., international golf tournaments at Brijuni, tournaments in equestrian sport in Zagreb and Đakovo, etc. According to the data of the Ministry of Maritime Affairs, Tourism, Traffic and Development of the Republic of Croatia in the year 2002 as many as 91,555 people visited the sporting events in Croatia. Out of this number 32.27% were foreign visitors (Hrvatski turizam u brojkama/2003, 2004:39). Such sporting events should be constantly encouraged, not only because of the economic effects of tourism and other industries, but also because of the fact that they represent the best way of promoting Croatia throughout the world. Various forms of ***winter sports tourism*** also have numerous opportunities of development. These forms of tourism can be successfully developed in the mountains, but also in spas, as well as at the seaside. In the mountain parts of Croatia there are natural and other resources (necessary infrastructure and facilities) for mountaineering, skiing and other winter sports (sleighing, cross country skiing etc.). This relates to Velebit, Gorski kotar and Medvednica. In these areas there are some accommodation facilities that should be improved by building better roads, and, particularly, by constructing sport, recreation and other accompanying facilities (ski runs, ski-lifts, etc.).

The outstanding results of Janica and Ivica Kostelić, who made Croatia famous in the whole world and who have created Croatia's special 'skiing image', largely contributed to the development of skiing-related tourism. Apart from the visitors from Croatia, it is also possible to attract the tourists from abroad to the winter sports resorts in Croatia. The organization of the race of the Skiing World Cup for Women held at Sljeme in January 2005 is an evidence of that. The skiing centre Sljeme is today able to organize big skiing competitions.

Apart from the sport-tourism-specific ones, certain possibilities of the development of sports tourism exist at the seaside and in spas. The basic prerequisites are the corresponding sports-recreational programmes, but also sports facilities and the sporting activities. For example, there are more than 1,000 tennis courts at the seaside in Croatia, and only several indoor tennis halls that offer the possibility for playing tennis and organizing tennis tournaments throughout the whole year. The building of indoor tennis halls and the accompanying facilities would enable a higher occupancy rate of the accommodation facilities in pre- and post-season. In spas, certain sport-specific programmes could be successfully combined with some health-specific programmes, for example, programmes for the recovery of athletes, of people who participate in sporting activities on a recreational basis, of people who are physically challenged, wellness, etc.

The biggest opportunities for the development of sports tourism lie in ***summer sports tourism***, primarily at the seaside, but also near the rivers, lakes and in the mountains. This is due to the fact that Croatia realizes the biggest tourist traffic in summer months. For example, in the year 2003 in July and August Croatia has realized 40% of tourist arrivals, and if we add June to this calculation, then we are talking about 65% of tourist arrivals to Croatia (the calculation of authors according to the data of the Ministry of Maritime Affairs, Tourism, Traffic and Development of the Republic of Croatia). The only longitudinal research on various characteristics of tourists on coastal destinations in Croatia is the one conducted under title «Attitudes and expenditures of tourists in Croatia – TOMAS». Thus, during the summer 2004 this study was conducted for the sixth time. Although it is not primarily based on investigating the sport- and recreation-specific supply, it still offers some information on the motivation of tourists for visiting Croatia and on activities that they participate in during their stay in coastal destinations.

Table 1. Motives for visiting Croatia*

Rank	Motives	%
1	Passive rest, relaxing	66.7
2	Fun	42.5
3	New experiences	24.6
4	Visiting natural attractions	24.4
5	Gastronomy	19.4
6	**Sport and recreation**	**8.8**
7	Affordable prices	7.9
8	Proximity of this place	6.7
9	Visiting friends and relatives	6.0
10	Visiting cultural attractions	6.0
11	Health reasons	5.1
12	**Diving**	**3.0**
13	Other motives	2.1
14	Shopping	1.5
15	Business	1.3
16	Religious reasons	0.2

* Multiple responses
Source: Attitudes and expenditures of tourists in Croatia - TOMAS summer 2004.

Table 1 shows that the basic motive of tourists to visit Croatia is a passive rest and relaxation, whereas the motive of sport and recreation is in the sixth place and is listed by 8.8% of the subjects. Diving is in the 12th place and is listed only by 3% of the subjects. As for the activity of guests during their stay in a destination, those connected with sport and recreation will be presented in Table 2.

"Compared to the previous research, in the year 2001 a significant increase occurred in the number of people who participated in various activities – this increase was noticed in almost all activities. The number of people who participated in water skiing, in sailing and in horseback riding, and those who were engaged in the health-recreation programme doubled" (Institute for tourism, 2005:48). This is a positive trend, however, the existing sport- and recreation-specific supply should be directed towards the plans for future development of Croatian tourism. The existing sports and recreation centres, as well as the sports facilities at the seaside that were built for large-scale tourism should be oriented towards individual sports that will provide "more discreteness" to individual guests.

Table 2. Activities during stay in a certain destination, ***

Rank	Activities	%
1	Swimming and bathing	98.3
6	Hiking or walking	72.9
7	Individual excursions	71.0
11	Excursions to national parks	47.7
12	Boat rides	47.0
13	Biking	45.0
14	Organized excursions	44.8
17	Scuba diving	37.9
18	Tennis	36.3
19	Fishing	31.8
21	Water skiing	24.2
22	Health and recreation under the supervision of an instruction	23.6
23	Windsurfing	22.9
24	Sailing	21.6
25	Horseback riding	18.1
26	Mountaineering	17.1
27	Adventure sports (rafting, hand gliding, etc.)	13.9

* Multiple responses ¨the percentage of subjects in the sample that take part of certain activity sometimes or often
Source: Attitudes and expenditures of tourists in Croatia - TOMAS summer 2004.

In tourist destinations such as Poreč, that will also in the future develop large-scale tourism, the existing sports facilities should be restored and supplemented, maybe even at the cost of an excess concentration of certain sports facilities (e.g. tennis courts). The maritime activities taking place on or under the water should be paid more attention to. However, in those tourist destinations that will develop elite tourism for 'richer guests' such sports facilities should be built that are complementary with these forms of tourism supply. The preferences of tourists as regards the selection of sport(s) should be analysed, particularly, when the sports in question are the 'expensive sports' such as golf, horseback riding, some water sports, etc. The past experience in Croatia, as well as in other developed tourist receiving countries, has shown that the investment in sports tourism contributes to the improvement of the quality of tourism in general. Additionally, the research showed that such investments are profitable particularly as regards some sports and sport-specific programmes (for a more detailed survey see Relac & Bartoluci, 1987; Bartoluci, 2004). The economic basis of physical recreation programmes may be a new challenge for entrepreneurs in the development of sports tourism in Croatia.

Conclusion

Sports tourism belongs to the area of the special forms of tourism that are based on meeting the primary motives for travelling and for the selection of a certain destination. As for sports tourism, the primary motive for travelling and for the selection of a certain destination is connected with sport in various ways. As regards the motives for travelling, the time and the place in/on which the activities are held, we have categorized various forms of sports tourism in Croatia as competitive sports tourism, winter sports tourism and summer sports tourism.

The analysis of various tourist resources such as climate, culture, hotels, hospitality, sport, recreation, personnel, etc. shows that Croatia has outstanding comparative advantages for the development of various forms of sports tourism. The trends of contemporary tourism demand, particularly from the West-European countries from which the tourist travel to Croatia, are also a big contribution to this development. However, for the future of sports tourism in Croatia it is necessary to restore the obsolete tourism sport-specific supply with new facilities and contents in accordance with the contemporary requirements of the tourism demand. The past experience in Croatia and in some other tourist receiving countries shows that the investments in this form of tourism are profitable.

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WHAT IS THE EXPECTATION FOR SLOVENIAN SPORT IN THE EUROPEAN UNION?

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Abstract

In the last 15 years conditions in the countries of former Yugoslavia and sport in general have significantly changed. After the fall of the Berlin Wall the processes of transition commenced in all East European countries: from a one-party system we changed to a multi-party one, introducing parliamentary democracy and moving from a planned economy to a market economy. The socialist model of sport based on self-management interest groups and finance from a proportion of the gross salaries of all employees no longer exist. National federations in each sport in each of the newly formed countries replaced Yugoslav federations which were responsible for international sports politics and became internationally recognised sports bodies; in all countries in transition newly created National Olympic Committees became responsible for sport. Essentially, the relationship between state (governmental) sports bodies and non-governmental sports organisations significantly changed, as did economic and international relations.

Key words: *the state and sport, legislation, the economics and organisation of sport, sports association*

Introduction

In this brief article we have analysed the situation and relations in sport in Slovenia and its possibilities for development (dilemmas and prospects) after joining the European Union, and that is that part of sport belonging to the sphere of "civil society". These are sports associations, their unions and federations established on the basis of the Associations Act (Official Gazette of the Republic of Slovenia, No. 60/95). Indisputably their primary activities are sports activities (Šugman, 1998a:38-39). It is also true that other organisations undertake sports activities, such as schools, police, the army, tourist organisations, health spas, etc., but their primary activity is not sport but education, arresting criminals, defence of the homeland, tourist offer and healthcare services, etc.

With respect to organisation into associations, Slovenia is one of the most highly developed countries in Europe. According to data from the Agency of the Republic of Slovenia for Public Records and Services there were 19,418 various associations (covering culture, drama, singing, tourist, dog handling and breeding, dance, philately, hunting, fishing, mountaineering, politics, sports, etc.) registered on March 11, 2005 out of which 6,856 were sports associations (AJPES, 2005). It should also be remembered that 300,000 to 350,000 people in Slovenia belong to sports associations and over 700,000 adult Slovenians actively engage in sport, both within and outside the sport organised by associations (Petrović et al., 2001:12-13).

Sport in Slovenia has become an important value and agency for quality living.

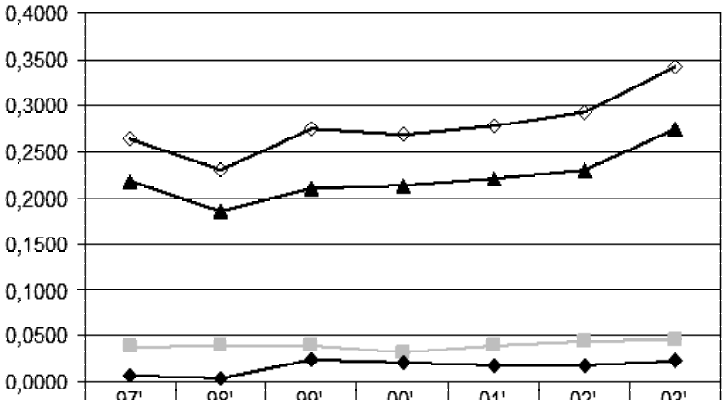
Discussion

We shall first take a look at the money allocated for sport from various sources since after 1991 the financing of sport in Slovenia underwent significant change (Bednarik et al., 2000:8-14). Sport obtains money from three state sources: (1) the budget, (2) the Fund for financing sports organisations of Slovenia and (3) funding from local governments. In addition to these sources of finance for sporting activities there are also (4) sponsors, (5) donators, (6) households (spending on sports services and products such as event tickets and membership fees) and (7) other self-created funding. The essential question is what proportion of the gross domestic product (GDP) from state and other sources is spent on sport compared to that in other countries and can we expect this to rise significantly in the future.

Let us look first at the state funding for sport in the GDP from 1997 to 2003. (graph 1.).

The graph shows in percentage GDP how the proportions of budget funding and funding from the fund for sport are rising. The largest growth in funding in Slovenia has been that from local government, which has contributed to the growth of budgetary spending on sport with respect to GDP. Public spending on sport in Slovenia is largely made through local government. This characteristic is also present in other EU countries.

What can we expect from these three sources in future years? According to the National Programme for Sport, Slovenian sport can get 11% more state funding. Significant increase is not expected however. Sport should get more funding from EU structural funds, tax friendly legislation for athletes and sponsors at home, acquiring foreign sponsors



	97'	98'	99'	00'	01'	02'	03'
total MESS, FSO, municipalities	0,2629	0,2298	0,2737	0,2677	0,2775	0,2934	0,3421
municipalities	0,2172	0,1847	0,2093	0,2129	0,2204	0,2303	0,2739
MESS - Sports Department	0,0376	0,0398	0,0397	0,0328	0,0392	0,0443	0,0454
Foundation for Sport (FSO)	0,0080	0,0053	0,0247	0,0219	0,0179	0,0188	0,0229

Source: Ministry of education, science and sport in Slovenia

Graph 1. State funding for sport in GDP from 1997 to 2003.

(at home the maximum number has already been acquired), reorganising competition systems to reduce travelling costs, reductions in bureaucracy and administration and participation of activities where sport can play an important part such as healthcare and tourism.

The allocation of money for sport in the future should be done to achieve optimum effects for the public good. In the West public finance is not used to subsidise commercial companies and therefore it is not used to finance professional sports clubs. Western countries (at state and local government levels) use public finance to promote all forms of sport, especially those attracting young people *en masse*, and selective activities. It has also been found in Slovenia that all segments of sport have a mutual high correlation. The positive development of one segment has a positive effect on the development of another. There will therefore have to be more subsidies from the state to organised sport, which is a trend and concept in Germany and Sweden. In these two countries sport is seen as a part of civil society and because it is subsidised it enjoys great autonomy.

Data from certain studies indicate that the proportion of all funding for sport (public and private) in Slovenia is comparable to that in most developed European countries. According to an international study (Andreff, 1996:23-35) Slovenian sport in 1994 took 2.33% GDP from all sources, which was equivalent to the average in the EU of that time. The latest study of sport from the Sports Institute in Hungary (Kristaly, 2004:15-31) shows that in 2003 Finland used 0.9% GDP for sport, France 1.7%, Germany 1.5%, the Czech Republic only 0.062% and Hungary 0.071% GDP. Data show that countries of East and West Europe differ greatly with respect to public and private spending for sport, which is of course dependent on the total GDP in individual countries and it differs significantly between countries (also EU members) and there are also differences in methods used to collect data irrespective of the mutually agreed methodology. The methodology of collecting data on money in individual countries can be controversial irrespective of the agreed criteria. In Western Europe funds for investment and maintenance of facilities and equipment are shown under municipal expenditure since larger facilities are owned or managed by the municipalities. The same applies to sport in the military, police, schools and tourism, etc. The methodology used to collect data means the global monetary data for sport in individual countries differs so much.

The Hungarian study mentioned shows that Slovenia spends on sport from public and private sources 2.134% GDP, making it the largest spender out of the 22 countries in the study. Irrespective of the questionable use of the methodology of data collection, and the possibly disputable results of comparative international studies we can conclude that in Slovenia known public funding for sport will not increase more than that envisaged by the National Programme for Sport. With respect to the greater obligations of the state and fall in personal standards generally, a decrease in public spending on sport can be expected. Even now the 73.3 million Euro public funds allocated for sport in Slovenia in 2004 is a relatively small proportion of the total public expenditure. Significantly more important is what will happen with private sources, which represent approximately 80% of all revenues of sports organisations (Bednarik et al., 2000:8-14). We have to be aware that public finance produces greater accessibility to sport and raises the competitiveness of top sports thus increasing the possibilities for private spending on sport.

The next area receiving more and more attention is sports legislation at home and in Europe. It is praiseworthy that sport remains a part of the national identity and integrity in the EU Constitution. Special and comprehensive EU sports

law does not exist even though sport as an activity cannot be extracted from the principles of governing laws (Kocijančič-Parrish, 2004:1605). In spite of this, however, many European institutions adopt legal acts important for sport (declarations, consensus, etc.), which after ratification in our parliament become a part of our legal system.

After 1995 Slovenia passed several laws on sport and adopted many legal instruments to implement them. It is impossible to compare the number of state regulations for sport with that existing before 1991 (Šugman et al., 2002:97-107) since until that year there was only one law and that was an act governing financing (Act on TKS, 1973). Along with these new laws came many laws dealing with sport in an indirect way such as the Public Assembly and Public Events Act, 1990, the Gambling Act, 1995, the Ownership Transformation of the Slovenian Lottery Act, 1996, the National Programme for Sport in the Republic of Slovenia, 2000, etc. In comparison with the previous system, we have found that Slovenia has adopted much more legislation concerning sport.

It is necessary to emphasise that the sports actors are not against state intervention in this area even though legislation on associations should treat associations differently from other forms of "sports performers" for which acts on stockholding companies apply and especially strengthen legislation on associations, which is exceptionally wide and binding on everything from associations to organisation at an international level and leave arbitration to their own organisation. It would be worse if there were some general law attempting to comprehensively organise sport in the EU, thus taking away the national integrity and identity of sport in individual countries. "… many governments worldwide are attempting to place their jurisdiction over sport and subordinate it to the interests of the governing political structure (parties) as they recognise how its political power and economic weight have grown in the last 30 years to be worth billions of dollars" (Šugman, 2002:93). Sport has become too strongly political capital and important for dominating in party politics. Therefore (Ilešič, 1994:3) … considerable importance of relationships within sport itself and between it and society in general and the fact that sport has its own specific system of norms should not be forgotten."

One of the important questions and dilemmas facing sport in all countries regards the relations between the state and organised sport. The basic question is when and to what extent should the state intervene into the "free" area of human activity and with what means. There is much political theory concerning state intervention in the civil sphere (including sport) and many political scientists have been interested in this dilemma worldwide in the last 10 years (Dahl, 1984; Cerny, 1990; Parsons, 1999; etc.) and at home (Fink-Hafner, 1994; Kotar, 2002; Rizman, 2000; Lukšič, 2003; etc.).

The decisive moment comes for state intervention into the free sphere of voluntary associations when the state and the associations find that the association's regulation is insufficient to remove harmful consequences of their operations or to protect participants in sport (e.g. taking forbidden drugs – doping) or where state sports bodies and associations themselves see that the state can help in the development of sport generally (monetary investment, personnel questions, research work, publishing, building sports infrastructure, etc.). "State intervention is justifiable and necessary in all social areas in which civil society players are unable with their own rules to regulate their operations". (Kustec Lipicer, 2004: 5). Due to the importance of sport for an individual and the state the latter steps into the game with its own mass sources of finance when civil society alone cannot provide for optimum operation of the "sports system". This does not mean that state assistance in this case is merely symbolic. Just the opposite is true. It is proportional to the level of development of sport and the importance the state places on its role in society.

There always existed a great danger (always present in a latent form) that at least one part of European sport will fall into the model of the former real-socialist system of east European countries where the state had the dominant position in sport or the ideology of the one-party system (Šugman & Žvan, 1995:256-264). The comprehensive "taking over" of sport by state authorities could quickly lead to it coming under the governing political party. We must ensure that political parties do not "appropriate" sports organisations, as sport must be above party politics. This of course does not mean state authorities not having any role in sport.

For the sake of autonomy and faster development of organised sport, we must all together better comply with international sports documents (UN, UNESCO, CE, etc.) in which after 2000 important definitions applicable to organised sport appeared. Central to these is the "Declaration of Specific Qualities of Sport and its Social Function in Europe" in which the support of independent sports federations and rights was first emphasised along with suitable forms of organisation. In addition the content of sport has been newly defined with "sport being an integrating factor, promoting inclusion in social life, tolerance, acceptance of differences and compliance with rules. It has an important cultural and social function…in its widest sense sport falls into the category of civil society although it also preserves public interest and attracts great attention from the modern state…" (CE, Nice 2000).

Conclusions

Essential to the prospects of sport in each and every country of the European Union is the preservation and improvement of the national identity of sport at all levels. How can we achieve this?

With respect to the total sum of money spent on sport, funds from the state will be fewer and fewer. This is a serious problem in transitional countries where there has already been a reduction in the amount of money from the state without a corresponding increase from private capital and where subsidising between partners has been inadequate. There is also

the fact that GDP per head differs greatly in transitional countries. This has led to many open questions and dilemmas concerning the future of sport in certain East European countries, including Slovenia. It must not be forgotten that organised sport, particularly in team games, is today "on the market". Managers of practically all teams in football, basketball, handball, volleyball, ice hockey, etc. select their players from around the world. European trends lean towards the adopted principles of the EU on the free movement of labour of which players are a part. This principle is realised in sport every day. Foreigners, particularly from Eastern Europe, play in all the clubs. There are certain sports in which at the top level practically all the players are foreigners. As these sports clubs are professional and they are financed primarily or completely through sponsorships from commercial companies who see investment in sport as good advertising, their sporting events have become truly spectacular. If commercial companies continue to see an economic advantage in such investment with minimal or even no support from the state, they will continue to support such sport. In Slovenia this segment is similar to that in "developed Europe", whereas in other countries this is not the case. An "exodus of male and female athletes and managers" from certain former countries of Yugoslavia therefore continues where national sport once prevailed.

Support should be given to all endeavours strengthening national identity in sport. The EU is not the USA where male and female athletes represent their country, and not its states separately. Male and female athletes in Europe continue to represent their own countries, not a European entity such as the European Union. The worsening or loss of national identity would be harmful in the long run to national sport as there would be less investment in its own (young) players. Along with the strengthening of national identity in sport it is necessary to improve the training of professionals, permit their free movement and personal development and pay far greater attention to research work and sport for young people.

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SELECTED ASPECTS OF SUBSIDY POLICY IN THE NON-PROFIT SPORT SECTOR IN THE CZECH REPUBLIC

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Abstract

In the Czech Republic, in comparison to other western countries, there is a significant number of non-profit non-governmental organizations that are connected with sport related activities. In the non-profit sector of other countries charity organizations are dominant. The persisting structure of these organizations relates to the previous trends in the Czech Republic and has a characteristic interpretation in financing sport, subsidy policy and grants. Subsidy and grant policy is changing on the basis of current economic changes. The policy is more decentralized and tends towards public utility services and programmes.

Keywords: *subsidy and grant policy, public utility services, mutual beneficial services*

Introduction

The understanding of the principles of sport and physical education activities in the Czech Republic is related to understanding the principals in the non-profit sport sector. The non-profit sport sector has always played a significant role in sport and it still dominates both in the organizational and in financial way. These points are very complex. This conference paper focuses on the selected aspects of the current situation and describes the basic problems of financing, subsidy and grant policy of sport clubs in the Czech Republic. After fifteen years of the economic system transformation, some characteristics of the former system are still to be found in the concept of financial support in sport organizations.

Methods

The methods of secondary and content analysis are used in this paper. To evaluate the share of the non-profit sector and grants the common statistic methods were used. The methods of synthetic and causal synthesis were used to draw the conclusion about the grant and subsidy policy, while the method of theoretical reflection was used for normative conclusion of the study.

Results

Phases of the development of non-profit organizations in the Czech Republic since the year 1989

The non-profit sector has a deep tradition in the Czech Republic. Foundations and clubs have always played a significant part in the national, cultural and political emancipation. The tradition was interrupted in the time of totalitarian regimes - fascist and communist, where free civil initiative was not welcome. During socialism the autonomous non-profit sphere actually did not exist. Some of the organizations existed as a part of the so-called National front. The year 1989 brought radical changes into this sector. Thousands of non-profit organizations were found and the non-profit sector has undergone many changes since then.

In the last 15 years the following 4 phases of the development of non-profit organizations in the Czech Republic can be observed (Vajdova, 2004):

1990 – 1992 The hopes and idealism of that time was reflected in the first law amendments of the non-profit sector (the law of grouping and legal adjustment of foundations) and formation of the Endowment investment fund. The new council for foundations was created as a government consultative authority for the issues of non-profit organizations. The liberal policy has created good conditions for rapid non-profit sector development.

1993 – 1996 The state expressed sceptical attitude towards the non-profit sector. Visions of the non-profit sector were influenced by debate of two leading political personalities Václav Havel and Václav Klaus about the basis of the so-called citizen society. The national policy did not follow the spontaneous development of the non-profit sector, but the state financial assistance remained stable (2 to 3 thousand million CZK).

1997 – 2001 The relation between the state and the non-profit sector is more intense and becomes more specific. The new law on foundations leads to the consolidation of the endowment sphere. Preparation of new laws and specific rules

for grants for different ministries is in progress. The activity of the Government council for non-profit non-government organizations was resumed and the first financial means from the Endowment investment fund were allocated.

2002-2004 Two big changes happened in this period. The public administration reform created regions, which affected the situation in the non-profit sector, and the entry to the European Union brought us the challenge of opening new relations and to using the EU founds. This changed the situation of many non-profit organizations; some of them will be more significant than others.

Representation of sport in the non-profit organizations

Citizen-action public in sport and physical education represents the biggest share of the non-profit non-governmental sector of the Czech Republic. This share corresponds the overall share of subsidies from the public budgets for non-profit organizations (see Table 2).

One type of non-profit non-governmental organizations which are created on the basis of uniting the citizens and membership is the Citizen-action public. Almost one half of the adult Czech population are members of these organizations. Five years ago only one third of the people were registered members. The difference may be caused by the fact that in five years the public knowledge of non-profit non-government organizations rose and people realized that interest groups also belong to this area. The floods in 1997 and 2002 may have had a mobilizing influence. The enlargement of the educated and well-reserved middleclass that is a traditional support in the non-profit sector can have some influences as well. Many Czech citizens are members of sport organizations, namely because 16 % of the whole population is organized in clubs like citizen-action public.

Financing the non-government non-profit sport organizations

Financing physical education from the national budget and municipal budgets

Financing physical education and sport from the public means and national budget includes these areas:

- subsidies from the national budget
- subsidies from the local budgets (regional and municipal budgets).

The national budget makes approximately one third of total financial resources, two thirds are from the local budgets. The support of physical education focuses on the operational sphere, where a stable growth is shown, more than on the investment sphere which depends on the approved and realized big investment projects in the corresponding years (see Table 2).

Table 2 shows that the financial assistance from local budgets in non-profit sport organizations and physical education has rapidly risen since the year 2000. On the contrary, the assistance from the national budget decreases. According to local authorities, since the year 2000 the infrastructure of sport, recreation and physical education has been de-veloping as a possible potential for a more complex development of the corresponding area and better services for citizens and tourists (Hobza, 2005).

Table 1. Number of non-profit organization according to their activities.

Activities	Number of non-profit organizations	%	Cumulative
Other Organizations	48,201	56	56
Sport	19,703	23	79
Union Movements	8,606	10	89
Activities for the Society	3,988	5	94
Hunting	1,696	2	96
Renting	911	1	97
Art & Entertainment	593	0.7	97.7
Professional Organizations	585	0.7	98.4
Adult Training	382	0.4	98.8
Social Welfare	290	0.3	99.1
Health Care	156	0.2	99.3
Livestock Production	149	0.2	99.5

Source: Czech Statistical Office, Praha, 2004

Table 2. State and municipal financial support in sport (in Millions CZK)

Financial Suppot	1997	1998	1999	2 000	2001	2002	2003
State Budget	**1 089**	**915**	**1 079**	**1 308**	**1 865**	**2 069**	**1 394**
- Investment (in the Real Estate)	216	150	178	303	763	982	260
- Other Activities	873	765	901	1 005	1 102	1 087	1 134
Municipalities	**2 364**	**2 319**	**2 490**	**3 431**	**4 471**	**5 276**	**6 097**
- Investment (in the Real Estate)	1 066	9 74	939	1 636	2 538	2 890	3 453
- Other Activities	1 298	1 345	1 551	1 795	1 933	2 386	2 644
TOTAL FINANCIAL SUPPORT	**3 453**	**3 234**	**3 567**	**4 739**	**6 336**	**7 345**	**7 491**

Source: Czech Statistical Office, Praha, 2004

The sport sector in the Czech Republic is characterized by these figures:
(the figures are from the Ministry of Education, Youth and Sport - MŠMT)

- Organized members in the sport sector - approximately 2,438,000 members
- Rough estimate of non-organized citizens in sport sector - approximately 4,000,000 citizens
- Number of sport clubs and physical education associations - approximately 40,000
- Volume of means set for physical education and sport approximately – 59, 1 billion CZK.

The cooperation of the central administration and non-profit organizations

The state has two roles for the non-governmental non-profit sector. It creates the legal framework for the existence and activities of the non- profit organizations and it supports them with financial means. The latter can be characterized either as financial support for the development or as a purchase of services for citizens. In not clear or not reflecting defined aim of subsidies and projects for the non-profit organizations, which varies in every ministry between pragmatic purchase of services and support of the non-profit organizations, is many misunderstanding not only between the public service but also between the government and no-profit organizations (Vajdova, 2004). This problem also arises when communicating with other sections of public services. The difference between financial support in non-profit organizations and purchase of their services is not yet clarified.

The other important sphere of mutual contact between central state administration and non-profit organization (NNO) is also a joint venture with respect to problem-solving. It concerns issues that belong to the domain of a particular ministry and at the same time they belong to the domain of activities of a certain NNO. The cooperation is organized rather *ad hoc* with respect to the actual time-limited task; only exceptionally it concerns a regular, methodical, continuous activity. The basic institutional form of cooperation between NNO and the Government of the Czech Republic is via the Governmental Council for NNO. Presently it is the only authority of the state administration involved solely in issues concerning the non-profit sector generally.

Cooperation between the state administration and NNO

The fundamental part of state budget is aimed at *state duties.* It refers to the activities that state administration is bound to provide for citizens: especially education, culture, transport, defence and safety, justice, prison service, old-age pension scheme, sports and physical education and many other functions provided for citizens on a daily basis. For this purpose the state (region, municipality) establishes its budget organizations or organizational units that have no legal entity. Why should non-profit organizations participate in providing public services? The answer is easy: they offer their services precisely there where they are on demand, they know the actual demand and can conform themselves to any

Table No. 3: Donations from public budgets for NNO projects in the main sectors of state donation policy in the year 2003 (%).

The Main Spheres of Activities	State Budget	Regional Budget	Community Budget
Social Welfare Services	35.7	20.0	15.1
Sport	**34.1**	**31.8**	**54.3**
Culture & Culture Heritage	11.2	21.5	14.7
Health Promotion	7.8	3.6	6.1
Support of Problem Population	6.4	10.5	6.6
Protection of the Environment	2.0	5.7	1.7
Support of the Nations Minorities	1.7	1.8	0.8
Other	1.1	5.3	0.9
TOTAL	100.0	100.0	100.0

Source: Government Council For Non-Profit Organization in Czech Republic (RNNO), Brno, 2004

At the time being, donation and grant support in the Czech Republic has the following priorities (Skarabelova, 2005): sports and physical education, culture and preservation of cultural heritage, rendering social services, care for the endangered and the problem groups of citizens, care for people with disabilities, etc.

Discussion

Grants and donation policy

As a result of the previously mentioned facts, the unbalanced donation policy towards non-profit sector has a great impact on the whole sector represented by sport. Besides, regional authorities and municipalities do not coordinate grant policy (including the definition of the non-profit sector) with central donation policy, at least generally. Clear (though different) rules and time schedules are very important.

Presently, the entrusted ministry (MŠMT) is engaged in the following programmes with respect to the sector of sports and physical education, concerning sport centres managed by the state, the support of talented youth, support of sport for all and the support of NNO:

Programme I. – National teams of the Czech Republic;

Programme II. – Sport Youth Centres;

Programme III. – Sport talent;

Programme IV. – Sport classes;

Programme V. – National program of "Sport for all" development;

Programme VI. – Sports and school;

Programme VII. – Sport for people with disabilities;

Programme VIII. – Maintenance and operation of sport facilities.

Referring to the grant and donation policy on all levels, the topical issue seems to be as follows:

Definition of public benefit via an act based on the support of programmes and selected activities. The relevant department, responsible for sport, should clearly specify the public benefit (beneficial services) as an essential characteristic of the donation program including partnership with non-profit sector.

Furthermore, the Ministry should also specify, why it provides funds for NNO activities, and if it regards a purchase of services for citizens or financial support for NNO development. This determination would not affect the capacity to influence state policy on sport and physical education, which is an internal programme document of the government for the relevant term.

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ESSAY ON THE THEORETICAL APPROACH TO UNEQUAL DIVISION OF REVENUES FOR ATHLETES PARTICIPATING IN SPORT ENTERTAINMENT

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Abstract

This pertains to a theoretical approach which permits an explanation of the level and the differences in revenues for athletes who participate in sport entertainment. This argumentation comes as a complement to a microeconomic approach (Sobry, showing how high level athletes' salaries are established, according to the teams and the interior of the teams themselves). It leans on the Theory of Tournament supplemented by the notion of the star in the sense of S. Rosen and the theory called "winner-takes-all market" of Frank and Cook. It follows from this work that if this theory is interesting as the basis of a study, other factors must be considered in order to understand the level of athletes' salaries and that the mode of distribution risks bringing about certain negative economical, social and individual phenomena are not to be disregarded.

Key words: *sport entertainment, revenues, theory of tournaments*

Introduction

Sports news is generally comprised of a certain number of events that are seen regularly on the calendar plus several others that punctually edge in between and with much reinforcement of publicity (The Race, The Jules Vernes Challenge); which permits following the exploits of several athletes whose names recur frequently, a little bit like in a series. One attentive observer notices that the number of these recurring names at the top of the news is minor, they vary according to the regions of the world and they establish a sort of turn over with a more or less rapid replacement of the leaders to the benefit of the newcomers, marked by an overlapping of generations, which economists call the "generation overlap", which lessens the rupture effect for the public at large.

We therefore have a base composed of the ensemble of athletes who permit the progression of events on which the sport show functions, and several individualities in the spotlight (and sometimes, especially in the United States, outside the sports arena - consider the Tonia Harding-Nancy Kerrigan affair, more recently the couple Marion Jones and C.J. Hunter, the survey making David Beckham a figure more important than the Queen in the eyes of the English, etc.). It is among these several dozen athletes that we find the highest revenues, without the public at large being capable of knowing their level, not even approximately. But if the revenues of these few dozen athletes are very high, it is the whole of the salaries of athletes participating in the sport show that has greatly increased.

We will first look at the attained level of the best paid, observe the perceptible evolution in certain sports and then attempt to clear up the causes both empirically and theoretically. In conclusion we will question the consequences of this very unequal distribution.

Several givens concerning the revenues of athletes

Observation of the table showing the salaries of the top ten best paid athletes in the world during the previous years (Table 1) shows all at once a domination of North American athletes, an over repetition of boxers, recalling that the revenues in this sport originate from "pay per view", and we see that the record established by M. Tyson, 75 million dollars for three fights, lasting a total of less than ten minutes, was not beaten until 2003. Indeed, the revenues of the very first, meaning their salary, their bonuses (matches, victories and other) and their revenues from publicity tend to settle down while the revenues of those following continue to increase. At the summit of the hierarchy, the dispersion of revenues tends to diminish. Gender equally plays a part in this distribution: Martina Hingis, the first woman on the list of the best paid athletes in 2000, was in the twenty-first place with 12 million dollars. Serena Williams is the first woman to enter the top ten (8th place) in 2002. But she moved back to the twenty-third place in 2003.

Many explanations, more or less serious, have tried to justify these levels and differences. The theoretical approaches (Human Capital Theory, efficiency salary) have tried above all to justify the level attained by the highest salaries.

It is the Tournament Theory completed by the notion of stardom given to certain athletes which will be referred to here. Without approaching it directly, the hypothesis of the division of athletes' salaries will be retained (Sobry, 2001, 2003).

Table 1: Revenues of the ten best paid athletes in the world (in millions of dollars).

	1996				1998			2000		
Rank	Name	Discipline	Revenue	Salary	Public revenues	Name	Discipline	Revenue	Name	Discipline	Revenue
1	**M. Tyson**	**Boxe**	**75**	**75**	**0**	**M. Jordan**	**Basket**	**69**	**M. Schumacher**	**F1**	**49**
2	**M. Jordan**	**Basket**	**52.6**	**12.6**	**40**	**M. Schumacher**	**F1**	**38**	**T. Woods**	**Golf**	**47**
3	**M. Schumacher**	**F1**	**33**	**25**	**8**	**S. Fedorov**	**Ice-hockey**	**29.8**	**O. de la Hoya**	**Boxing**	**43.5**
4	**S. O'Neal**	**Basket**	**24.4**	**7.4**	**17**	**T. Woods**	**Golf**	**26.8**	**M. Jordan**	**Basketball**	**40**
5	**E. Smith**	**American football**	**16.5**	**13**	**3,5**	**D. Earnhardt**	**Car-racing**	**24.1**	**E. Holyfield**	**Boxing**	**35.5**
6	**E. Holyfield**	**Boxing**	**15.5**	**15**	**0,5**	**G. Hill**	**Basketball**	**21.6**	**M. Tyson**	**Boxing**	**33**
7	**A. Agassi**	**Tennis**	**15.2**	**2.2**	**13**	**O. de la Hoya**	**Boxing**	**18.5**	**S. O'Neal**	**Basketball**	**31**
8	**A. Palmer**	**Golf**	**15.1**	**0.1**	**15**	**P. Ewing**	**Basketball**	**18.3**	**L. Lenox**	**Boxing**	**29**
9	**D. Rodman**	**Basketball**	**12.9**	**3.9**	**9**	**A. Palmer**	**Golf**	**18.1**	**D. Earnhardt**	**Car-racing**	**26.5**
10	**P. Ewing**	**Basketball**	**12.9**	**11.9**	**1**	**G. Sheffield**	**Baseball**	**17.2**	**G. Hill**	**Basketball**	**23**

	2001			2002			2003		
Rank	Name	Discipline	Revenue	Name	Discipline	Revenue	Name	Discipline	Revenue
1	M. Schumacher	F1	59	T. Woods	Golf	69	T. Woods	Golf	78
2	T. Woods	Golf	53	M. Schumacher	F1	67	M. Schumacher	F1	75
3	M. Tyson	Boxing	48	M. Jordan	Basketball	30	M. Jordan	Basketball	35
4	M. Jordan	Basketball	37	S. O'Neal	Basketball	30	S. O'Neal	Basketball	30.5
5	D. Earnbardt	Car racing	34.5	A. Rodriguez	Baseball	25	O. De la Hoya	Boxing	30
6	S. O'Neal	Basketball	34	K. Garnett	Basketball	22	K. Garnett	Basketball	28
7	L. Lewis	Boxing	23	M. Ramirez	Baseball	21	A. Rodriguez	Baseball	26
8	O. de la Hoya	Boxing	23	S. Williams	Tennis	20	G. Hill	Basketball	25.5
9	G. Foreman	Boxing	21	C. Delgado	Baseball	18	A. Agassi	Tennis	24
10	K. Barnett	Basketball	20.1	J. Horvard	Baseball	18	J. Villeneuves	F1	23

Source: Forbes et forbes.com. Le Nouvel Economiste No. 1073 – 14/02/99.

Theoretical approach to the level and distribution of salaries for athletes participating in the sport show

-1- S. Rosen (1986) defines the phenomenon of stardom in the general sense of the term, meaning in the arts, cinema, music, etc. by the fact that few people dominate their field and earn large sums of money. Two elements are common to all sectors in which the phenomenon of stardom occurs.

- A narrow relationship between the considered person's revenues and the dimension of his market.
- A strong concentration of the demand and by consequence of the revenues of the person reputed the most talented in a field.

We can see therefore that a small difference of excellence between two people translates into a big difference in revenues, this difference strongly increasing near the summit of the hierarchy. This non-linear and even highly unequal distribution would find its origins in the imperfect substitutability of the agents. In the sport arena, the fine difference which separates opponents of similar levels, who meet each other in duels, always with uncertain ending but statistically dominated by one of them, allows the development of the *Winner-Takes-All-Market,* as say Frank and Cook (1995). The characteristic of these markets resides in the estimation of the amount which takes into consideration the relative performance whereas economic theories are usually interested in absolute performance. In other terms, in the traditional economic approach, the remuneration of the salaried is determined by the number of produced units during a given period, or the realization of an objective for example, not by his efficiency (his productivity) compared to that of his colleagues. The approach serving to highlight the relative performance is usually only taken into account for the distribution of bonuses, marginal gains in the form of gifts and perks (incentives). But in the case of the star, athlete or not, it is this measure which is used to decide his/her basic remuneration.

-2- If the notion of stardom is so important, why do some athletes go from the status of champion to that of star?

Star status was given to certain athletes well before the arrival of television and money which participated in the introduction of more and more sports stars. Nevertheless the globalisation of images gave a particular pattern to athletic exploits, propelling the champions in a field which at its origin is not their own. This is the transformation of the sports exploit as a media phenomenon, the creation of images from the event (slow play, magnification, multiple angles, etc.) the repetition of its diffusion, the surveys/investigations around an exploit, etc. which make of the athlete a star, which goes to say an image, a virtuality deformed in contrast to reality. Technology introduced by the

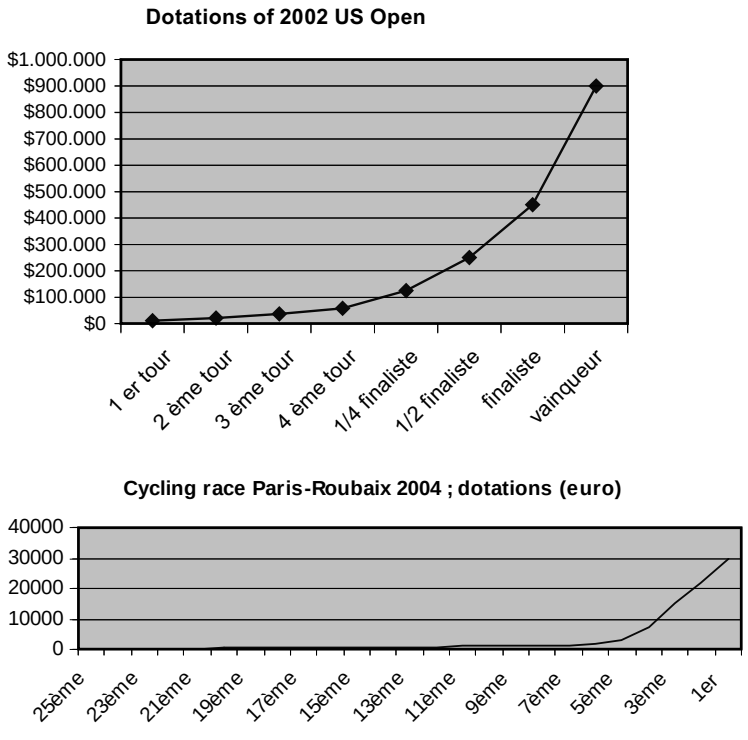
media permits what one can call a greater productivity of the star. The presence of cameras on the sporting event does not change the intensity of the effort of the athlete, but it multiplies the number of people witnessing the event.

The Superbowl 2004 was seen by 120 to 140 million Americans and was broadcast in 22 languages so that the 30 seconds of publicity could be sold for 22.6 million dollars. The Olympic Games in Sydney were viewed in 220 countries by an estimated 3.6 billion viewers. Those in Salt Lake City were seen by 3 billion viewers in 160 countries and those in Athens by 3.9 billion people. The last FIFA World Cup (2002) was viewed by more than 40 billion people. Technology permits economics of scale, the image of the champion being put out there/resonating with or without distortion according to the way in which it is presented.

Each athlete participating in the sport show brings at the same time his/her technique that one can liken to the notion of marginal efficiency and his/her charisma which plays on his/her partners as much as on the public. It is this combination that one can qualify as marginal excellence, varying from the notion of marginal productivity applied to the small segment of stars, and it is this marginal excellence which the important teams dispute. The brilliant technician presents only a limited interest if he/she does not add a personality to his/her performance. Certain sports, having lost their leader in terms of personality, have seen the notable regression of interest by the public and the media. This is undoubtedly what is happening now in men's tennis.

To summarize, imperfect substitutability, effect of resonance and marginal excellence are as much elements which, combined, give the champions or their agents a strong power of negotiation in the face of employers.

-3- If the qualities of a champion which give him/her star status give him/her a considerable power of negotiation of his/her revenues, the people in charge of the sport show are well-advised that all the participants give the best so that the show is attractive. Now we can talk about the "Tournaments Theory" (Lezear and Rosen, 1981) created to understand the distribution of salaries in companies. To illustrate, let us suppose a director who earns three times more than his four assistant directors. If he leaves, one of the four takes his place and can see his salary multiplied by three from one day to the next. The explanation for this difference lies in the motivation which must be developed for each salaried person by big salary gaps between two levels in the hierarchy. In this way, each person is supposed to be in competition with another person, like in a tournament, and therefore is supposed to give his/her best in order to be chosen to reach the superior scale with all its advantages, instead of being satisfied with the level reached at a certain moment. Using this theory, we can suppose that an athlete who is placed at a certain classification level or performance level "n" has a function putting in relation a marginal cost made of the effort that he/she needs to move from level "n" to level "n+1". It is this difference which allows to place the level of effort that he/she accepts to produce in order to reach a certain classification level or performance level. If, on the contrary, the concentration of gains is made on the highest classification levels, the motivation will be stronger, same as the accepted efforts. In road races, the application of this distribution mode translates into an improvement of times achieved by the winners and density of times achieved by the following runners. The more the distribution of gains is unequal, the better the performances, the more athletes disputing victory and places of honour, therefore the more interesting the race, spectacular, ready to be broadcast.



Graph 1: Non-linear distribution of gains in regard to ranking

The equipment distributors follow in the same sense giving bonuses to sponsored athletes according to their level in a tournament with the same principle of gaps in growth as they approach the summit.

Some close developments can be led to show that everything that has been said at the individual level can be applied and spread out to teams, to their composition. Inside the team, the division of revenues must incite each one to produce the best of his/her abilities, each player being considered to be in rivalry at the same time against those who are waiting on the bench and against those who are waiting and who have the potential to join the team, and between teams, the distribution of bonuses must also be sufficiently attractive so that each team invests enough, in money and in physical effort, in order to reach its best possible level.

Bonuses for performance: including equipment distributors

Examples of bonuses given by a major equipment distributor for singles tennis tournaments last year (in euros).

	Grand Slam	Master Cup	Masters Series
Winner	150 000	35 000	20 000
Finalist	70 000	15 000	10 000
Semi-finalist	30 000	7 500	6 000
Quarter-finals	12 000	3 500	3 500
Eights	5 000		2 000
Sixteenths	2500		1 000
Thirty-seconds	1500		
	Grand Slam	Master Cup	Masters Series
Winner	150 000	35 000	20 000
Finalist	70 000	15 000	10 000
Semi-finalist	30 000	7 500	6 000
Quarter-finals	12 000	3 500	3 500
Eights	5 000		2 000
Sixteenths	2500		1 000
Thirty-seconds	1500		

We can therefore distinguish several levels of pressure which act upon the rise in level of salaries for the best athletes participating in the sport show:

1) the imperfect substitutability of athletes,

2) audiovisual technology,

3) organizers' interests in the sporting event, and

4) even though not developed here, the media's interests in finding viewers and subscribers, linked with those of the announcers who use sports as a carrier of communication, without forgetting the agents who are remunerated by the percentage. Hence this establishes an inflation spiral that can only stop if the number of viewers remains stable or diminishes.

Conclusion

The pressure, either direct or indirect, placed upon athletes by organizers of the sport show, the media and their entourage also have a negative side. The application of the principle according to which the winner takes all has serious negative social and personal consequences in the sport show: disinterest of the public in the face of uninteresting competition even if the technical level is high, the lack of young athletes who move toward a milieu which only keeps a small minority, division between, research of individual interest relative to the collective interest, etc. These points can be approached with regard to the prism of the theory of games, the dilemma of the prisoner in particular. In order to reduce the risk and to respond to the challenge posed by competition and investments accepted by other athletes, equally to realize their dream, but also to respond to pressure from their entourage, some can be tempted to use the means not accepted in sport ethics. These are, therefore, other consequences, this time of the individual kind, to which the well-known champions, the stars, are subjected: injuries, diverse illnesses, sometimes lethal, diminution of life expectancy. Scandals and victories or records stained with doubts, only they know the price of their exploits, to take again the conclusion of the portrait of the sprinter M. Johnson at the moment of the announcement of his retirement from sport. In addition, as the investigation by P. Irlinger (1993) demonstrates, "once you've entered the competitive logic, and above all have taken on the image of the champion, the proportion of those who approve or tolerate practices unacceptable to sport ideology seems to increase." Looking into the mode of distribution of athletes' revenues is like opening the Pandora's box which leads us to ask questions and investigate the far removed influences of the spirit which drove P. de Coubertin.

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CITIES, SPORTS, TOURISM, AND NEGOTIATING FOR A WINNING DEAL

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Abstract

Across the past three decades dozens of cities have negotiated deals with sports teams that involved agreements to invest billions of tax dollars in ballparks, stadiums, and arenas. Many of these studies have questioned the magnitude of the anticipated benefits but the social significance of sports continues to attract cities' interests in sports teams, events, and facilities. Given this on-going importance of sports as a civic asset a key task for public administrators is to learn from past deals how they can protect or advance the public's interests.

With sports investments by cities continuing there is a need for state and local administrators to understand what can be included in deals to advance the interests of communities and the public sector at the same time that the interests of others are also satisfied. This paper, through an assessment of the sports investments made in Cleveland, provides a view of some elements that can permit a center city to benefit from its "sports deals" and the issues that still remain after a substantial investment of public dollars.

Key words: *economic development, public sector negotiations*

Introduction

While cities invest billions of tax dollars in ballparks, stadiums, and arenas, many studies have questioned the magnitude of the anticipated economic development and civic identity benefits (Holupka and Shlay, 1993; Noll and Zimbalist, 1997; Eckstein and Delaney, 2003). However, despite these cautionary notes, cities remain attracted to sports because of its social significance. The ancient empires of Egypt (chariot racing), Greece (Olympics), Rome (gladiatorial games and the professionalization of sports), and the Ottomans (chariot racing) each emphasized sports for celebration and urban design (Wilson, 1994). In the modern era, the British Empire and the American epoch have popularized soccer, rugby, cricket, tennis, baseball and basketball and made these staples of modern life and the hierarchy of cities (Sandy, Sloan, and Rosentraub, 2004). While the level of the economic benefits of teams and facilities for cities does vary, the time-tested social significance of sports has not been diminished (Rosentraub and Swindell, 2005).

A key task for public officials is to learn how they can protect or advance the public's interests. Replication of successful sports development partnerships can only come from a careful understanding of the issues and elements that were part of the deal or commitments. Baade (2003: 59) in assessing Los Angeles's deal to build the Staples Center concluded that "…the present value of net benefits over the twenty-five year life of the agreement accruing to the City of Los Angles from its investment in the Staples Center approximates $49 million." For public officials, the most critical question may well be: "What can I do to get a deal like this and avoid one that is less favorable?"

The need to understand the dimensions of deals that help a city is underscored by three explicit concerns. *First*, corporate groups play lead roles in all of these negotiations and as one would expect this group – similar to others – has incentives to protect and advance their interests. There have been examples when this group has captured the vast majority of the benefits from a sports facility or a team's presence. *Second*, sports facilities are usually advocated in terms of a strategy focused on downtown entertainment and tourism and this sector often produces too few benefits and jobs for city residents. *Third*, public policy bias towards entertainment or tourism projects obfuscates alternative strategies with potentially larger returns for cities from (1) neighborhood-focused urban development, (2) import substitution initiatives, (3) improved public education and labor force development, (4) the building of housing of interest to people attracted to an urban lifestyle and (5) "the development of alternative (unknown or untested) ideas about how city economies function and how best to promote local economic vitality" (Imbroscio, 2003: 274; Imbroscio, 1998; Jacobs, 1972; Florida, 2002). This paper, through an assessment of the sports investments made in Cleveland, provides a view of some elements that can permit a center city to benefit from its "sports deals," and the issues that still remain after a substantial investment of public dollars.

Sports and Cleveland: A Brief History

Cleveland built three facilities for professional teams in the 1990s and the numerous sports, commercial, entertainment and tourist projects were financed using a typical array of federal grants, countywide taxes, and municipal property tax abatements. The large amount of money spent on sports and the relatively small proportion of resources directed towards neighborhoods raises the issue of why Cleveland did not place more emphasis on improving communities. Two

sets of factors suggest why partnerships with capital to maintain a corporate presence in the city were of paramount importance. *First*, the city lost a substantial proportion of its population from 1950 through 1990, and those who moved to adjacent suburbs were largely middle class. Median family income as a percentage of US family income in Cleveland declined by more than one-half from 1960 to 1980. In 2003 31.1 percent of Cleveland's population lived in poverty. The city's population shrank from 914, 808 in 1950 to 478,403. In 2003 the US Bureau of the Census estimated Cleveland's population had declined to 461,324.

Second, the city lost a number of corporate headquarters and by the 1990s the number of Fortune 1000 corporations in Cleveland had dropped to 14. In the 1950s Cleveland had as many corporate headquarters as most other cities. *Third*, the higher income individuals who might well be attracted to sports events were leaving the city and had fewer reasons to come downtown and bring with them the economic activity of their spending which could hopefully produce local taxes.

Sports Deals and Redevelopment Focus: Some Outcomes for Cleveland

A goal for Cleveland's redevelopment strategy was to reverse disinvestment patterns that had defined the city for decades as a result of the loss of residents, businesses, and higher income individuals. As in other communities where decentralizing pressures reduce the economic prominence or stability of the center city and county in a region's economy, responses to Cleveland's loss of population and wealth was focused on deflecting economic activity back to downtown. The pressure to succeed was acute, as Cleveland's finances became dependent on an earnings' tax paid by workers based on the location of their job.

To analyze private sector investment in Cleveland an analysis of construction data collected by the FW Dodge Corporation was performed. This firm tabulates construction costs for all non-residential projects. Data for Cleveland and Cuyahoga County were available for the years 1995 through 2003. This information was analyzed at the zip code level so that figures for downtown and other Cleveland neighborhoods could be tabulated. To compare outcomes from earlier years, information was collected from Cuyahoga County government offices and Cleveland.

Between the years 1995 and 2003, there was a total of $3.6 billion in construction activity in non-residential projects throughout the entire city of Cleveland and $632.3 million in construction activity in the downtown area. The year-by-year total for the downtown area and Cleveland, as well as the value of the projects in current dollars (2004), are contained in Table 1. Construction figures for 1980 through 1989 are also tabulated, and the current value (2004) value of this figure for Cleveland is contained in the table.

Comparisons across time periods are always difficult in that national and regional economic conditions vary and contribute to any observed differences. Further, there are a myriad of tangible and intangible factors that influence investor confidence. In the absence of any binding agreements that firms would make specific investments if a particular public/private partnership was created, it is not possible to attribute any observed outcomes to the building of a particular asset.

With these caveats in mind, from 1980 to 1989 Cuyahoga County reported that private construction projects in the city of Cleveland had a cost of slightly more than $1 billion. When these figures are converted to 2004 dollars, the value of the construction projects is $1.85 billion. For the period 1995 through 2003, the present value of the non-residential construction projects was $4.1 billion or more than twice the figure for the 1980s. In downtown Cleveland alone, an area marked by the loss of many businesses in the 1980s, $717 million (in 2004 dollars) was spent for new construction (see Table 1).

Table 1. Construction costs for all non-residential projects in Cleveland and downtown Cleveland

Year	Yearly Construction Costs		Construction Costs - 2004 Dollars	
	Downtown	*Cleveland*	*Downtown*	*Cleveland*
1995	$ 38,923,393	$ 118,108,363	$ 47,961,493	$ 145,533,392
1996	82,521,064	149,483,906	98,982,520	179,303,234
1997	46,646,432	156,259,076	54,298,675	181,893,029
1998	90,953,454	2,359,125,487	104,236,260	2,703,651,239
1999	184,384,537	306,025,561	207,839,417	344,953,949
2000	64,695,993	120,163,442	72,925,733	135,448,992
2001	60,159,490	169,771,013	63,629,569	179,563,630
2002	55,949,990	120,443,538	58,508,968	125,952,249
2003	8,051,997	115,529,928	8,207,099	117,755,326
Total	632,286,350	3,616,060,311	716,589,734	4,114,055,040
1980-89	Not Available	1,006,959,500	Not Available	1,842,735,885

Sources: Data from 1995 through 2003 from the FW Dodge Corporation; data from 1980-1989 from Cuyahoga County public records and reports collected and maintained by Greater Cleveland Tomorrow.

From 1980 to 1989, Cuyahoga County reported that $54.8 million was invested in residential properties in Cleveland; the value of these expenditures in 2004 dollars is $100.3 million. From 1990 through 2002, almost four times as much was invested in residential real estate in Cleveland (see Table 2). The value of construction in the City of Cleveland can be added to these data in the years from 1990 to 1994 as reported by City (see Table 3). This construction activity took place during the expansion of the US economy and some might be tempted to argue that the outcomes would have taken place with or without an emphasis on enhancing economic vitality in downtown Cleveland. However the city's loss of residents compounded by a population decline in the county (Bier, 2004) suggest that without an emphasis on downtown a lager proportion of this construction activity might have taken place in suburban counties.

Table 2. Construction costs for residential projects in Cleveland

Years	Annual Construction Cost	Construction Cost – 2004 Dollars
1980-89	$ 54,827,800	$ 100,334,874
1990	10,880,991	15,817,579
1991	7,574,744	10,422,307
1992	6,968,739	9,345,478
1993	14,592,407	18,951,710
1994	26,992,227	34,192,616
1995	24,257,806	29,890,523
1996	32,109,205	38,514,409
1997	30,389,211	35,374,493
1998	35,767,450	40,990,914
1999	40,869,604	46,068,476
2000	33,711,063	37,999,324
2001	35,278,693	37,313,615
2002	39,325,609	41,124,239
Total	338,717,749	396,005,683

Sources: Data from 1980-1989 from Cuyahoga County public records and reports collected and maintained by Greater Cleveland Tomorrow; data from 1990 through 2002 from the Maxine Goodman Levin College of Urban Affairs, Cleveland State University.

Job, Earnings' Tax Revenues, and Public/Private Partnerships. In terms of the number of private sector jobs, in downtown Cleveland in 1992, there were 149,523. In 2000 there were 161,704 for a net increase of 12,181. More importantly, relative to the finances of Cleveland, in 1993 downtown workers earned $5.9 billion in salaries. This figure increased by 20 percent (in constant dollars) to $7.1 billion in 2002. The increase of $1.2 billion in salaries meant that in 2002 Cleveland received $23.9 million dollars more in tax revenue than it did in 1993. The $23.9 million annual increment figure for 2002 represents 2 percent (the earnings tax rate) multiplied by the increase in gross payroll. Capitalized across 30 years at a discount rate of 4 percent, this would amount to a revenue stream with a value of $413.3 million for Cleveland. While it is likely that other enhancements to downtown would be needed across 30 years to insure that this cash flow was maintained, this outcome, taking place when both the city and county continued to lose population is obviously important.

Other Revenues: Admissions and parking taxes. Cleveland collects an amusement tax on the sale of all tickets to events in the city held by for-profit firms. Cleveland's receipts from the amusement tax grew from $2.4 million in 1992 to almost $14 million in 2000. Capitalized for 30 years with a 4 percent discount rate, and assuming $12 million in annual revenues, this income stream would produce 207.5 million for Cleveland. Cleveland's parking tax is equal to eight percent of the fee charged for parking a vehicle. After generating in excess of $2 million in revenue during 1995 (when the ordinance was in effect for only part of the year), revenue increased to approximately $10 million in 1996. Capitalized for 30 years assuming $10 million in annual revenues would net $172.9 million for the City of Cleveland.

Alternative Development Strategies

These outcomes cannot be looked at in isolation from what actually took place within Cleveland's neighborhoods as each set of efforts – neighborhood and sports downtown – contributed to the outcomes. The same group that focused on downtown did not ignore neighborhoods although some have argued residential areas received far less attention. The institutions that oversaw both development strategies were comprised of the leadership of every major business, the largest foundations, the region's dominant newspaper, the county commissioners, and the mayor. Numerous studies described the governing, corporate, and philanthropic elites that joined together to advance this policy and practice, and little needs to be added to these works. It is sufficient to note that a powerful coalition representing all three sectors guided the development policies that lead to the building of the numerous structures in downtown Cleveland (Swanstrom, 1991).

Table 3. Public and private investments for development by location, 1990-1994.

Year	Downtown Investments		Neighborhood Investments	
	Public	*Private*	*Public*	*Private*
1990	$ 77,500	$ 361,000	$ 684,500	$ 14,901,697
1991	0	-	1,791,000	11,843,841
1992	250,000	1,761,000	4,182,680	151,907,006
1993	8,152,000	27,880,938	2,209,200	7,695,836
1994	3,840,951	16,337,931	1,373,340	46,121,900

Source: City of Cleveland

The elite groups emphasized sports and a downtown focus but created Neighborhood Partnership, Incorporated (NPI) to administer grants and other funds for both neighborhood development and to sustain Cleveland's extensive networks of community development corporations (CDCs). NPI remains an extremely effective organization and at the center of efforts to build new housing in Cleveland's neighborhoods. In 2003 and 2004 Cleveland led all cities in Cuyahoga County in terms of the number of permits filed for new home construction. This achievement is a direct result of the efforts of NPI and its creation by Cleveland Tomorrow.

Most notable in terms of the alternative development strategies was the building of a new housing initiative at a time when there was no new construction in Cleveland's neighborhoods. Lexington Village located near the site of the 1960s riots that inexorably altered Cleveland and its political, social, and economic landscape, was criticized and described as unworkable and destined for failure. Philanthropic and corporate support made this project possible and a success. It is notable that as a result of this project's success, the development of a cadre of neighborhood leaders for community development, and a set of abatement programs that Cleveland has built a housing program generating more permits for new single family homes than any other suburban community in Cuyahoga County.

Making Sports Work For Cities – Lessons From Cleveland And A Game Plan For Center Cities

There are several important lessons from Cleveland's successes and history that provide insight into a bargaining strategy involving sports facilities and teams to advance a central city. *First*, the financing unit for the sports facilities was the county and this shifted a large portion of the burden from Cleveland's homeowners to the wealthier suburban cities and business property across the county. This minimized the outlay from Cleveland's residents. Lesson one, then, is to insure that the area's wealthiest citizens and businesses support as much of the financial burden of the facilities as possible.

Second, Cleveland was able to secure for itself sole possession of the taxes produced by the sports and downtown redevelopment plan. *Third*, Cleveland was able to leverage a set of neighborhood initiatives funded by the private and nonprofit sectors by underscoring the need for greater social equity and concern for the plight of inner city neighborhoods. *Fourth*, and most importantly, there was an unwritten but still enacted linked development strategy whereby (1) new or sustained commitments for investment in downtown Cleveland were made and (2) leading businesses remained downtown protecting and expanding Cleveland's revenue from the earnings' tax. This strategy propelled earnings' tax revenues to the city and left the Cleveland Public Schools with a large commercial property tax base.

Would a complete or more concentrated focus on neighborhoods have produced similar or better results for the city? While the data here do not permit that question to be answered, it would be difficult to imagine a scenario for countywide financing to assist Cleveland's development without the inclusion of regional assets. In that regard, in terms of how one regime operated, Cleveland was able to enjoy enhanced tax revenue streams, distribute the burden for financing redevelopment across a county's tax base, and initiate a neighborhood strategy complete with support for an inner-city school district within a sports-inclusive approach to urban economic development. While that is the core of the policy debate that will continue to rage, Cleveland's experience does highlight how to protect some of the interests of a central city if sports is part of a region's development strategy.

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PHYSICAL RECREATION PROGRAMMES AS PRODUCTS

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Abstract

In this paper the example of the Recreational and sports centre (RSC) "Jarun" and its success to present itself as a MARKETING PRODUCT are presented. The importance and responsibility of professionals are accentuated. All essential characteristics of the PRODUCT are described.

Key words: *sport centres, recreation centres, recreation contents, brand, confidence of consumers*

Introduction

Physical recreation in its whole is a very complex activity in which every man, woman and child can take part. Because of the utility and applicability of recreation, people can participate in it throughout the year, on the continent and in the water, outdoors and indoors.

Physical recreation is supposed to meet the needs of its participants/consumers by offering an increasing number of various programmes and exercise contents which are popular nowadays in the world and in Croatia.

The trends in physical recreation have changed. A couple of decades ago it was popular to exercise indoors (gyms, fitness training gyms, swimming pools), whereas nowadays contemporary physical exercise programmes are returning to the natural environment and they consist predominantly of the natural forms of movement (Andrijašević, 2004).

It is important to accentuate here that physical recreation, as we understand it in Croatia, is an organised activity which is realised through various programmes. People pursue physical activities for enjoyment and to refresh their bodies and minds.

For a physical recreation programme to be acceptable and pursued by all age and social groups, it must be recognised, that is, it must become a PRODUCT which will be joyfully bought by consumers/participants and from which they may get valuable feedback (Bartoluci, 2002; Bartoluci & Omrčen, 2003).

For a PRODUCT to be recognised and accepted, it must have the following characteristics:

- image
- attractiveness
- durability
- quality
- brand
- result
- professional expertise
- high selling rate

The Recreational and sports centre "Jarun" as a PRODUCT

The Recreational and sports centre "Jarun" had all the characteristics of a sport centre with the defined status of rowers, kayakers and sailors, but the physical recreation contents for a wide population were not designed in an appropriate way, they were not interconnected; therefore, the participation rate of citizens was not high. The then sport manager failed to use the contents and transform them into a recognisable brand name as the PRODUCT of not only the Centre, but of Zagreb as well.

Several crucial business moves, like the construction of trim tracks, introduction of new recreation contents, openess throughout a year, on the one hand, and professional experts, that is, the staff consisting of kinesiologists, economists and technical support and maintenance workers, on the other hand, elaborated the PRODUCT which is accomplishing the expected results, as can be seen in Figure 1 and Table 1.

Table 1. Estimated number of visitors to the RSC "Jarun" across the last four years.

	2001	2002	2003	2004
Estimated number of visitors	986,000	1,615,000	2,480.000	3,450,000

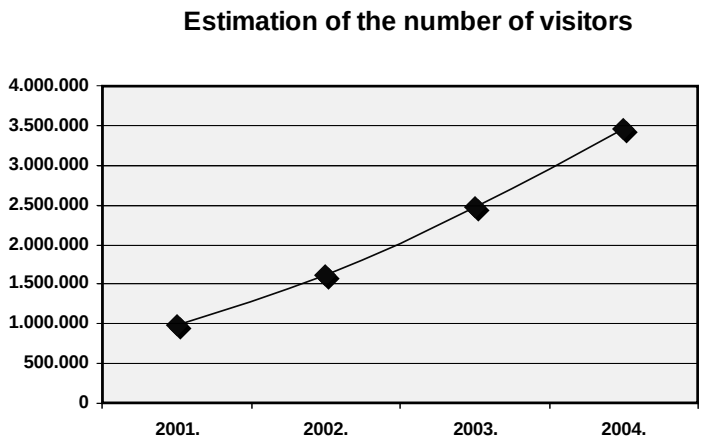
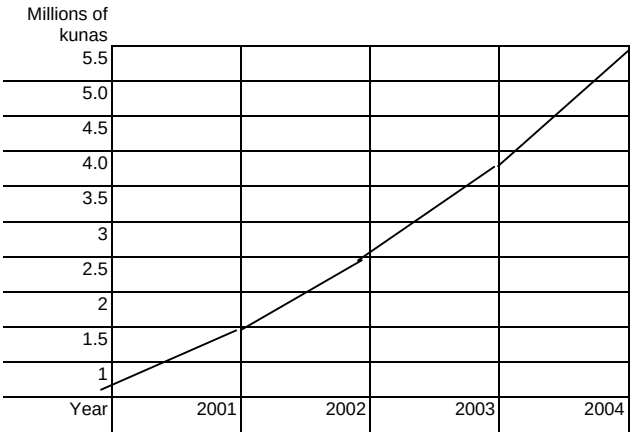


Figure 1. Estimated number of visitors to the RSC «Jarun» across the last four years.

Table 2. Rate of income from the PRODUCT.



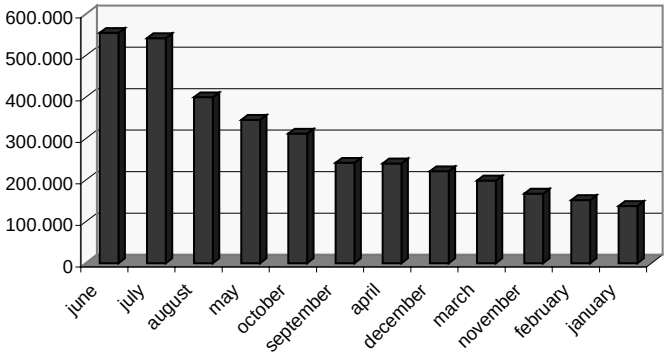


Figure 2. The number of motor vehicles registered at the entrances to the RSC "Jarun".

The data from Table 1 and Table 2 are correlated – the increase in the number of visitors produced the increase in the rate of income made on the basis of consuming the PRODUCT, which is constantly growing, as can be seen in Table 2.

All the promoting characteristics of the PRODUCT should be continuously maintained so that the PRODUCT should be consumed and accepted well and never become boring. That maintenance of the PRODUCT is the chief responsibility of the profession in general and the staff.

The profession designs the PRODUCT by planning and constructing the facilities, by designing various programmes of physical recreation, by naming them, by elaborating attractive contents and their application and by interviewing the consumers whether their needs and expectations have been met, that is, whether they are satisfied. The profession is the crucial factor in providing the PRODUCT with a recognisable name, colour, touch and taste.

The profile of a professional for such a job has not been defined in literature yet; no Croatian college or university has produced it yet, and it does not have a direct correlation with a qualification. Expert professionals should work in the described PRODUCT making, or in similar programmes, primarily kinesiologists, but there is also space for the persons from sectors of tourism, health-care, economics, industry, sociology, etc. An ideal person should not be only interdisciplinarily educated, but he/she must have some characteristics of a good animator, he/she should speak at least one foreign language, and he/she must have some qualities of a good group leader who is able not only to recognise, but to anticipate the needs of a group and/or individuals and to react adequately and promptly in difficult, even risky situations by «changing the rules» and by creating an atmosphere of safety. Briefly, he/she should be strong enough to take control over any situation due to his/her knowledge, skills, personal traits and general personality, thus inspiring confidence in the PRODUCT consumers, in its goal, purpose and quality.

The result says how a PRODUCT achieves the expected results which is a guarantee that it will be used across a certain "life-cycle span" and not only for a short time (it is not a one-shot PRODUCT).

The image of a PRODUCT is reflected as the quality of apparatuses and facilities, the way in which it can be used, the logic in the sequence of construction, perfection and tidiness, maintenance and leadership of the programme.

The attractiveness of the PRODUCT is realised through animation performed by programme leaders, promotion bill-boards and posters, number and types of events, results of consuming the PRODUCT, and the continuity of its appeal.

The durability of the PRODUCT is manifested as a whole-year usage and a usage over several years. During this time the participants satisfy their needs and wishes.

The quality of the PRODUCT is embodied in all the already mentioned characteristics - image, attractiveness and durability – the characteristics that, when combined, give quality to the PRODUCT. The quality can be measured by the consumption rate, that is, by a number of consumers and the level of their satisfaction.

The most important thing is that the PRODUCT has its BRAND which connects it with the similar products (centres) in Croatia and abroad. The brand of the RSC "Jarun" is unique in Zagreb, but also in Croatia and even in the world, as regards the number of events, their types and the number of consumers/participants. Due to the above-mentioned, the consumers/visitors of the brand RSC "Jarun" perceive it expectedly as a centre of excellency or quality supply in the market.

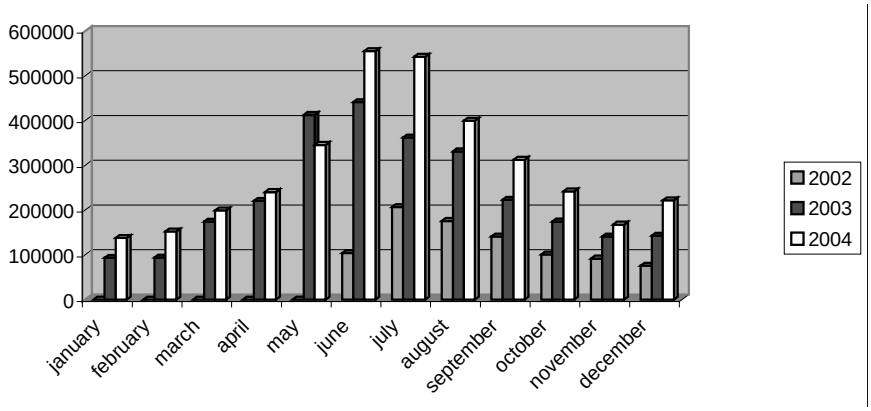


Figure 3. The comparison of traffic rates at the pay tolls in the period 2002-2004.

The **selling rate** of the PRODUCT is manifested as a number of participants who either buy a whole package of the PRODUCT or just any part of it. It often determines animation activities, professional expertise of programme leaders, image and attractiveness of the PRODUCT.

The selling rate of the PRODUCT depends on the supply of the product, animation, professional expertise of the programme leaders and on the control of the consumption of the PRODUCT.

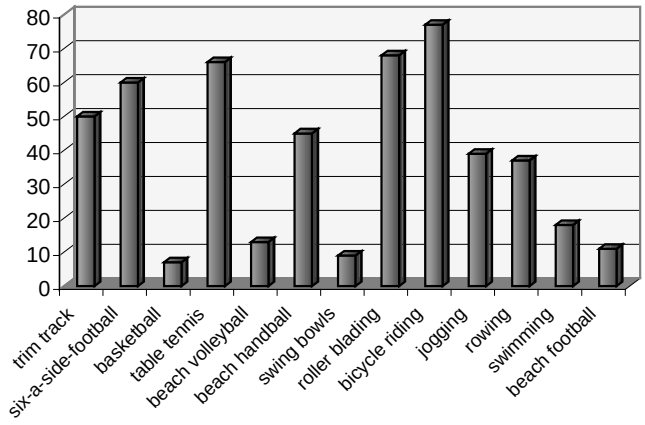


Figure 4. The use of physical recreation programmes in sport centre Jarun

The PRODUCT **selling results** are manifested as a number of buyers who are satisfied with the PRODUCT which has accomplished the final goal – the psycho-physical benefits for a consumer who, in turn, wishes to buy the PRODUCT again.

Conclusion

In the paper only one example from the practice has been presented of how it is possible to make a recognisable PRODUCT out of a variety of physical recreation programmes. Today it is the Recreational and sports centre "Jarun", tomorrow it can be Medvednica, Makarska, Plitvice Lakes, Umag or any other place which can become the "PRODUCT of Croatia". Croatia is considerably rich in resources for such worldly recognisable Croatian PPRODUCTS, but profession (expertise of the staff) should be improved to accomplish the ambitious, but attainable financial goals.

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ANALYSIS OF THE COMMERCIAL AND MARKETING ACTIVITIES OF NATIONAL ASSOCIATIONS WITHIN FIFA

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Abstract

In this research, the main focus is on Football National Associations (NAs) and how they conduct commercial and marketing activities which are crucial for their survival in today's competitive world. All NAs in the world were the samples for the survey, as FIFA currently has 205 members. The questionnaire composed of seventeen questions, of which all are closed, was used as a method for the collection of data. The results showed that football, although a sport leader by participation rates and through economic impacts, has just recently began a transformation process towards an organizational business approach. NAs, the cornerstones of football development, are rarely structured adequately enough to meet the new challenges of a professional sport environment.

Key words: *sport, business, development, strategy, market, football*

Introduction

The world of sports has experienced dramatic changes in the past few decades due to technical developments and economic impacts. Sport organizations today must face fast environmental changes. Therefore, there is a need to develop new strategies in order to find resources which will allow them to finance their activities and to guarantee their survival.

The development of the game is the main mission of National Associations (NAs). NAs need money to be able to pursue their main objective. This need has lead and continues to lead the NAs towards adopting business- and market-oriented approaches that have become a part of the everyday life of the associations. "Organizations that will flourish will have managers who adopt an entrepreneurial approach, relentlessly seeking out new resources as well as aggressively exploiting existing sources to ensure that their constituents, clients and/or fans receive the most effective service or experience possible" (Howard, Crompton, 1995). Despite this current transition there has not been much information regarding what the successes and the difficulties of this process are. Not much exploration or surveys have been made regarding what exactly NAs are doing within these areas, what the means used are, and how they are competing with other sports and industries over TV and over the sponsorships pile of money, which as a result of world recession has become more limited then it was before.

This research investigates the actual organization of the Marketing Departments of NAs, its strategy and relationship with partners/sponsors, the sources of revenues and Internet communication. The results of this analysis are the starting point for recommendations that can improve a marketing activity inside the NAs.

Methods

The collecting of information and data included the following methods:

- Research of the literature published on the topic of sport marketing, management, organization, and sponsorship: including books, papers, journals, news articles, and other materials
- Review of official FIFA and NAs documents
- Collected information based on conferences and seminars exploring the different aspects of sport business
- Search and review of websites of official governing bodies, clubs, and specialized sport press for relevant news and archived materials
- The survey:

The survey was the main research tool for this research. Its purpose was to get an insight into the current general situation of NAs commercial and marketing activities, to identify the problems, to find the NAs that are the best practices, to collect knowledge from them and to use their knowledge in the development of less successful NAs.

In the survey, as a method for the collection of data, the questionnaire was used especially devised for this research and dedicated to the current commercial and marketing activities of NAs. The questionnaire is composed of seventeen questions of which all are closed. This allowed managing the standardized answers with an easily comparable and measurable method, simple to codify and complete. The questions were divided into 6 subjects:

a) organization of marketing departments in NAs
b) commercial and marketing activities

c) marketing research
d) sponsorship
e) Internet communication
f) marketing strategies and objectives

All NAs in the world were the samples for the survey, as FIFA currently has 205 members. The survey was addressed to the General Secretaries of NAs. The General Secretary is the main operative of an NA and therefore, he/she is in the best position to perceive the political and the operative aspects of his/her organization.

The questionnaires received were processed in order to eliminate the unnecessary data; they were then codified and later analyzed. For the analysis of the data the descriptive methods have been used, mainly the frequency distribution and the standard deviation. Based on these methods, general conclusions regarding each question and section of questions were made. Where it was possible, a cross-comparison of Confederations was made in order to try to find the biggest discrepancies and regional specificities.

Results

Figure 1 shows the distribution of answers according to Football Confederations. Only 3 Confederations: CONMEBOL, CONCACAF and UEFA have returned enough answers from which general conclusions regarding specific region could be drawn.

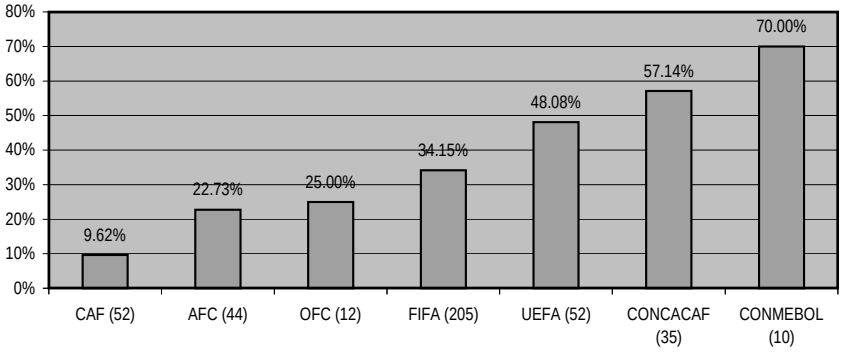

Figure 1. Distribution of answers on questionnaire per Confederation and total

The results showed a big discrepancy as regards the number of employees in NAs. Only 31.5% of NAs have marketing departments in their organization. On average 4.3 employees work on marketing activities in NAs. This means that on average 7.3% employees of NAs work in a marketing department. On average, the NAs employees who work in marketing activities consist of 5.6 employees with a university degree or higher and 1.9 do not have higher education.

Most NAs use similar methods of promotion: events, parties and dinners, and newsletters are the main forms of promotional tools. The most commonly used methods in advertising are: TV, radio, newspapers, billboards, other ads as well as e-mail. For publicity the NAs use: press conferences, press releases and external coverage on TV and radio. Other promotional methods are rarely used. There are 5 main sources of NAs revenues: TV rights, sponsorship, events, FIFA Financial Assistance Program (FAP) and the government. The revenue situation shows a lack of diversification and a large dependency of NAs upon TV and sponsorship money, and various donations. Distinctions among sources of revenues have to be made between small and other NAs. For the small NAs often the main source of revenue, in some cases even 100% of it, is FAP and government donations. 54% of the NAs are outsourcing fully or partially their marketing activities, including a good number of NAs that have marketing departments.

Looking at the frequency of market research, if we consider the sum of those that have declared "Never" and those who said "Seldom", the low attention and interest of NAs towards evaluating the effectiveness of their action and stakeholder's perception is clearly noted. The main focus of NAs marketing research is on the new promotional campaign and their brand and image perception.

On average, NAs have 6 to 7 sponsors and licensees and a slightly smaller number of official suppliers. The average duration of a contract stipulated between NAs and other parties is 3.3 years. Around 45% of sponsors and official suppliers offer in kind and image support and free or discounted services. In most of NAs licensing is used more as a promotional method than as a revenue generator.

Great opportunities to promote image and services through the Internet have been considered by almost all NAs. 82% of NAs in the survey stated that they had a web page. Nevertheless, we should take into consideration that this number is only representative of the quantity and not the quality of the various web pages. The links that are most visited on the NAs web pages are the news and information on national teams and leagues. It is positive to note that 58% of NAs that have a web page update it on a daily basis.

Among the objectives that can be favoured by the growth of the activity of marketing; the sport success, relationship with fans, TV exposure, sponsor/supplier relationship and public perception of NA image are the most relevant factors. The

main factor that facilitates all others is the success on the pitch. Without it, most of the NAs stated that the development of marketing strategies is very questionable. It is widely recognized that a sport institution has to use different communication channels in order to promote the sport and reach all involved stakeholders and in this way satisfy them. The analysis has shown that the most important communication tools are the national TV, the press and the radio. International TV and local communication are not perceived as significant communication tools. A strategy of marketing is perceived as beneficial for the promotion of NA events, increase of NA and athlete's image, and sponsorship. The overview of the opinions of the people in charge of marketing activities shows that the main marketing objective is fund raising. Nevertheless, most answers to this question stated that the main objective behind raising new funds is: "for the development of the game of football".

Discussion

The objective of this research was to provide data and information on what exactly the NAs do regarding the commercial and marketing activities. The analysis of the questionnaire results provided many pieces of information, which has enabled the author to reach the following conclusions:

- Marketing is not yet well developed inside NAs either as a function or as an organizational independent structure.
- There is a certain degree of confusion in identifying the exact role of marketing and sometimes these activities are distributed into different divisions and/or departments;
- The mission of marketing, inside NAs, is still limited to a closed number of objectives. This attitude demonstrates how low the degree of knowledge on its practical applications is.
- NAs rarely use a scientific approach (marketing research) in order to identify their stakeholder's needs, and generally speaking the NAs do not have a planned and structured way of satisfying these needs.
- In most of the cases, NAs do not have long-term marketing plans and strategies;
- The Internet is still not perceived as an important communication tool among NAs, although most of them do have web pages.

To maintain sustainability, NAs have to be innovative. They must seek to diversify revenue sources and adopt a marketing orientation similar to that of commercial entities. Many studies have made very strong arguments about the virtue of market orientation for football organizations, which leads to marketing effectiveness and inevitably improved organizational or corporate effectiveness. Organizations that adopt this approach tend to be generally well run, because an enormous amount of emphasis is placed on being resourceful and on operating profitably (Hudson, Herbane, 2000).

On the basis of the collected data from this research, identified success determinants, and the opinion of experts, it is possible to select the best practices in each football Confederation. The further step in research should be the analysis of these NAs and the identification of what their competitive advantages are. It would also be useful to look at what the closest competitors from other sports and industries are doing and in which direction they are going i.e. basketball, American professional sports and the entertainment industry. The collected information should be processed and used in order to identify the barriers restraining the development of the NAs commercial and marketing activities, and organizational skills needed for the improvement of these. Based on identified problems and organizational skills an easy understandable manual should be created. The manual should be designed to help the NAs of a different developmental, organizational and financial level. Based on these three criteria the NAs should be segmented and for each segment recommendations, guidelines and methods should be given.

Mr. Nelson Mandela once said: *"Sport has the power to unite people in a way that little else can. Sport can create hope where there was once despair. Sport speaks to people in a language they can understand".* Nevertheless, to be able to bring sport to everyone, sport organizations need resources. Sport organizations now have to fight for resources in the open market. Therefore, the transformation from not-for-profit, only development-focused organizations to organizations with a business-oriented approach is a necessary mean for the survival within the today's football reality.

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PLANNED MANAGEMENT OF A TOP-LEVEL SPORTS CLUB - CASE OF SLOVENIAN HANDBALL

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Abstract

The present behavior of Slovene top-level sports clubs and their organization with some rare exceptions, remains on a rather primitive level. This is seen in legislation relating to the adjustment of relations (between ownership, privatization issues, etc.) and the anarchistic working conditions in which some of them operate. Not all leading clubs make a profit in their success. On the other hand, the general social circumstances revolving around sport club management, not only show a formal, but also subjective bases of some managers. They primarily redefined their subjective and objective viewpoints relating to sports as elements of a society. The planned management of a club is determined by the influence of scholastic qualifications of clubs employees which has decreased to an all time low. This can be achieved if a club operates on the basis of long- and short-term visions of team development. This is visible in some Slovenian handball top-level sports clubs, above all in the case of RK Krim Mercator and RK Celje PL, both very successful teams in international competition.

Key words: *top-level sport, organization, management of sport*

Introduction

Much has been written about the business process change nowadays with regard to sports clubs (Sims, 2002, Dawson, 2004). The bottom line remains that any company that really succeeds at a business process change does so because people care and people organize to integrate the organization around processes that are aligned with the organization's strategies (Dawson, 2004). It is similar in top level sport management (Doupona Topič & Bon, 2004). The main goal of top-level sport is success. The success of a club could not be measured fairly against team results or competitive success, but assessed from the viewpoints that assure a systematic, long-term and complex solution. If so, legislation regarding top sports in Slovenia, has to be implemented as soon as possible. Official and private interests in top sports must be divided so that their influences will affect subjective consciousness of athletes in a positive way.

It seems that the present behavior and organization of Slovene clubs, with some rare exceptions, are at a rather low level presently. Some viewpoints regarding club organization must be made more objective. In many sports branches, we witness that the main financier (i.e., the club sponsor) wants immediate payback on his or her investment and this can cause the short-term operation of a club (Bon, 1999). Poor results in competition can lead the sponsor to abruptly leave a club. The sponsor invests funds in a club because of the promotional (advertising) benefits and therefore the sponsor cannot be its owner. Clubs belong to nobody; they are neither public nor private and are therefore subject to various machinations and manipulations. Such problems should be solved as soon as possible. However, the current draft law on sports does not deal with these problems in great detail. Instead, their contents are only briefly mentioned.

In the best Slovenian handball clubs, the situation is a bit different. This is shown also through excellent results achieved by these teams on an international level. Recent history, witnessed the women's handball team, the Krim Club, as a four time finalist in the 'League of Champions' and double titleholder of the European Champions. In 2004, the men's handball team of Celje Pivovarna Laško became European Champions while also being in the semi-finals of the League of Champions on four occasions. The club of Gorenje from Velenje was also successful in European competition. For several years now, the teams of Prevent from Slovenj Gradec, Termo from Škofja Loka and Trimo from Trebnje have been also quite successful at the top levels of handball competition. All of these clubs operate on the basis of many years of tradition and follow a very clear vision. Unfortunately, there are also many clubs which have appeared briefly to successful results, but declined rapidly. The most known case is that of RK Prule and RK Slovan (in men's handball) and RK Piran (in women's handball).

The goal of our work is to obtain useful information which will have to adapt to new conditions in Slovenian clubs as a legal organizational operation in Slovenian clubs becomes adapted into club environments which have been previously, pseudo-capitalistic, and help use this to create new and innovative relations within club organizations and thus be deemed an important part of consideration when implementing long-term planned management of top-level sports clubs.

Method

We use a descriptive method based on the information and facts gathered from the knowledge of the situation, information based on interviews as well as any discussions with individuals and groups who lead the most successful organizations in Slovene team sport, such as RK Krim Mercator, RK Celje Pivovarna Laško, KK Union Olimpija, etc.

The tested historical experience is to comply with the specific traits such as:

- topical social – economic moment
- geographical - demographical characteristics (quantity and thereby connected quality of play and professional staff),
- traditional and specific cultural values,
- social-physical characteristics of the nation.

Results

The planned management of a club is influenced by various scholastic (coincidental) factors relating to the sports club staff, which has now decreased to the lowest possible level. This could be achieved if a club followed an organizational plan with long- and short-term objectives and vision for future development. The plan is a consequence of the selection of priority needs of the team that depend on both subjective and objective bases. Therefore, new viewpoints should lean on the old ones to enable continuous planned management. Only in this way, can top success be achieved (Bon, 1999).

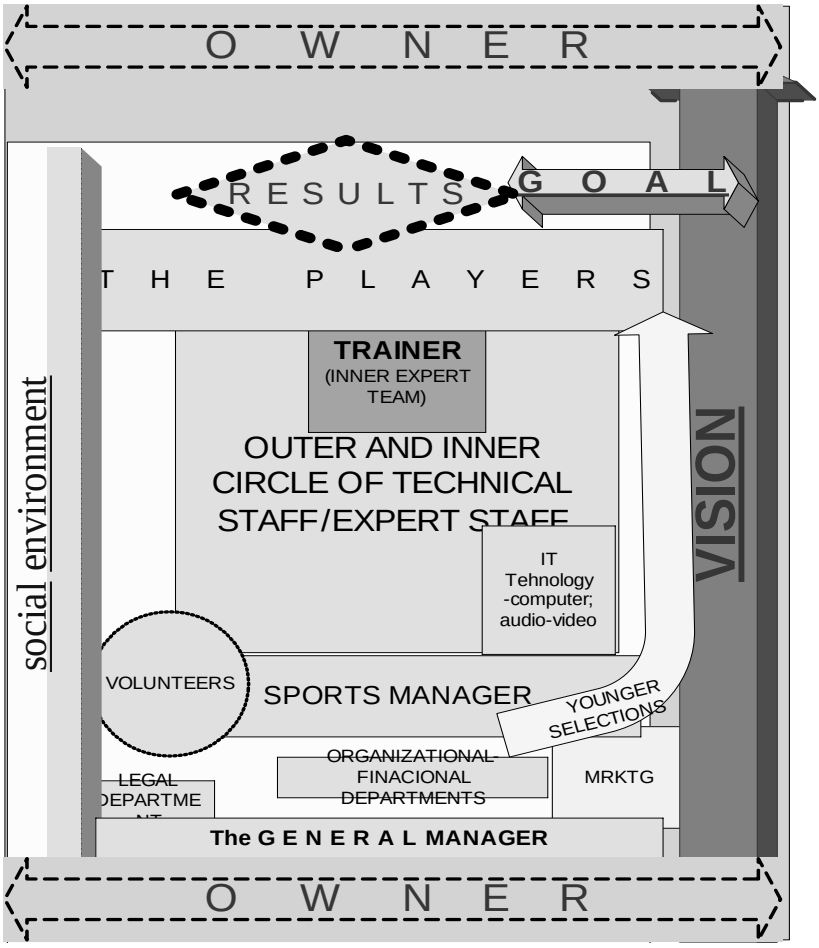

Figure I: A model of a top level sport club

Based on findings from research and models of the working and organization of some Slovenian top-level clubs, a model of working and organization (as in Figure I) is presented.

Due to the fact that stochastic influences intrinsically exist and in the model of sports organization, the model of operation could not be completely mastered and 100 % predict the success of the work. Our purpose is to decrease the stochastic variables and its influences, thereby limiting the so called »improvisation« to that value which will have a character of inventive and innovative co-operation.

Operations model of best clubs is very similar to this model. On the other hand, most of them are working on a quite different basis. General social circumstances show not only formal, but also the changing subjective bases of managers. People who manage top sports organizations should re-estimate their subjective and objective viewpoints as related

to sports as elements of society that can also be viewed from a marketability angle. Only »fresh« theory will provide possibilities for the application of better methods in club management as specific economic companies.

Conclusion

The major problem of organization and operation of top sports groups is that no real bases are set in our society. It is not clear who a club owner is. Organizations that are predominantly still in possession of the state, are basically not considered 'a club'. A club consists of people that ensure the existence of the club (including its players, coaches, other staff, ...). Legally, a club could not be privatized in the past and thereby, made professional in our society. As legal viewpoints change, relations in a club could change as well. A causal connection in opposite direction could be expected – changes in operation and organization of clubs will have to reflect this in new legal documents (Bon, 1999).

The best example from the handball area is RK Prule. After being a semi-finalist in The League of Champions in the 2002/03 season, it experienced a tremendous fall. Now it only vegetates in the Slovene leagues. A similar case is RK Piran in women's handball, a team which was also a part of numerous European competitions, but then sank into debt and only continues to function in younger age category. There are still other examples in Slovene sport as well as the previously mentioned handball teams of Krim with women and RK CeljePL in men's handball, which have both demonstrated a definite 'path' to top success. Both clubs are currently operating from rather different starting points.

Sport is a very 'busy area' in which it is difficult to forecast the working dynamics and how it can predict club success. Sports branches such as handball are by definition, 'complex'. Many factors are connected with it. Some of these factors are directly related to success; many of them are unforeseeable because there are many stochastic influences inside and outside of the model of a sports organization. The operating model cannot be controlled completely and predict a one hundred percent success rate. However, with the presented model, we can approximate these factors to some level of precision so that we minimize the stochastic influences and connection. With this, we can also limit the so called 'improvisation' on that value which will have the most innovative and inventive co-operation.

Generally, Slovenian handball shows a successive path to success in many areas. The re-evaluation of Slovenian handball federation (RZS) in the last ten years has triggered, for the first time that it could work in a goal-oriented fashion based on modern management principles. The model of the organization should also be an elementary part of the vision so that it appears that the final vision is not only in the head of individuals, but also 'on paper' (as a very "clear" and transparent version). This is a way to a working model of a sports club that operates in a systematic, long-term manner, on the basis of the acceptance of an organizational operation, produce success when measured against international standards, and can achieve this consistently.

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SPORTS BOWLING CENTER – A CASE STUDY

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Abstract

This article is designed to put forward the case for the use of case studies in the Sports management programme at the Faculty of Sports Studies at Masaryk University. This is an interactive method of study in which students are challenged to resolve real world dilemmas and scenarios, the basics of which are presented in the case study to analyse them and discuss them. The objective of this specific example is an analysis of the operational environment of the Sports Bowling Centre (SBC), an outline of the major opportunities and risks inherent in the situation and the probable reactions of the organisation to certain specified changes in the operational environment. In this case study, which incorporates a description of the SBC in the Olympia mall, the students were called upon to identify strengths and weaknesses in the project and suggest possible strategies on the basis of SWOT analysis.

Key words: *case study, operational environment, analysis, bowling centre, opportunities, risks*

Introduction

Changes in the operational environment place ever-increasing demands on students leaving secondary school, and need to be taken into account when we attempt to prepare them for the outside world. To ensure that their knowledge is not limited to the purely theoretical, this kind of interactive method of study is most advantageous, perhaps almost necessary. The use of case studies is a classic example of such a method. A case study is an accurate description of a real world scenario. Normally it includes a description of the specific company involved, the operational environment and certain real events which occurred and which will play a role in the development of the scenario and ideas. The description of character is vital, as this is the role which students will be asked to take on, that of the decision-maker. The approach is almost identical to that applied in business in real life. Students analyse available data, assess it, define the core issue, lay out possible solutions and endeavour to select the best. In dealing with such cases the students come into contact with the same problems they will encounter in real life, such as frequent gaps in the data available, incompatible and occasionally conflicting goals, and shortcomings in the resources which can be expended on the task in hand. It is generally the case that there is not a single "correct" solution to the scenario.

Case studies have been around for some 117 years, since they were first employed at Harvard Law School, and from that time their use has spread world-wide. *The Case Research Journal*, published by the North American Case Research Association, cites the existence of some 450 formalised case studies used in the teaching of eighteen subjects, among which there must, perforce, be a vast range of approaches and opinions as to the implementation and employment thereof. Classification is thus extremely difficult. From the perspective of the demands imposed upon students by the task, we can generally divide them into the three following categories:

- Type one - these contain a description of the situation, the problem and the solution (students are called upon to explain the solution)
- Type two - these contain a description of the situation and an outline of the problem (students must put forward suggestions for solutions)
- Type three - these contain only a description of the situation (students themselves need to deduce probable difficulties and potential solutions).

J. Almaney, in his article "International students´ attitude toward the case study Method" (1999), defined some of the difficulties attendant upon the use of case studies as a teaching tool. For his study he looked at a group of 29 students of a mixture of nationalities. These included students from Hong Kong and the USA, Japanese, Malaysian, Philippine, Polish, Russian, Taiwanese, Tanzanian, Thai and Turkish students. 75% of respondents were in favour of the use of case studies in teaching, with even more women (86%) than men seeing them as useful. The main reasons given were: a more interesting and engaging approach, more relevant to real life, sharper analysis, all leading to easier recollection, and the general discussional and disputational skills which it promotes, together with teamwork. Almaney further noted a distinction between US and other students, with 86% of the former but only 76% of the latter giving preference to case studies. This was ascribed to cultural differences, with Asian students in particular being accustomed to a traditional student - teacher relationship, a dynamic which is lacking in case studies since the "dominant" opinion or solution is not imposed.

Methods

This article is a report of a case study in use, and may serve to show the teaching of analytical skills referent to operational environment in the context of sports management. This subject is taught across four semesters of daily and combined studies. The starting data was culled from the Internet pages and interviews with employees of the Sports Bowling Centre (SBC). The outcome was the identification by students of opportunities and risks inherent in the scenario, which led to projected courses of possible action, in response to changes in the operational environment, by the organisation and derivation of initial data for a SWOT analysis (for a complete analysis it would be further necessary to evaluate internal strengths and weaknesses of the organisation involved).

The case study

2003 was drawing to a close and the upper management of Planet Bowling were discussing how to evaluate the success (or otherwise) of each of their bowling centres. The first had been opened in September 2000 in the Olympia mall in Brno, followed by two more across the next year in two other cities. The management were now wrestling with the issue of a slight drop in takings at all their Czech centres, a clear consequence of changes in the operational environment. They decided to commission an analysis, on the basis of which they would formulate their future policy for the centre. For such a strategy, clear-sighted analysis of both external and internal features is requisite. This report describes perceived opportunities and risks and outlines the organisation's best course of action in a number of foreseeable scenarios.

A brief history of bowling

Bowling is possessed of illustrious and far-reaching roots, and today is one of the world's favourite sports. The first "footprints" of the sport can be found in the sands of time somewhere around 3200 BC. Its growth as a popular pastime, however, can be traced back to England in 1366, when the gaze of the king, Edward III, turned away from archery and toward bowling, the rules undergoing near continuous, albeit slow, change ever since. Women began to take up bowling in the second half of the 20th century, just as an innovation, the automatic "ball retriever", breathed new life into the sport. The first of these was to be found in 1951 and its growth was almost exponential. These days the USA boasts some 8,000 bowling centres comprising some 140,000 lanes. About 100 million people world-wide, in over 90 countries, bowl. The international Museum of Bowling is in St. Louis, Missouri.

Here in the Czech Republic, bowling is a far more recent arrival, being almost unknown under communism, although skittles did have a place. Some time after 1990 bowling began to make headway, and became more structured and organised in 1997.

Today the Federation Internationale de Quiller (FIQ) comprises some 110 member states, and aims to promote the growth of the sport, organise international competitions, including the World Championship, and push for the sport to receive recognition as an Olympic event. The Czech Skittles and Bowling Federation, with its headquarters in Prague, encompass the ČBA - Czech Bowling Association (Česká bowlingová asociace). With the establishment of this latter, bowling became a recognised sport in its own right here. The ČBA holds members-only tournaments, and it was in this regard that certain problems first arose.

Here in the Czech Republic there were no centres which conformed to American standards for the game. This led to a sudden spate of building projects, as developers rushed to meet this perceived demand. In the planning stage it is, of course, vital to take into account the exact dimension and quality requirements of the lanes, as well as their number, in order that they may continue to conform to the standards needed to host national and international competitions.

Given the "youth" of bowling, and how many people have never even tried it, it is vital to create a good first impression, and design an environment where people can relax and have fun, as well as play seriously if they so choose. The basic rules need to be propagated and published, and here there is a definite snag in the form of the lack of qualified trainers (only two in the whole country) and the fact that the ČBA has no authority to issue training licenses. Until recently the dearth of quality bowling centres was acute. In 1999 the boom began, comprising a number of centres which conformed to international standards. In response, the public also started to take notice of these new buildings springing up all over the place, and found an opportunity to take up a form of recreation involving gentle exercise, and looking for precision and balance, mental and physical, far more than physical strength. For this and other reasons, shopping malls, seeing a symbiotic opportunity, began to "sprout" bowling centres, while the parking possibilities tempted those who do not like the hassle of finding a spot for their car when they try to do other things, and free buses from city centres helped encourage the non-drivers to take the plunge. The bowling centres are designed with the spectators as much as the players in mind, a wise step since so many people come for social more than sporting purposes, so centres with six, ten or even more lanes are no longer considered special. Supply and demand is responsible for the explosive growth of almost everything connected with bowling. Bowling shoes, to protect and preserve the surface of the lanes, are a necessity, and can be borrowed or rented on site, allowing anyone to walk in off the street and play. It is just a part of the all-round service modern centres offer in an effort to attract customers. Customer service and care is paramount, with the vast majority

of centres having a bar and a range of comfortable sitting areas in the vicinity of the lanes. Even restaurant facilities are by no means unusual in such places, allowing the players to replenish their strength.

Macrocosm - basic characteristics

- Political and legal context

  The owners are obliged to run their centres in accordance with the Czech business law. From a political point of view, the situation seems stable, with no major changes anticipated. Since sport was, under the previous regime, under state control, and thus subsidised, finding sponsorship is, perhaps, the major area where sporting institutions need to be aware of the law, and some inconsistencies could lead to complications.

- Economic context

  GDP: in 2003 there was a 3.1% growth with respect to the previous year, in 2002 1.5% and in 2001 it was 2.6%. The vitality of the economy in 2002 was down on the previous year, although in the two years prior it had exceeded the EU average.

  Inflation:

Table 1. Inflation

Year	1997	1998	1999	2000	2001	2002	2003	2004
Inflation in %	8.5	10.7	2.1	3.9	4.7	1.8	0.1	2.8

Source: www.czso.cz

National budget: in 2002 the deficit in the budget stood at almost 396 billion Czech crowns (Kč) (approx. $13 b), in 2003 at 493 billion Kč and in 2004 at 593 billion Kč.

Foreign trade: The trade deficit continues to decline but is still considerable. A further blow was dealt to the tourist trade in particular by the floods of summer 2002 which decimated a number of areas including Prague itself. Heavy foreign investment accounts for the relatively healthy state of the big picture.

- Social context

  The over-riding factor to consider, perhaps, is the falling birth rate, and thus rising average age, of the Czech populace, which will inevitably lead to a larger and larger percentage of retirees. The increase in unemployment, which in some regions can reach 15%, was about 8% for Southern Moravia in 2003. As the foundation of economic growth and the prevailing factor in determining the quality of life, extreme emphasis is laid on the education of the entire populace. At present, of those over fifteen years of age, 9.2% have a degree from university (or more), 29.9% a general education (secondary) and a school leaving exam (maturita), 36.4% a specialist secondary education and 24.5% a "basic" education. The number of students in grammar schools is rising, and their education tends to be designed with a university place in mind. Household income and expenditure: The official figures for the Czech Republic 2002 list 4,053,811 households with an average 2.46 members each. The rest of the populace live in retirement homes, youth housing, centres for the physically disabled etc. The gross income per household member was 109,011 Kč in 2002, and in 2003 rose to 114,760 Kč.

Table 2. Growth of income and expenditure by social group (in CZ and Kč)

	Household member	Employee	Self-employed	Agricultural	Retiree
Income					
2000	97 807	106 478	91 749	87 024	75 553
2001	105 776	114 853	99 562	95 229	81 717
2002	109 011	117 791	101 953	99 968	86 444
2003	114 760	125 157	104 605	101 803	90 520
Expenditure					
2000	94 010	101 130	90 832	84 471	76 009
2001	99 897	106 872	98 015	91 571	80 788
2002	102 732	109 731	98 059	94 185	85 926
2003	108 023	116 534	100 071	96 850	88 410

Source: www.czso.cz

With the entry of the Czech Republic into the EU, it is possible we will see increased emigration in search of work, particularly among young people.

- Technical and technological context

  In this context the operational environment has been radically altered by the huge boom in information technology and equipment. The explosion of internet users, thanks to which, via the net, companies can reach unprecedented numbers of potential clients, also allows them to avail themselves of innumerable services to enhance customer satisfaction. In the particular sphere of bowling centres, the advances in construction methods and technology are particularly relevant, as are the possibilities of electronic scoreboards and the like.

- Ecological context

  New laws enacted in the early 1990s changed the "green scene" here in the Czech Republic, in the preparation for EU membership. Conformity with EU standards across the board is the current priority in this area. ISO Certificate 14001 is required for these purposes in the Czech Republic today for any company building a structure such as a bowling centre. It indicates that certain "eco-friendly" EU norms have been met. To be granted such certification, a company must create, keep records of, maintain and continually improve a system of "environmental management".

Professional context

Suppliers

In the term "suppliers" we comprehend the physical and legal entities which sell products or provide services which the company requires to achieve its goals. In the case of Planet Bowling, suppliers can be divided into two categories, based on whether they supply goods or services.

Customers

Customers fall into a number of categories:

1. Companies looking to hire the entire facility for an "in-house event"
2. Competitors in individual competition
3. Competitors in company sponsored (organised) competitions
4. Occasional customers (plus friends and colleagues) who come on an irregular basis
5. Regular customers
6. Serious competitors who train regularly at a bowling center
7. Spectators (visitors) who come to watch a particular event
8. Visitors making use of the bar or restaurant
9. Customers from bowling-related businesses

Service Competition

The Czech Republic has three major bowling centres run by Planet Bowling, in Brno, Hradec Kralove and Ostrava. Each of them is located in a shopping mall, and offers a relaxing environment in which to bowl, have a meal or down a cocktail at the bar. The lanes are of the highest quality, and meet all international standards. A big screen gives customers the chance to sit back and enjoy coverage of many major sporting events. A range of services (company outings and tournaments, parties and general get-togethers) can be booked as easily as reserving a lane, by phoning the centre or visiting the website. All the accessories are available to hire or buy on site.

Other bowling centres in Brno:

Boby centrum **-** four lanes (not up to international standards), pins on strings.
Sportcentrum Radost - Bowling + Squash – two lanes (not up to international standards), pins on strings.
Bowling – Billiard Club two lanes (not up to international standards), pins on strings.
Parkhotel Brno
Atlantis Brno – Rozdrojovice

Conclusion

This case study of the operational environment of Planet Bowling contains the basic information given to students of Sports Management at the Sports Studies Faculty at Masaryk University. The students' primary task is to extract relevant data and using that and other available data to formulate a list of opportunities and risks inherent in the scenario. The clearest opportunities and risks for the company are as follows:

Opportunities: Increasing income (and disposable income) in households, improving economic condition of the populace at large, growing interest in sports in general - positive impact of regular exercise on health, the Internet

promotion possible to "sell" the bowling centre and its services, location in shopping malls in major cities (with considerable passing trade), high quality materials available for construction and maintenance of lanes, ongoing research into new, related technologies, the boom in interest on the part of the younger generation, the absence of competition which meets international standards, the possibility of constructing further bowling centres in other shopping malls, potential growth in incoming EU citizens with existing links to bowling, and the organisation of company tournaments.

Risks: Increasing household expenditure, limited coverage of bowling in the media, lethargy on the part of the public at large - particularly a resistance to the "push" for sports, saturation of the market with bowling and seemingly similar services, the high cost of pursuing any sport to a tournament level, improving facilities elsewhere**,** the lack of qualified, licensed trainers and the fact that the ČBA cannot issue such licences.

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Sport for All, Fitness and Health-related Activities

4th INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

"SCIENCE AND PROFESSION – CHALLENGE FOR THE FUTURE"

Editors:
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HEALTH-ENHANCING PHYSICAL ACTIVITY – AN IDEAL PUBLIC HEALTH MEASURE?

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Abstract

Health-enhancing physical activity (HEPA) meets the criteria of an ideal public health measure well if not perfectly. However, the potential of HEPA is only partly in use causing enormous burden to the health of populations. HEPA has many favourable characteristics for successful promotion, but vast experience shows that large increase of HEPA requires systematic long-term efforts that involve multiple partners to work in close collaboration. Even in the best cases the results will developed slowly and usually in lesser degree than expected. A great immediate challenge for the researchers, practitioners, planners, and decision makers is to develop and implement more effective means of HEPA promotion.

Key words: *physical activity promotion, prevention*

The *criteria of an ideal measure to improve the health of a population* as adapted from G. Rose are:

- it influences favourably and in significant degree several common public health problems
- it influences also positive aspects of health
- its use produces positive experiences in itself
- it can be used for the benefit of most people in the population
- it is safe to use, and
- it is economical to use

Health-enhancing physical activity can be defined as any physical activity practiced for any reason and in any mode that is shown to produce regularly and safely physical, psychological, or social effects that directly or indirectly maintain or improve health of individuals, populations or communities. In order to produce meaningful health-enhancing effects, physical activity has to be of at least moderate intensity, frequent, and regular.

How does health-enhancing physical activity correspond to the criteria of an ideal public health measure?

Effects on common public health problems: moderate regular physical activity has been shown to have significant favourable effects in the prevention, treatment, and rehabilitation of more than 20 diseases and their precursors including most of the conditions causing the greatest public health burden, e.g. coronary heart disease, stroke, diabetes, osteoporotic bone fractures, some forms of cancer, depression, elevated blood pressure, obesity, and premature decline of physical and mental functions with age. The size of many of these effects compares favourably with most of the other modifiable risk factors of these conditions, and some of the benefits are unique to physical activity.

Effects on positive aspects of health: good health includes appropriate structures and functions of all organ systems, adequate regulatory systems, sufficient functional capacity for the needs of daily life and occasional more strenuous activities, good perceived health, positive mood and good social relations. Physical activity that meets the criteria of HEPA has the potential to influence favourably all these aspects, and for the maintenance and improvement of organ structures and functions as well as functional capacity physical activity is an irreplaceable and one of the most effective means.

Experiences of the practice of HEPA: for most people one or other form of physical activity meeting the criteria of HEPA produce enjoyable and desirable psychological and social effects.

Availability of the favourable effects of HEPA: due to the large variety of physical activities the opportunities to benefit of some forms of it in some ways are available for the large majority of people regardless of their sex, age, social and economical status, residence, time of the year etc.

Safety of HEPA: risk of acute or chronic injuries, cardiovascular and other complications, addictive behaviours or other untoward and unexpected effects of HEPA is small in terms of frequency and seriousness. This is true especially regarding the most popular modes of HEPA such as walking and other individual activities. In medical terms, "the therapeutic width" of HEPA for healthy people is broad, and approaching the limits of safety is most often indicated by clearly recognizable symptoms.

Costs of HEPA: some of the most effective and feasible modes of HEPA such as various forms of walking can be practiced nearly without costs for individual people and for the community. Even the investments that are definitively

needed in order to make HEPA attractive and available for a large part of the population can be modest and long-lasting. Economic calculations of the cost – benefit ratios of the investments in HEPA show favourable results indicating that the resources used in HEPA promotion have to be considered as good investments and not as costs or spending.

It can be concluded that HEPA meets well if not perfectly the criteria of an ideal measure to influence public health. However, the great potential of HEPA like that of many other good measures to improve the health of populations is only partly in use. The high prevalence of insufficient physical activity causes enormous burden to the health of populations. Despite of the many favourable characteristics of HEPA for successful promotion, vast experience shows that large scale increase of HEPA is possible only by systematic efforts that involve multiple governmental and private parties for many years in close collaboration, and even in the best cases the results have developed slowly and have usually been less than expected. Thus, a great immediate challenge for the researchers, practitioners, planners, and decision makers is to develop and implement more effective means of HEPA promotion.

CONNECTING KINESIOLOGICAL AND MEDICAL PROFESSIONS AND SCIENCE IN THE FIELD OF RECREATIONAL SPORT AND ITS DEVELOPMENTAL DYNAMICS IN SLOVENIA

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Abstract

In all societies, health is becoming a more and more appreciated value and good, and at the same time, a social, economic, societal and environmental category. It is important for an individual and family, for a smaller or larger group of people and for the nation as a whole. Regular physical activity and participation in recreational sport also have a marked positive role in connection with health. The health value of regular and systematic participation in recreational sport and of various movement activities is visible and definable both in terms of prevention and therapeutics. Hence, more active connections and cooperation between the sports and medical profession and science are useful and important. The so-called HEPA project can play here an important role both in Slovenia and in other European countries. In Slovenia, considerable progress can be noticed in terms of the proportion of people involved in sport activities and also in terms of greater regularity of this activity. Especially positive are the changes in the female population who only slightly lag behind men. The reasons lie in the overall rise in the living standard, a larger and better offer of sport programmes, the availability of a multitude of expert and popular articles on the importance, benefits and beauties of sports activities in a number of different media, with strong expert support both from the medical and sport field in the background.

Introduction

Among the individual areas of activity which are more or less systematically dealt with and investigated in the European Area in the framework of kinesiological science there is also the area of recreational sport or sport for all. In the last three decades, appropriate attention was paid to this field in Slovenia as well. With the accession to the **European Union** (**EU**) there emerged the need for the application of a common scientific research methodology, above all for the purpose of carrying out comparative or comparison studies. In the framework of modern trends, we speak more and more of the connection between sport (sport recreation) and health or wellness or health-related fitness. Therefore, the research in the field of sport or recreational sport (sport for all) related to health as an important component of the quality of life of the population is becoming increasingly topical. This can also be attributed to the efforts of the Council of Europe to give sport in general an its individual variants, in particular recreational sport, the appropriate place in society. The adopted European Charter "Sport for All" was an important factor for the spreading of this kind of movement in the European Area although each country spread the idea of regular and systematic participation in recreational sport in its own specific way. Basically, what is concerned here is an activity that significantly contributes to the welfare of the nation and to successful economy; therefore, sport, especially recreational sport or sport for all, will also have its place in each of the European countries in the future. In Slovenia, considerable attention was focused on the study of the participation of the population in recreational sport in recent time periods.

In the sense of mutual cooperation, the EU member states increase their investments into researches, while at the same time, the European research area **(European Research Area - ERA)** has been created in the framework of the common market area. **ERA** actually means the integration of the up to now fragmented European research efforts and the reduction of losses incurred due to the same researches and due to the development of similar products in two or even more parts of Europe. The objective of the said research area is also to enhance cooperation among researchers; to create common development infrastructure for various projects and above all, to increase mobility of researchers **(Kezunovič in sod., 2003: 82).** This in particular applies to the field of sport or recreational sport related to the field of health or medicine.

Importance of the dealing with and the study of the relation between recreational sport (sport for all) and health

In the European area and also in Slovenia, integral health is becoming more and more a good and for many also a value and an important component of the quality of life. In 2002 (Radenci, 2002), on the occasion of the World Health Day, a declaration which defines health as a lifestyle, development resource and investment was adopted in Slovenia. In the said declaration, the following is stated: "In the context of prevention of the occurrence of the nowadays prevalent, noncommunicable, civilisation diseases and a global change from exclusive concern for diseases and the ill to greater concern and responsibility by the individual, social community and the state for health, the latter has become a

fundamental value, means and the goal of development and an important individual and societal development resource and investment."

Health related to recreational sport (sport for all) or participation in recreational sport and physical movement and its positive effects **(Wilmore, J.H. & Costil, D.L., 1994, 1999; Spirduso, 1995; Vidmar, 1997; Berčič & Tušak, 1997; Burger & Marinček, 1999; Ihan, 2000; Berčič, 2000)** is placed more and more in the foreground. The health value of regular and systematic recreational sport activity and various movement activities is visible and definable both in terms of prevention and therapy **(Corbin & Pangrazi, 1993; Oja, 1995; Mišigoj – Duraković, 1999, 2000, 2003; Fras, 2001, 2002; Poles, 2003; Zakrajšek, J. et all (2003).**

From the starting points given in the Introduction it may be concluded that in the present developmental period there shows more and more the need for a deeper and closer interprofessional and interscientific integration of the various expert and scientific fields. When we speak of man and his regular recreational sport activity related to health, common involvement of kinesiological and medical research is here of paramount importance and indispensable. The adopted **Bologna Declaration** at the same time binds and directs activities, in particular in the field of education in the framework of different professions and sciences or pedagogically oriented expert and scientific fields in the wider European area. Taking into account the fundamental idea of the Declaration there shows the need for renewal and enrichment of individual study directions and programmes at different faculties and higher education institutions that deal with kinesiological and medical issues.

For kinesiologists this means to accept the findings of the medical profession and science and to incorporate them into theoretical kinesiological models and implementation projects; and for experts and researchers from the field of medical science, to include kinesiological knowledge and findings in the preventive, curative and rehabilitative treatment of individuals and people in general. Efforts of this kind must gain ground in the study and educational programmes at individual kinesiological (sports) educational institutions and medical faculties and medical institutions. As a consequence, the said cooperation should gain ground in various sports clubs and primary health care units.

What show epidemiological studies in Slovenia in connection with the dealt with issues?

Since epidemiological data are a very important indicator of the health state of the population, let us look at some results of the last study in Slovenia "Risky Behaviour Associated with Health and Some Health States in the Adult Population of Slovenia" **(Zaletel-Kragelj, Fras, Maučec-Zakotnik, 2004).** In the cross-sectional and overview epidemiological research there were analysed those risky forms of behaviour which are associated with the most frequent causes of death in the adult population in Slovenia. These are risky stress behaviour, smoking, consumption of alcohol, unhealthy dietary habits and insufficient physical activity.

As regards risky behaviours, the prevalence of stress behaviour in the adult population in Slovenia was estimated at 24.3%. Even 73.4% of women fall into this group. It is exactly working women at the age of 30-39 and from 40 to 49 who are subjected to greatest stresses in the adult population. Here we have to do with two groups of women: those in the lower education group (unfinished primary school) and those with the highest level of education (completed faculty, higher school or academy). The issue of stress behaviour requires a special treatment with a range of antistress programmers, also in the working environment, where movement/sport activities should have an important place.

The prevalence of smoking in the population of adult inhabitants of Slovenia is estimated at 23.7%. Here more men are at risk than women. In men, these are those at the age of 30-39 or 40-49 with a completed 2/3 vocational training and active employment. They fall into the working class or middle social class in rural environment. Women at risk are working, from 30 to 39 years old and have a completed 4-year secondary school. Despite a relatively successful containment of the tobacco epidemy in the last years (restrictive legislation and preventive-educational programmes, there still remain pressing issues associated with smoking. Smoking is spreading above all among the young, where young girls are especially at risk. Exactly in connection with this it will be necessary to act even more preventively as up to now, where a visible role can be played by various recreational sport programmes.

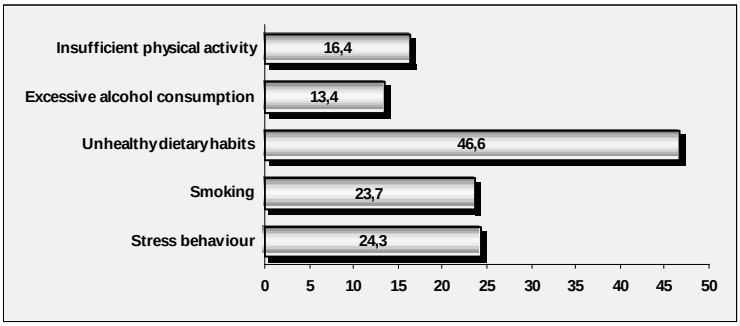

Chart 1: Risk behaviour forms in the population of Slovenia

The results show that unhealthy dietary habits are a serious problem in Slovenia since even 46.6% of the adult inhabitants eat unhealthy food. Unhealthy dietary habits are associated with overweight, obesity, diabetes, elevated blood pressure, hypertension, cardiovascular and cerebrovascular diseases that are based on atherosclerosis.

Among those with the highest risk for this risky behaviour are mainly men; however, at risk are both men and women. Men who fall into this risk group are aged between 30 to 39

years or from 40 to 49 years, mainly with a completed 2/3 vocational training, they are actively employed and fall into the working class or middle social class and live in rural environment. Women at risk are aged from 40 to 49 years, also with a completed 2/3 vocational training, they are actively employed and live in rural environment. To the problems of unhealthy diet we must also add the lack of physical activity or non-participation in recreational sport, which makes the picture even more complete. The solving of the problems of this kind requires an integrated approach at all levels, and it is especially necessary to promote a healthy lifestyle with lots of moderate physical activity or involvement in movement-sport in the groups at risk.

To the risk behaviour forms of the population in Slovenia also belongs excessive consumption of alcohol. Owing to the prevalence of this phenomenon, this is becoming one of the most serious problems. The prevalence of alcohol drinking in the adult population of Slovenia is estimated at 13.4%. Among those whose risk for this risky behaviour is above average are above all men of lower education levels, from lower social classes and rural environment. Among the groups at risk these are above all working men in two age groups: from 30 to 39 and from 40 to 49 years. These are mainly men with a completed primary school and up to 4 years of secondary school (mainly with 2/3 of vocational training). This is also reflected in their social class which is mainly the working or middle class. Alcohol issues should be above all solved by way of prevention with numerous measures and activities to which also belong healthy and man-friendly habits.

Among the individual risk factors we also include insufficient movement/sport or physical activity. In the study by the said authors, only physical activity of walking was studied, but not also the participation in a variety of recreational sport activities. The prevalence of insufficient physical activity of this kind among the adult inhabitants of Slovenia is estimated at 16.4%. Into the group with the highest risk there fall women at the age of 30-39 and 40-49 who are actively employed, with a completed 4 years of secondary education, who fall into the middle social class and live in urban environment. However, into this group also fall men from 30 to 39 years, employed, with a completed 4-year secondary education and coming from urban environment.

Linking the sport, health and pedagogical professions − the imperative of the future

In Slovenia there has ripened theoretically the realisation that for an integrated approach to the treatment of the participation of the population in movement/sport activity related to health, co-operation of the various professions, above all of the sport, medical and pedagogical profession, is necessary. For this purpose, cooperation between the medical, sport and pedagogical profession was studied, among others, in the framework of the target research project (CRP) (Physical/Sport Activity for Health« **(Završnik et al, 2005)**, which took place in Slovenia from 2001 to 2004. It was found that cooperation among the said experts or expert and scientific fields is not at a satisfactory level, and even to a lesser extent at high level. Only slightly less than 30% of health workers, slightly more than 30% of sport experts and slightly more than 40% of pedagogical workers are of the opinion that certain cooperation exists. Worrying is the fact that the vast majority of health workers consider that between the said expert and scientific areas there is practically no cooperation at all.

From the above said it may be concluded that more attention should be paid particularly to cooperation between sport and the medical profession at the macro, mezzo (intermediate) and micro level. At the macro level, we should establish a system of permanent connecting and cooperation between the **Ministry of Health, Ministry of Education and Sport and Ministry of Higher Education, Science and Technology**. At the macro level we should also take care of the connecting and cooperation between individual educational institutions or faculties, especially between the **Medical Faculty of Ljubljana, Medical Faculty of Maribor, University College for Health Care, and Faculty of Sport, University of Ljubljana.** At the above-named higher education institutions we should enrich certain selected study programmes with expert and scientific results and findings resulting from connecting the recreational sport (sport for all) and health, scientific results and expert findings in linking recreational sport and health. Therefore, graduate and postgraduate study programmes at the Faculty of Sport of Ljubljana should be supplemented with wider findings from the field of integral health and in a certain segment, graduate (optional and mandatory) study programmes at the both Medical faculties and at the University College of Health Care with scientific-theoretical models and with practical implementation programmes from the field of sport or sport recreation. This kind of connecting should be implemented in the education in the framework individual professions and scientific fields in the directing, advising, preparation and implementation of diverse public sport-health programmes.

At the mezzo level, experts and researchers from the field of kinesiology or sport and medicine or health should as teams especially connect with each other in planning and programming recreational sport transformation processes or participation in movement/sport activities for health for the various groups of population. These should be physicians and other health workers, specialists in the field of sport recreation, various instructors and personal coaches, and other experts. By means of accessible technology, they should take care of suitable, efficient and safe movement/sport or physical activity both of the beginners and those with poorer abilities as well as of the more fit recreational athletes.

At the micro level, the connecting of the said expert fields by means of diverse programmes should be aimed at an individual, above all at the preservation and improvement of his health status, at good physical and psychophysical status

and at personal well-being. With common cooperation we should also take care of a high self-image and self-respect, satisfaction with oneself, equilibrium between spirit and body, and good social adaptability.

Monitoring Recreational Sport Activities in Slovenia

In Slovenia, recreational sport activities of the adult population are systematically and relatively regularly monitored from the far year 1973 **(Petrović, Hošek, Momirović, 1974)**, when within the survey of public opinion in Slovenia carried out by the Centre for Public Opinion Research at the Faculty of Social Sciences, University of Ljubljana, questions related to sport activities were included into a questionnaire for the first time. Over years, the questionnaire was improved, but all the time it preserved the basic idea and hence also comparability over several years, i.e. longitudinal comparability. The questions deal with the proportion of those actively involved in sport, the frequency and organisation of sport activity, the selection of place and sport activity group and involvement in individual sport activities. In all years, the answers from the field of sport were compared with the variables for the evaluation of the economic-social-demographic characteristics, such as are sex, age, education, social status, income, profession, place of residence, etc. From time to time, the questionnaire offered the possibility of connecting sport also with other interesting fields, such as are health care, ecology, tourism, value system, motives, financing of the sport, etc. In addition to this central studies on representative samples of the adult population of Slovenia there was, of course, also carried out a range of other researches which dealt in more detail with certain areas of Slovenia, certain sports and specific sport issues.

Among the studies shown in Table 1, mainly all, with the exception of three, were carried out in cooperation between the Faculty of Sport and the Centre for Public Opinion Research at the Faculty of Social Sciences at the University of Ljubljana. Namely, in the year 1999, an attempt to use the same questions questions as used in the directed and individual type of surveying in all years was carried out. The results have shown that the answers people give to the same questions by phone differ considerably from those obtained by written surveys. Therefore, some results also differ considerably from the usual ones and do not allow any serious or in-depth comparisons (year 1999).

The results of the surveys are not completely exact data on the phenomena, acts, opinions and attitudes to which questions relate. Namely, the answers are affected by a whole range of factors whose effects can be exactly opposite.

Table1. Overview of studies on recreational sport activities of Slovenes

	Year	No. of subjects (18 years and more)	Proportion of those actively participating in sport	Variables included in the questionnaire
1	1973	2098	about 42%	Forms[1] and manner[2] of activity, selection of sport activities, SDC[3]
2	1976	2059	about 37%	Forms and manner of activity, selection of sport activities, membership in sport clubs, SDC
3	1978[4]	2064	about 30%	Number of hours of sport or recreational activity, SDC
4	1980	2031	about 45%	Forms and manner of activity, selection of sport activities, opinions: boycott OI Moskva, OI Sarajevo, SDC
5	1983	2067	about 51%	Forms and manner of activity, selection of sport activities, SDC
6	1986	2053	about 56%	Forms and manner of activity, selection of sport activities, SDC
7	1989	2093	about 56%	Forms and manner of activity, selection of sport activities, SDC, watching sport on TV
8	1992	2085	about 58%	Forms and manner of activity, selection of sport activities, SDC, motives for sport activity
9	1996	2059 in 1024	about 50%	Forms and manner of activity, selection of sport activities, number of hours, especially walking and cycling, SDC, membership in sport clubs, financing of sport, watching sport on TV, attending sport events
10	1997	1005	about 51%	Forms and manner of activities, selection of sport activities, SDC
11	1998	1008	about 53%	Forms and manner of activities, SDC
12	1999[5]	1350 (telephone poll)	about 68%	Forms and manner of activities, number of hours, membership in sport clubs, watching sport on TV, SDC
13	2000	1100	about 50%	Forms and manner of activities , selection of sport activities, number of hours, memberhsip in sport clubs, financing of sport, SDC
14	2001	1087	about 48%	Forms and manner of activities, number of hours, sport in individual age periods, other physical activity, evaluation of health and physical fitness, nutrition, smoking, SDC
/	2003	855 (Kovač et al 2004)	about 52%	Forms and manner of activities, sport and value system, attitudes, importance of sport results, SDC
15	2004	1442 (15 years and more)	about 60%	Forms and manner of activities, selection of sport activities, number of hours, membership in sport clubs, financing of sport, other physical activity, SDC

[1] Forms of sport activities mean organised or unorganised activity and competition or recreational activity.
[2] Manner of sport activity defines whether it is regular (at least 2 times a week) or occasional, irregular.
[3] SDC – Social demographic characteristics – gender, age, education, income, marital status, characteristics of the place of residence (rural, urban), size of the place of residence, …
[4] In 1978, Faculty of Sport did not participate in the study.
[5] In 1999, telephone survey was carried out in association with the Faculty of Sport by Mediana, Institute for Market and Media Research.

Today, it is much more topical to talk and think about sport recreation, above all in relation to health, body posture, beautiful figure and general well-being than it was 25 years ago. Therefore, some answers can be slightly positively biased (more activity).

In 2004, the 15th study was already carried out in the series of the aforementioned longitudinal researches. It was carried out within the Target Research Programme »Competitiveness of Slovenia 2001-2006« with the title »Physical/ Sport Activity for Health **(Završnik et al, 2005)**; it was conducted by the Scientific Research Centre Koper in the framework of the University of Primorska. Surveying was again carried out by the Centre for Public Opinion Research within the Research Institute FDV – SJM 2004/2 and in the framework of a wider European research in social sciences and humanities.

In addition to the above mentioned researches concerning the recreational sport activity of Slovenes within SPO studies (Slovenian public opinion) at least three important research projects need to be mentioned. Let us mention as the first one the study »Attitude of the Public towards Sport Recreation« **(Damjan et al 1987),** which was carried out on the incentive of the then Scientific Council for Sport Recreation at the Sport Federation of Slovenia with the aim to set up starting points and strategy for a later wide and all-Slovenian action »Bring Movement into Life«. The questionnaire contained three basic clusters of questions: interests as reflected through activities in leisure time, a scale of attitudes towards sport recreation and a scale of values. The study defined four levels of sport (in)activity: never, occasionally, often and regularly. It was conducted on a sample of 1292 adult inhabitants of Slovenia and yielded the information that 52.1% of population was inactive.

The second research project involves studies which represent a constituent part of a wider international project in the framework of the World Health Organisation: **CINDI Health Monitor** (Countrywide Integrated Noncommunicable Diseases Intervention Health Monitor). The data are presented in the study »Risk Factors for Noncommunicable Diseases in Adult Population in Slovenia« **(Zaletel-Kragelj, 2001)**. Similar studies were already carried out in 1990 and 1997; however, only in the area of Ljubljana and its surroundings **(Maučec-Zakotnik, Fras, 2000)**. As already stated, the studies are a reflection of the efforts of the medical profession, both on the international and on Slovenian scale, in preventive activities and efforts to promote healthy lifestyle also in the field of movement and sport activities.

The third study was carried out during the longer period between SPO studies in 2003 (Kovač et al, 2004) with the title »Sport in the Role of National Identity of Slovenes« in the framework of the target research project. In addition to other interesting fields, the research dealt with the manner and frequency of recreational sport activities. In the study, above all answers of the so-called general public – representative sample of 855 adult inhabitants of Slovenia in the age from 19 to 65 years – are interesting and comparable.

What brings the 30-year period?

In the dynamics of human development, a period of 30 years can be extremely short, but it can also mean a relatively long period, especially when certain changes in social life are involved. In our country, the last 30 years were, without doubt, very dynamic as we went through large political, economic, state-related and social changes and even a short war. The said changes are reflected in all areas of social life and thus also in the area of sport activity. We could say that the relation is significant, however, indirect and with a certain time lag. The average living standard increased in the said period, and sport activity increased at least by that much as well. There are fewer and fewer people who only talk about sport and are passive observers of sport events. There are more and more those who are actively involved in sport, who live a sporting life and buy sport clothes and equipment. Table 2 shows a comparison of the data which are 31 years apart.

The answers obtained in 2004 to the basic question on the **frequency of sport activity** and at the same time on the **proportion of those actively participating in sport** tell us about a considerable progress in terms of more and also more frequently active population. There are less sport-inactive and more those who participate in sport and regularly participate in it. The relationship between the inactive, occasionally active and regularly active is today 4:3:3, while 31 years ago it was approximately 6:3:1, which shows of a very large reduction of the proportion of the inactive and a large increase in those who are regularly active - at least two times a week.

Table 2: Frequency of sport (in)activity – comparison 1973/2004

Frequency of sport activity	Results from **2004**				**1973***
7-level scale	%		3 levels	%	%
I do not engage in sport, recreation	32.4	→	no	40.9	57.8
Once to several times a year	8.6	→			
Once to 3-times a month	10.2	→	Occasionally	29.4	30.7
Once a week	19.2	→			
2 to 3 times a week	16.1	→	regularly	29.6	11,5
4 to 6 times a week	5.7	→			
Every day	7.8	→			

* The data are slightly modified solely for the sake of easier comparison.

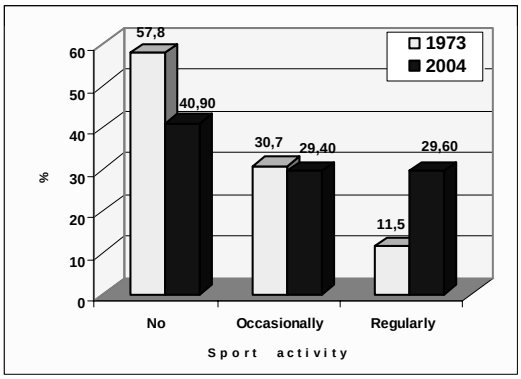

Chart 2: Sport (in)activity 1973/2004

In comparison with the European countries, we can be very satisfied with the above shown situation since we rank immediately behind the northern countries that are the most developed in terms of sport: Finland, Sweden, Denmark, Ireland, and Great Britain, ahead of the Central European in even to a greater extent ahead of the Mediterranean countries (**European Commission. 2004).** Today, it is modern, topical, healthy, pleasurable and necessary to actively participate in sports. And to write about it is also very topical. It were difficult to find magazines, both general and specialised, both those for men and for women which would not dedicate columns to movement, sport and health or healthy life coloured with movement or sport.

The results that speak about a larger increase in active individuals in **women,** that is about the reduction of differences in sport activities between genders, are encouraging. In the studies from the early seventies of the past century we can see that the relationship between women and men actively involved in sport is 4:1 in favour of men; in the eighties, a progress can be noticed: two active women every three active men, and in the nineties, 3 active women every four active men. Today, the differences between the genders are very small, hardly statistically significant. In today's way of life, a responsible working women is willing to take time for an enjoyable and at the same time useful activity and not at all to lag in this respect behind the man (partner) who also (mainly) supports her in it.

As usual, a **decline in sport activity related to age** can also be established from the data from 2004. A favourable finding is that with ageing mainly those cease to participate in sport who are irregularly active, while those regularly active remain faithful to sport and sporting lifestyle until late age (Chart 3). What tell the studies from the past? For the seventies, it is written that for the majority sport ends at 25 years. In the eighties and nineties, certain milestones of greater declines in activity after the 50th and 60th year of age were established. For the present period we could say that sport activity is affected by the age more due to the roles in life different age brings and not so much or only because of aging itself. Less activity can, namely, be noticed after the 25th year, i.e. the period of the formation of family, creation of material and existence prerequisites for normal life and work. However, when this period nears its end, the proportion of the active increases again, and also the regularity of activity - which at the same time means the quality of the activity - is also at a higher level.

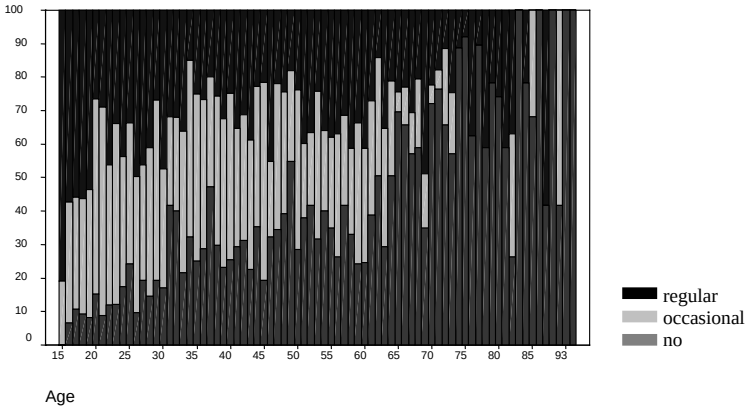

Chart 3: Sport activity relative to age

When thinking about the relation between sport activity and individual socio-demographic characteristics we have thus established that there are practically no differences between the genders, that in the past period, the decline of activity due to aging decreased, and that, however, the **level of education** is still a very strong and important indicator of sport activity. Of course, the general level of education increased in the dealt with period; however, the level of sport activity increased as well, and the relationship is has remained almost the same. Today it is still, and perhaps even more, true what was true of the past periods: that the level of education (which as a variable contains also income, belonging to a certain social class, the character of work, place of residence and lifestyle) is the most important factor of sport activity and even an indicator of orientation towards certain sports (football, skittles, tennis, Alpine skiing, sailing, golf, ...).

Conclusion

Integration into European Union means for the member states and also for other countries in the near neighbourhood an important incentive for development and also a challenge. This is especially the case as regards the connecting and cooperating in the framework of various projects associated with recreational sport and health. Indeed, health of the population is that wealth and value category of every society which should receive much attention and research energy in the framework of the European Research Area in the future. With this is associated movement/sport activity which,

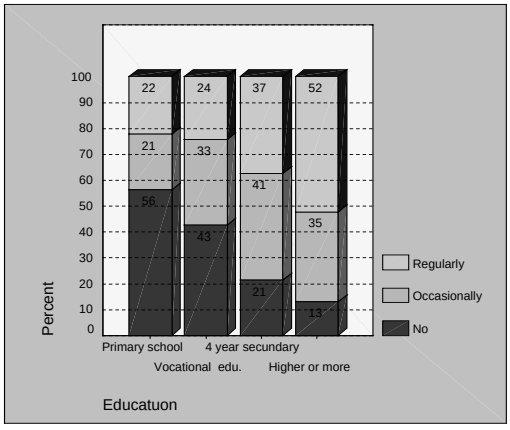

Chart 4: Sport activity relative to the level of education

based on the results of numerous researches, has important positive effects. The connecting and cooperating of the sport, medical and pedagogical profession is especially emphasised in this context. To such connecting and cooperating binds us also the Bologna Declaration. Closer and deeper connecting, which is now still not satisfactory, should be established at the macro, mezzo and micro levels.

The study of the relation between health and participation in movement/sport is coming more and more to the foreground in individual countries, and with it also epidemiological studies. In Slovenia, the prevalence of individual negative phenomena has been established in the framework of the study of risk behaviour of the population. The prevalence of stress behaviour is estimated at 24.3%, where women prevail. In the adult population, 23.7% smoke; here more men than women are at risk. Unhealthy eating habits have 46.6% of the population, among which men are the most endangered, but women are also endangered. The prevalence of excessive alcohol consumption in the adult population in Slovenia is estimated at 13.4%, in the group of the above-average endangered are above all men. Insufficiently physically active are 16.4%, among them slightly prevail women. The epidemiological picture is thus not favourable and calls for serious consideration. Certain preventive and therapeutic role can also be played by carefully planned, suitably intensive, sufficiently frequent and man-friendly movement/sport activity.

In general, an increase in the recreational sport activity has been noticed in recent years both as regards the proportion of the active sport population and as regards the regularity or frequency of activity. Particularly positive are changes in the female population where women only insignificantly lag behind men. The reasons for it vary, however they can, without doubt, be found in the overall increase of the living standard, better awareness and knowledge of the negative consequences of sedentary life, but also in a larger and better quality offer of sport programmes and in their more aggressive promotion, in numerous mass events carried out by various organisers at the national and local level, the availability of a large number of expert and popular articles on the importance, benefits and beauties of sport activity in numerous and various media, with a strong expert support in the background both from the medical and sport field.

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SOME CHARACTERISTICS OF THE HEALTH ENHANCING MOTOR/SPORTS ACTIVITY BEHAVIORS IN SLOVENE POPULATION

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Abstract

Numerous processes stimulated by the modern society environment, which negatively influence the health of the population in general, are being increasingly present also in the Republic of Slovenia. In order to analyze the present situation of health in connection with motor status and health behaviors of an average inhabitant of various age, gender and other target groups, we performed a research project "Health enhancing motor/sports activity in Slovenia" (Završnik, Pišot, Fras, Zaletel Kragelj, Strel, Sila) during the period from 2001-2004. Data were collected from the sample of altogether 4185 participants from 10 – 65 years of age (children (n=832), adolescents (n=1079) and adults (n=2274). Methods used were divided among (1) questionnaires, (2) motor tests, (3) anthropometric measurements, as well as (4) clinical checkups and laboratory measurements (in adults). Behavioral factors in children and adolescents showed that modern lifestyle trend influence this population similarly as adults and that the majority of children and adolescents are not being physically active enough. The share of sedentary individuals, as well as the prevalence of obesity among Slovene youth is increasing. Regular and sufficient spare time physical activity in the adult population of Slovenia is generally related to their better health indices. Study participants engaged in a regular activity sufficient for health protection revealed with a lesser frequency of individual risk factors as well as a global degree of risk for manifest cardiovascular disease in the near future. It was found that 32,4% of the adult Slovene population aged 25 to 64 years are sufficiently engaged in motor/sports activities for health protection, while on the other end of the spectrum there are 16,8% of completely inactive individuals. Further analyses and comparisons have made note on some opportunities for the state to proceed in building the strategies for improvement and enhancement of health and general life quality of its inhabitants. Comprehensive promotion and enhancement strategies aiming at the increase the level of health enhancing physical activity (HEPA) should be considered and implemented.

Key words: *health enhancing physical activity, targeted research project, population, age groups, state strategy, Slovenia*

Introduction

During the evolution, human motor activity represented much more than solely the simple tool for transport movement. Its competence developed along with the needs for survival, personal creativity and human will for individual expression, and with practicing various sports, also the contents of social interactions and integration were added. Nowadays, in modern times, particularly in the countries of developed part of the world, motor activity has lost its crucial role. We ascertain over and over again, that our organism which has adapted to motor active lifestyle for centuries is no longer able to catch up with the modern requirements. Changes of the lifestyle, occurring lately in our environment in a dizzy speed, dictate a brand new mode of survival, stimulating the adjustment of the human organism and his psychosomatic status as a whole [**1**]. Is it really necessary to agree with these new requirements to become sedentary, being able of a rapid processing thinking, functioning more or less indoors, in front of a computer screen with a "mouse" in our hand? Could we adjust ourselves to such a requirement? Can we really change as fast as development of information and communication technologies expect us to? Would the development of technologies itself finally overcome the problems it has created?

Lack of a sufficient motor/sports activity (MSA) is strongly associated with development and manifestations of complications of chronic noncommunicable diseases (NCD), which represent a cause of the great majority of deaths in the modern world [**2**]. According to the World Health Organization (WHO) data, lack of appropriate MSA is among the seven most important risk factors for chronic NCD [**2-4**]. Regular MSA prevents humans from developing most chronic NCD, e.g. atherosclerosis, hypertension, non-insulin dependent diabetes, some forms of cancer as well as complications of osteoporosis. It also maintains psychophysical and functional abilities of the human body and consequently enhances the capability of independent life in older age; it lowers stress and depression; it stimulates self-confidence, and thus affecting directly the general social prosperity of individuals and families and indirectly the whole nation [**3-5**].

What are the reasons for the increase of prevalence of sedentary lifestyle in the majority of countries of the developed wold, despite numerous research data make note of the MSA crucial benefits for health and its role in the human life?

Majority of reasons usually taken into consideration could be explained by some trivial modern environmental factors. For example, information support accompanies humans in their every step and in almost every action they perform has actually facilitated our lives, but has also estranged us from various social activities such as MSA. The media world has litteraly flooded our lives forcing us to a sedenatary lifestyle. It has become almost impossible to address people seated in comfortable armchairs of the positive role of MSA or to try to awaken their opinion to its valuable meaning. Running cannot be offered on the supermarket shelves, walking cannot be purchased on the internet. Essential MSA contents and programs are often distant in space and time and frequently inaccessible also from the financial point of view.

All of the above listed processes that are still in progress in the modern society (and bear negative influences on the human health in numerous ways) regretfully did not by-pass Slovenia [**6**]. Taking into consideration relatively unfavorable health indices of the Slovenes and aiming at slowing down the troublesome trends (or probably even reversing them), our team of experts designed nationwide strategy on integrative programs of the MSA for health promotion at the state level [**7**]. Adequate state policy should place at its focus of interest its citizens and their needs and desires. From the management point of view it follows also the principles of economy, therefore it cannot and must not neglect the health protection and health enhancement of individuals, families and the whole population as the basis of a quality and productive life, as well as of a general social prosperity. The final aim is to come as near as possible to the definition of health according the WHO – health is not merely absence of a disease, but a state of absolute physical, mental and social welfare. In future, these contents should become a regular part of every Slovenian's everyday. As a constituent part of a quality, modern and Europe comparable lifestyle it should become a strategic argument reflecting the value of a country that is economic and responsible towards its citizens.

The basic information that allows planning of changes in the future is the analysis of the present situation which should be assessed before starting a design of concrete quality plans for the promotion of the health enhancing MSA as well as to design concrete programmes of activities for people to be motivated enough to join and practice. Awareness that the quality and successful programs need to be directed to where they are actually needed, as well as bearing in mind the WHO definition of health, our team of experts started simultaneously an integral analysis of the situation on situation of the MSA of various population groups in Slovenia [**8**] within the Targeted Research Project "Health enhancing motor/sports activity in Slovenia", co-sponsored by two Slovene state ministries, the Ministry of Education, Science and Sport and the Ministry of Health of the Republic of Slovenia.

Aims and objectives

Objectives of the present research, schematically presented below (Fig. 1) originate from the problem already announced and described above and point out a hierarchical dependence - starting from the evaluation of the present situation through the analysis of possibilities related to the available human resources and finally its practical possibilities for design and implementation of the program for the promotion of the health enhancing MSA in Slovenia.

The analysis of the current situation, based on a systematic examination of a representative samples and objective indices, was set to determine the health and motor status of children, adolescents and adult inhabitants of Slovenia, thus to identify the key arguments for strategic changes in the field of MSA for health.

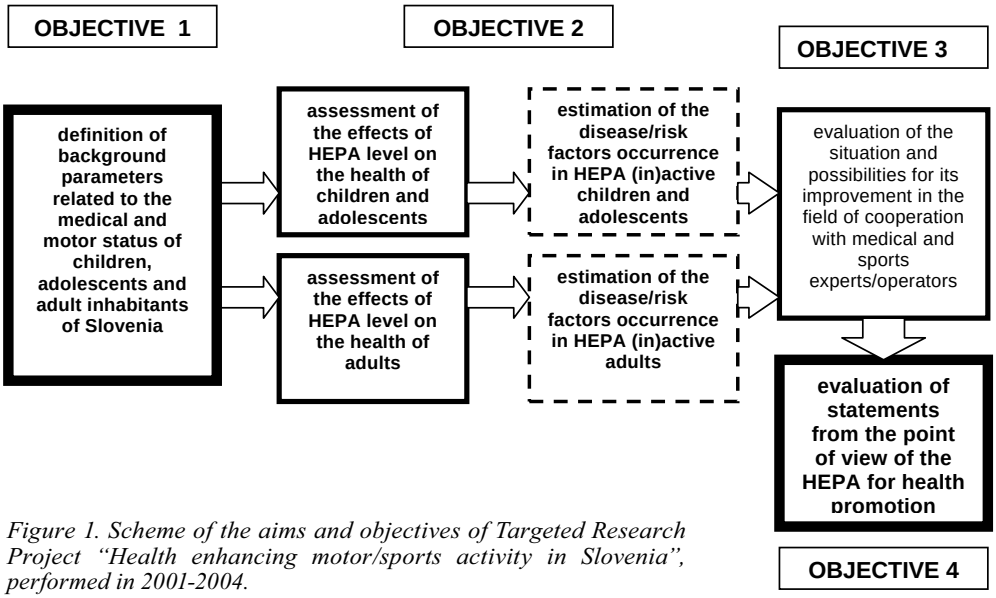

Figure 1. Scheme of the aims and objectives of Targeted Research Project "Health enhancing motor/sports activity in Slovenia", performed in 2001-2004.

Subjects and methods

Subjects. Altogether, 4185 children, adolescents and adults were involved in different parts of the research project. The sample of children and adolescents was represented by male and female pupils of the fourth (n=429) and the seventh grade (n=403) of the nine-year elementary school and male and female students of the first, third and fifth year of secondary school (n=1079) on the whole national territory. Within the group of adults 2274 individuals responded to the questionnaires and clinical checkup, while 871 adults responded to physical endurance tests.

Methods used were divided into four groups:

1. questionnaires,
2. motor tests,
3. anthropometric mesurements and
4. clinical checkup and laboratory mesurements (adults).

Questionnaires were filled in by investigators assisstants who were in personal contact with the study subjects. Questions covered many various areas of the research project:

- gender, age, social status, level of instruction and living environment,
- diet, smoking and alcohol consumption,
- motor/sports activity and inactivity,
- spare time activities,
- medical condition and health care.

Two different questionnaires were designed for different age groups, the first one for respondents aged from 19 to 65, and the second for the participants from 9 to 19 years of age.

Anthropometric measurements. The following variables were selected:

- body weight and height,
- triceps skinfold thickness and
- body fat proportion using "MALTRON" and "TANITA".

Motor tests. In the selection of motor tests to be performed, various criteria were considered, such as applicability to all age gropus, comparability accross groups and as well as various hypothetical dimensions of the examinees' motor space. The battery of tests comprised physical endurance, strenghth, balance, flexibility and coordination tests.

The study protocol was approved by the National Commitee for Medical Ethics of the Republic of Slovenia.

Statistical analyses. In addition to basic descriptive statistical methods, differences between and within the groups were calculated by means of a chi-square test. Differences were considered as statistically significant at p=0,05. Data were analysed by means of the computer statistical package SPSS version 11.0.

Results and discussion

Children and adolescents

In their spare time, average fourth-graders spend almost 4 hours daily sitting, while average seventh-graders spend almost 5 hours sitting at home after spending 5 to 6 hours sitting at school. Thus, at weekdays children spend sitting 10 hours or more altogether, while during the weekend they are engaged on average 4 to 5,5 hours a day in sedentary activities. High school students spend 4 to 5 hours sitting in their spare time at weekdays, while during the weekends sitting lasts for even 5 to 6 hours. In their spare time, 60% of fourth-graders and 54% of seventh-graders are frequently engaged in MSA, while 6,3% of fourth-graders and 4,3% of seventh-graders are never engaged in MSA. In high school students, more than 60% of males (all classes) are frequently engaged in MSA, while most female students practice MSA occasionally (50%). The attention was also paid to the forms of MSA adolescents most frequently participate in. Both children and adolescents are the mostly physically active in school, being almost unaware of the possibilities and existence of the out-of-school activities. Females tend to be less MSA than males in all forms and age groups.

Children and adolescents in all age groups expressed a relatively highly positive (more than very good) opinion on their current general state of health. As a rule, the younger the respondent, the more satisfied he (she) is with his (her) general state of health. Most pupils, declaring to be in an excellent state of health are the fourth grade elementary school children, while on the other hand in the fifth year of the high school the students' opinion on their state of health is the lowest (however on average still more than good). A positive correlation emerged between the health status and the MSA engagement frequency in fourth-graders: students frequently engaged in sports activity define their life quality as excellent while at the same time those students who are never engaged in MSA are the ones that most frequently define their life quality as extremely poor. Students frequently engaged in MSA also consider their current health condition and physical fitness as more important than physically inactive individuals. We consider as particularly interesting the motifs stated

by children and adolescents as the most important for their engagement in MSA. They are usually not related to health factors, fitness enhancing factors or body enhancement, but on the contrary to social motifs as well as to the self-image, entertainment and relaxation factors.

General endurance has been decreasing gradually over the past ten years in both children and adolescents with no substantial gender differences. Somehow larger are the age related differences according to different age groups [**9**]. Between 1993 and 2003 general endurance decreased for approx. 10% in the fourteen-year-olds, while younger children reveal an even more substantial decrease of nearly 20%. This finding points out again the inappropriate changes in the home environment as well as in the school system where also from the point of view of the children's fitness sports education assessments results are inadequate. Motor ability in male and female students aged 15 and younger shifted markedly toward higher levels between 1990 and 2000 [**9**]. In the whole national territory, in the year 2000 examinees revealed a higher motor ability level with respect to the national average level for the year 1990. However, the problems of awareness raising and living a MSA lifestyle as factors of life quality and permanent behavior pattern are still present. The present state in the adolescent and adult population shows that these ought to be the areas of our future attention.

In male examinees overweight index (defined through elevated body mass index, BMI) increases gradually between the fourth grade elementary school (18,1) and the fifth year high school (24,4). In female examinees attending elementary school average BMI value is slightly lower than 20; in the fourth grade 18,4, while in the seventh grade it increases to 20,6. In high school BMI value was between 20,8 and 21,2. Data were compared to previous investigations carried out on a representative samples (n=1596 in 1983, n=1732 in 1993 and n=1835 in 2003), and studying the overweight phenomenon in Slovene male and female children aged 7 to 10 years, according to the international standards (IOTF). Data show a substantial increase of overweight in male pupils aged 7 to 10 (from average 0,6% in the year 1983 to 6,3% in the year 2003) as well as female children in the same age group (from average 1,45% in the year 1983 to 7,53% in the year 2003). The results of some tests for motor ability of children and adolescents confirmed that those pupils/students with inappropriately high BMI express lower motor abilities (Fig. 2 and 3).

So, the analysis of the behavioral factors in children and adolescents showed that modern lifestyle trend influence this population similarly as it is perceived in adults - in fact, the majority of children and adolescents are not being MSA enough.

In the past, numerous more or less successfully designed projects of promotion, rising of awareness, as well as projects to stimulate different population categories to participate in MSA were carried out in Slovenia. The foundation of a positive attitude towards sports activity and motor active lifestyle is certainly a systematic and quality motor and sports education at all levels of instruction: in kindergarten, elementary school, high school and university likewise in families, sports associations and other similarly organized sports organizations. Unless younger age groups are involved in this process we can only continue to repair the damages in the adult ages. It should be emphasized that important beneficial actions within the age group of children and adolescents sports education have already been taken.

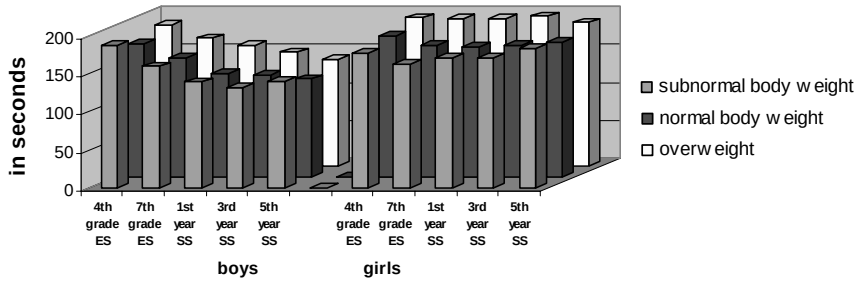

Figure 2. The results of 600 meters running test of on in children and adolescents according to body weight and gender.

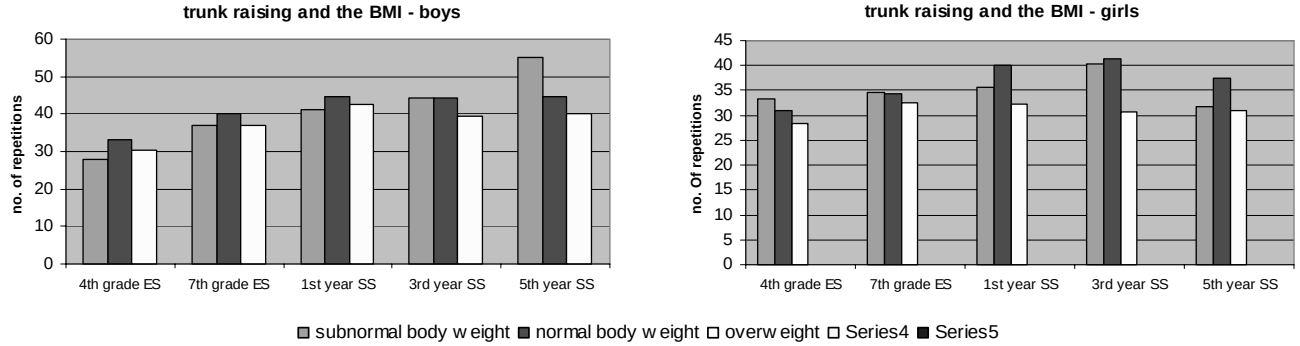

Figure 3. The results of the trunk-raising test in children and adolescents according to body weight and gender.

Adults

Investigating spare time MSA among adults, our team aimed also to study the present state of health, motor status and behavior style as well as at the establishment of contents and form of MSA, its frequency and intensity with respect to the examinees' gender, age, social class, communal milieu, and medical region or area. From the near past (2001) research data it emerged that measures which are to be implemented to increase physical activity frequency ought to be directed to the following risk groups: female population, inhabitants aged 40 to 49, lower-class inhabitants and urban population [**6,10**].

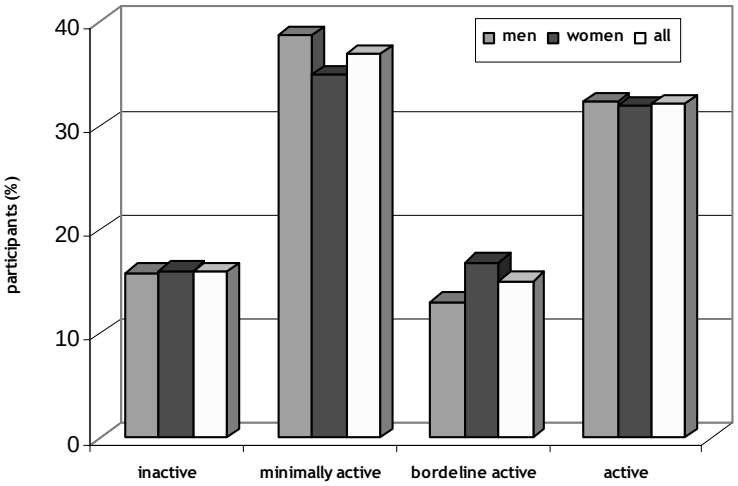

Figure 4. Health enhancing motor/sports activity among Slovene adults according to gender.

It was found in our present study that 32,4% of the adult Slovene population aged 25 to 64 years are sufficiently engaged in MSA for health protection (exercise 5 times a week at moderate intensity or briskly walking for at least 30 minutes), while on the other end of the population spectrum there are 16,8% of adult Slovenes completely motor/sports inactive. Among adults, 35,5% of the population is minimally active, while 15,3% are engaged in borderline sufficient MSA for health protection. Among the most important are the results on the situation of regularity of moderately intensive MSA according to gender and age groups. Surprisingly, it was shown that the shares of regularly active males and females are comparable (Fig. 4); the age-related percentage of regularly physically active adult's decreases after age 30 and it increases again after age 50. (Fig. 5).

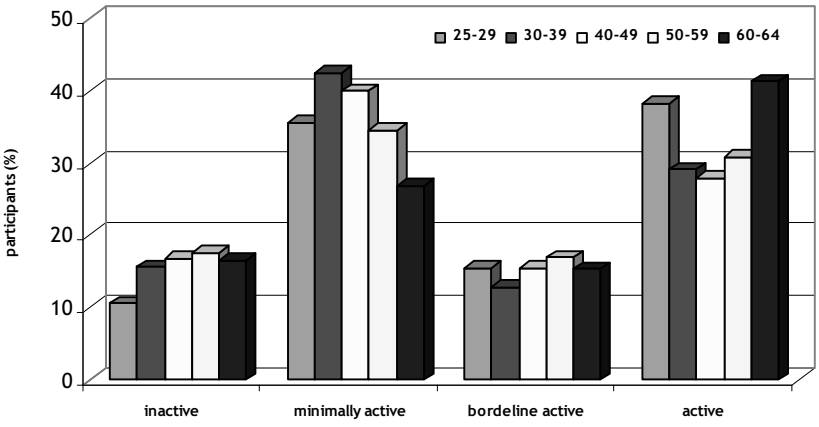

Figure 5. Health enhancing motor/sports activity among Slovene adults in different age groups.

A comparative analysis for the Ljubljana region (its population was investigated upon the level and regularity of physical activity by the research projects CINDI Ljubljana 1990/91 and 1996/97) could demonstrate a general improvement of MSA of the adults in the past six years for all categories investigated. However, this improvement should be considered as encouraging but not entirely satisfying.

More important are the data demonstrating that 47,3% of adult Slovene population are engaged in at least one form of a regular MSA, while additional 42,3% participate in at least one form of MSA occasionally. It should be emphasized that the largest proportion of regularly and occasionally active adults is in the non-organized activity category, and the proportion of the population participating in various forms of organized MSA (in sports associations, clubs, in private organizations or within the employment organization) is relatively low.

Regular and sufficient spare time MSA in the adult population of Slovenia is generally related to better health indices. Study participants engaged in a regular MSA defined as sufficient for health protection by some generally adopted international standards, revealed with a lesser frequency of individual risk factors as well as global degree of risk for manifest cardiovascular disease in the near future according to Framingham risk score charts.

In participants with arterial hypertension prevail individuals who are never involved in any form of MSA (57,1%), whereas those declaring as active revealed a substantially lower hypertension occurrence (38,9% in regularly and 36,6% of occasionally active participants in at least one form of MSA). The latter demonstrates that occasional participation in at least one form of MSA is possibly protective against arterial hypertension incidence. Similar results emerged from the total serum cholesterol analysis; in participants with high cholesterol prevail those never involved in any form of

MSA (79,6%), followed by occasionally active examinees (76,6%), while the lowest proportion of participants with high cholesterol emerges in the group of regularly MSA (72,1%). Likewise, in individuals with high BMI (25,0 kg/m2 and more) significant differences associated with the frequency of MSA were found. The highest proportion of overweight adults could be found among individuals who are not physically active in any form of MSA (31,1%), the proportion of overweight is much lower in those occasionally engaged in at least one form of MSA (21,5%), and the lowest being the proportion of those regularly active (17,2%).

The highest coronary heart disease risk group profile (20% and higher probability of manifest disease occurrence within the next 10 years) was more pronounced in participants declaring not to be physically active in any form (29,7%), 15,1% were occasionally active in at least one form of activity, while conversely, in examinees identified as at moderate risk for manifest heart disease in the near future there are larger proportions of occasionally active (57,6%) and regularly active (57,8).

Instead of conclusions - some backgrounds and directions for nationwide strategy for increasing health enhancing physical activity strategy development in Slovenia

Modern society, particularly its rapid and persistent development of information and communication technologies, aims at facilitating the life of individuals and technically speaking, it did reduced distances and it made our life more comfortable and, at first sight, friendlier. At the same time, probably unwillingly, it has estranged the vital human life contents. It has been forgotten that movement and sports are among humans' crucial health sources. Due to the increasing use of topmost technologies motor activity has been decreasing, and in some of the most developed parts of the world it has been almost disappearing.

Many research findings confirmed that active lifesyle, characterized by regular MSA, represents one of the crucial health protecting and health enhancing factors [**11,12**]. Adequate MSA is extremely important for enhancement of not only physical, but also mental, spiritual and social health. To summarize the results of numerous comprehensive international researches, as well as the results of our research we can conclude that the implementation of strategies for the increase of the MSA in the population, both in primary and secondary medical prevention likewise in a general process directed at stimulating quality life and permanent development factors growth, the role of adequate MSA quality and quantity must be considered [**13**].

Current recommendations comprise regular physical activity, for at least 5 to 6 hours of various forms of at least moderately intensive MSA weekly [**14**]. Programs of MSA quantity and frequency increase designed for a previously passive individual, ought to be individualized, based on the evaluation of his motor capacity and they ought to comprise a recommendation relative to adequate contents of exercise [**15**]. Professional and organized counseling is crucial. From the conditions found as well as from the key professions experts opinions we can anticipate a future better cooperation among medical and sports experts as well as didactic operators in the MSA programs analysis, design, implementation and evaluation likewise in motor promotion and in giving effect to a regular motor activity for health [**13**].

In order to achieve better results we ought to direct our attention to the processes of problem awareness and awareness rising simultaneously to children and their parents [**16**]. Today, parents willing to educate their children to live and maintain a physically active lifestyle, still lack the opportunities to realize this goal [**17**]. Despite numerous projects currently being carried out in Slovenia, it is still very difficult to access sports recreational programs for the youngest children. Most programs offered by various sports clubs and sports associations are designed for children aged 6 and more. Even where children programs available are sufficient they are rarely carried out as a non-agonistic activity. The driving force of sports programs remains the identification of young talents to take to the highest agonistic levels. Peak problem seems to be the secondary school level where sports education teachers complain about a total lack of sports education motivation in their students. Thus, fundamental directions and approaches to the sports education contents in secondary school need to be redefined. Because it seems that particularly motor/sports inactive are female students, the adequate mechanism, to stimulate them to engage in regular physical activity more frequently, must be found. Higher motivation could be achieved if students' desires and needs (self-image, socializing and entertainment) were involved in the chosen contents and process organization. While monitoring activity, a greater attention ought to be directed to the evaluation of the students' persistence, creativity and cooperation.

Aiming at shifting regular MSA to higher levels, an integral national program ought to be designed and consistently implemented [**7,13,18**]. Such a program should comply with conditions for an everyday, regular sports and/or motor activity and to stimulate the implementation of regular physical activity into the active lifestyle of the population of Slovenia, resulting primarily in a more quality and healthier life. Particular target groups demanding additional attention are children and adolescents whose lifestyle behaviors are still taking shape [**19,22**]. Adjusting promotion actions to their needs, approaching their interests in the design of contents could bear considerable interest already in the near future. However, promotion activities ought to be directed at young population simultaneously with the awareness rising in adults who represent a model to young people and influence considerably the children and adolescents behavior and lifestyle with their own behavior [**20,21**]. It should be emphasized at his point, that only regular MSA is a true health protection

factor in all age groups, while on the other hand, occasional and inadequately intensive physical activity could represent a risk greater than the expected positive effect on health [**1-5**].

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WELLNESS PROGRAMMES IN CROATIA*

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WELLNESS - THE WAY TO BECOME A CREATOR OF YOUR LIFE!

Abstract

Wellness is the expression that has only recently been introduced in the Croatian language. Considering its ideal prerequisites Croatian tourist offer has experienced a sudden development of wellness services, however the knowledge of the overall wellness concept and its potentials is still insufficient. At the moment the *wellness concept* is mostly perceived as a range of relaxation and 'beauty services'. The share of such services in the total *wellness offer* in the country demonstrates that, and is further supported by this research. The data were collected from the services catalogs of 16 *wellness centres* in Croatia and were checked as valid by the method of interview. The data were classified in a table according to their properties. In the course of data processing analysis and synthesis methods were used. The results were transformed into percentages and frequencies and outlined in charts and tables to facilitate their interpretation.

Key words: *wellness in tourism, wellness offer, wellness programs, wellness concept, wellness center*

Introduction

Although the concept of *wellness tourism* is present in Croatia for some time and notwithstanding a wide array of services in *wellness centres* in the country, the overall *wellness offer* is insufficient. It does not contain all the aspects of *wellness* like an integral concept which should be the way to achive overall healthiness and should improve the quality of life. By its definition *wellness* includes all the aspects of human health, which means that the offer must contain programmes and services which will satisfy all the segments of the entire *wellness concept.*

Wellness is not simply the absence of disease. *Wellness* reaches beyond the point at which a person has no physical symptoms of disease toward an ideal state of optimal health through awareness, education, and personal growth. To quote a great health educator, optimal health is "a positive physical and mental condition that enables individuals to live to their fullest potential; have the energy, knowledge, and skill to play and work optimally; and experience life as satisfying, meaningful, loving, and happy." Actually, these ideas are not all that new. In 1947, the World Health Organization (WHO) expanded their definition of health as "physical, mental, and social well-being, not merely the absence of disease." Spiritual well-being has since been added to th is definition. In the 1950s, Dr. Halbert Dunn, the first director of the National Office for Health Statistics, introduced the idea of high level wellness (HLW). He defined it as "an integrated method of functioning which is oriented toward maximizing the potential of which the individual is capable, within the environment where s/he is functioning." Dunn believed that ordinary people could learn to know themselves, and become better balanced and able to deal adequately with problems. (www.goaskalice-cms.org)

In Croatia there are about 20 *wellness centres* which are mainly situated along the Adriatic coast.

The goal of this research was to present the *wellness offer* in Croatia, to analyse it, to examine its strengths and weaknesses, and to find a way to improve it by implementing new *wellness programmes* and services which would enrich and improve the quality of *wellness offer.*

Methods

The data were collected from the services catalogs of various *wellness centres* and classified in a table according to their properties. The sample consists of 16 *wellness centres* in Croatia., and the sample of variables consists of 9 different service categorys from *wellness offer* of these 16 *wellness centres.* In the course of data processing the analysis, synthesis and interview methods were used. The results were transformed into percentages and frequencies and outlined in charts and tables to facilitate their interpretation.

* *Young researcher award*

Results

According to the records of the tourism sector of the Croatian Chamber of Economy there are sixteen *wellness centeres* in Croatia. The research was conducted only in those situated on the Croatian Adriatic coast. Most of them are recently reconstructed or newly built and offer a wide array of *wellness* services which are further listed in the below table and analysed in histograms and frequency charts.

"Wellness Hotels" which are on the list of Croatian Chamber of Economy (HGK) are the following: 1.Sol Umag (UMA), 2.Sol Koralj (KOR), 3.Diamant (DIA), 4.Villa Astra (AST),

5.Millenium (MIL), 6.Ambasador (AMB), 7.Admiral (ADM), 8.Bonavia (BON), 9.Solaris (SOL), 10.Bratanide (BRE), 11.Uvala (UVA), 12.Argentina (ARG), 13.Pinija (PIN), 14.Croatia (CRO), 15.Meteor (MET), 16.Palace (PAL)

Table1 gives an outline of the hotels which offer *wellness services and programmes.* There is also a list of all *wellness programmes and services* which are classified in groups according to their characteristics. (All the hotels have a swimming-pool.)

Table 1

HOTEL	MASSAGE	SOLARIUM	BEAUTY	FITNESS	SAUNA	BATHS	JACUZZY	HOLIST.+ EDU.PROG	KINEZ. PRO.
1 UMA	11	1	18	1	3	3	1	0	0
2 KOR	22	0	17	1	2	6	1	5	2
3 DIA	10	1	20	1	4	9	1	0	0
4 AST	8	0	3	0	0	2	0	3	2
5 MIL	10	1	20	1	2	0	1	0	1
6AMB	3	1	8	0	1	0	0	0	0
7ADM	/	/	/	/	/	/	/	/	/
8BON	/	/	/	/	/	/	/	/	/
9SOL	8	2	20	1	5	1	2	0	1
10BRE	18	1	24	1	4	1	1	6	1
11UVA	8	1	19	1	3	7	2	0	1
12ARG	18	0	25	1	2	0	2	3	1
13PIN	5	1	10	1	1	0	0	0	0
14CRO	5	2	10	1	2	0	1	0	0
15MET	5	1	10	1	2	0	2	0	0
16PAL	11	1	18	1	2	0	2	0	0
493	142	13	222	12	33	29	16	17	9
100%	28,8 %	2,6 %	45,6 %	2,4 %	6,7 %	5,9 %	3,2 %	3,4 %	1,8 %

The subject table shows that *beauty treatments* make up the largest percentage of the total *wellness offer* (45.6 %). Massages hold the second place with (28.8%), while there is a significant shortage of educational and holistic programmes which make up just (3.4%) of the total *wellness offer* as well as kinesiology courses focusing on relaxation techniques which make up only (1.8%). The predominance of beauty treatments and other passive relaxation programmes is undeniable whereas there is a considerable shortage of different educational, kinesiological and preventive programmes and medical services, which represent a vital segment of the *wellness concept.* Without the latter ones the overall healthiness may not be achieved and neither may the wholeness of the *wellness offer.* Although in the majority of the mentioned hotels there are additional sports and recreational activities, kinesiological exercises with an relaxing character (the so-called body and soul programmes) are insufficient and so are the educational programmes aimed at teaching the individual how to help himself and permanently improve the quality of life in all segments.

These programmes include better knowledge of ones body, physiological, emotional and mental processes, communication with oneself and ones environment, learning techniques aimed at relaxation of body and mind, concentration and focusing skills, and other techniques whose purpose is to obtain better understanding of oneself and one's actions and to learn how to point these actions towards the desired goal.

We will further discuss the importance of including such programmes in *wellness offer.* We will also discuss their features and list the specific programmes that might contribute to a better quality and a broader scope of *wellness services.*

Discussion

Wellness concept is a lot more than enjoyable relaxation treatments, saunas, aromatherapy oils and lamps which are currently the core of the wellness offer in Croatia. Having in mind the complexity of the *wellness concept*, its goal may not be achieved merely by beauty and relaxation treatments. Therefore in order to achieve this goal *wellness offer* should

be supplemented with additional programmes. Among many programmes that are aimed at preserving and improving health, *weellness*, that has appeared in the last several decades, integrates various programmmes and treatments intended for the contemporary person for the improvement of health. (Andrijašević, 2005)

This type of programme requires active participation of the individual as well as awarness and dedication to learning. The essential problem of people today is that they expect others (doctors, aesthetic surgeons, healers, magic slimming pills and painkillers, rejuvenating creams etc.) to take care of their health and happiness.

It is almost as if they do not want to see through and understand that they have to change themselves and their way of living, in order to change their lives for the better. Nevertheless it is ourselves who are most responsible for our health and happiness which means that in addition to outside help (experts, products and so on) we have to take our own efforts. It is therefore necessary to learn how to help ourselves, how to achieve awareness, harmony and right living habits which implies that we are actively involved at mental, emotional, physical and spiritual levels. This is the most difficult way but it will yield the long self directed learning, and permit us to feel good in our skin, to live in peace with ourselves and to find pleasure in life.

When we go on holidays and use *wellness* services we want to feel well and we almost always succeed in it. This is the time when we feel free. We do what we want and not what we have to do. However, our daily work life is different. We are restricted in many ways, which is frustrating and causes stress and various phychosomatic disorders and illnesses.

The main problem is constant physical and psyhical tension brought on by permanent conflicts within ourselfes and with the environment. Conflicts between what we want to do and what we have to do, or caused by not being able to do everything we want or have to do in a limited period of time. This is why we often make concessions that are in conflict with our beliefs so we gradually lose ourselves which again creates tension, dissatisfaction on the psychological and subsequently physical level as well.

The American Medical Association reports that 80% of illnesses are stress-related.

According to the American Institute of Stress, stress is a reason for many physical and psychological disorders most of which represent common illnesses and causes of death of the present day. (www.clarityseminars-nw.com)

These disorders are also known as managerial illnesses. This is the reason for the present day's increasing need for rest and relaxation which results in a rising number of relaxation programmes, techniques aimed at reducing stress, and permitting ones body to recover. This includes getting in touch with oneself and becomming aware of ones needs, views, wishes and with ones true self. Finally, *wellness* arises as a result of this needs.

Wellness centres of many European and other tourist destinations include a wide range of kinesiological programmes, programmes for body and soul, various spiritual techniques, many medical and diagnostic services. It includes as well various educational programmes that teach us how to cope with stress, how to improve communication skills, eat healthy, how to think and feel with more effiency and harmony, how to uncover one's own potentials and get rid of everything that blocks us, so that we may function in harmony with our self and our environment. These programmes are conducted by skilled persons which use individual approach or practice in small groups.

The basic principles of such *wellness programmes* include: creating awareness of our psychosomatic reactions, learning to relax mentally and physically, to integrate physical and psychological aspects of our being, to breathe properly, to become aware of one's body and its limits, to make the senses keener so that we can perceive any potential harm to the natural balance within our bodies, and to recognize the illness at its very beginning . Since we live in pressure, we do a lot of things automatically and half consciously, we simply speed through time without being aware of what is going on with us. Consequently, we gradually lose touch with ourselves and lose sight of our true needs until something suddenly stops us and "tells us" that we have disturbed our natural balance and that we are doing something wrong. Unfortunately these 'messengers' are almost always the bearers of bad news which usually take the form of backpains, headaches, hypertension, heart attacks and other discomforts. *Wellness programmes* and services are an excellent instrument which helps us to learn how to keep life's balance.

Relaxing kinesiological bodywork which is focused on psychophysical health and which may supplement the range of services in Croatian *wellness centres* includes:

RELAX YOGA, DYNAMIC YOGA, STRECH &RELAX, WALKING YOGA, ANTISTRESS WORKOUT, PILATES YOGA, MEDICAL YOGA, THAI CHI, YOGA IN THERMAL WATER, MEDITATION, BREATHING EXERCISES and many other programmes.

The main characteristic of this type of *wellness programme* is the synergy of physical, emotional and mental aspects of every individual. We are consciously trying to connect the body and soul which teaches us to feel the presence of this moment. We do not allow our body to "function" automatically and our mind to wander somewhere else being busy thinking and making plans for the future and lingering over the past. Furthermore these programmes are focused on individual performance, awareness, relaxation, feeling one's own limits and potentials which allows better understanding of oneself. Learning about conscious reaction is particularly important factor on both the physical and psychological levels. Learning how to master relaxation reactions permits the individual to stay relaxed even in stressful situations and it is an excellent means of preserving health and fighting stress. (Benson, 2001)

Conclusion

Considering its climate, natural environment and the benefits of the overall natural healing agents Croatia has ideal prerequisites for implementation of these programmes. Most of them may be implemented both outdoors and indoors, in all seasons which means that tourists may be attracted to its rich offer the whole year long. Since almost every *wellness centre* provides pool, sauna, solarium, whirlpool bath, relaxation and other facilities it is clear that weather conditions or winter season will not prevent guests to benefit from these services and have a nice rest. Supplementation of the existing *wellness offer* will enable guests to spend a quality time on holidays regardless of the time of year. Thus, the basic goal of *wellness* consisting in recovering full health, development of one's potential, creativity and achieving a better quality of life might be realised. Only by creating awareness, developing potentials and achieving one's healthiness a breakthrough may be made in any segment of the society and the society as a whole.

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A WELLNESS PROGRAM: IMPACT OF YOGA*

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Abstract

Extensive research has demonstrated that stress is one of the main causes of health problems of the modern society. The most evident among them are the so-called "managerial illnesses" and "silent killers" such as hypertension, overweightness, diabetes, headaches, insomnia, nervousness and depression which are often the indicators of more serious complications that may have a fatal outcome. The purpose of this research is to find out to what extent can yoga contribute to the prevention and therapy of such complications.

Key words: *yoga, effects on physical and mental health, wellness*

Introduction

Inufficient physical activity, a heavy work schedule, and a busy rhythm of life result in the decrease of health and work efficiency. There is an increasing number of well documented studies evidencing a relation between this way of life and rising occurrence of many chronic diseases and low functional capacity of the body (M. Mišigoj-Duraković, 1999). Chronic physcial and mental overload brings on negative stress which is the main cause of most of the modern day illnesses resulting in an ever rising percentage of ill and dying population. The American Medical Association reports that 80% of all diseases are stress related.

Having in mind that the adequate physical activity is an important factor in preserving health, recreation activities shall include suitable sports activity as well as the training load necessary for achieving positive goals (M. Andijašević, 2000).

A Medical Yoga programme has been developed for persons exposed to modern busy rhythm of life, stress, and worries which brought on the typical modern-day discomforts such as: backpain, nervousness, insomnia, headaches, increased body weight, hypertension etc. This concept comprises physical exercises, breathing exercises, relaxation exercises (yogic deep relaxation techniques, autogenic training, meditation), seminars that teach how to improve one's health by means of yoga and other exercises, how to change one's habits, reduce negative stress in life and prevent the occurence of some illnesses.

Yoga is a specific system of physical and mental exercises aimed at reaching harmonious, conscious and control over one's body, emotions and thoughts so that overall healthiness, spiritual growth and well-balanced life of the individual and therefore a society as a whole might be achieved (Fraser, 2002).

Based on researches carried out on the positive effect of yoga techniques on fighting illnesses caused by stress, one hypothesis states that yoga is ideal as a therapy and prevention of some discomforts which affect the largest share of the modern-day population. (6)

Since 1984, the National Institute of Health recommends meditation over prescription drugs as the first treatment for mild hypertension.

Since yoga does not only include mere physical exercises but integral approach to healthiness it is recommended that it shall be included in wellness services as a programme that improves physical, emotional, mental and spiritual health.

This survey is aimed at determining the subjective assessment of health from individuals who practice yoga as well as answering the question if there is a connection between regular yoga exercises and the individual's health and quality of life.

Methods

The sample of respondents

The respondents in the conducted survey consisted of eighty-one women whose mean age was 45.47 years. They have been practicing yoga for 2.69 years on average, two or three times a week.

The sample of variables

The sample of variables consisted of twelve questions from the stated survey referring to health after a longer period of yoga practicing. Two of the questions refer to the; *age of respondents* (Y) and the *period of practicing* (YP).

* *Young researcher award*

The variables related to the subjective sensation and healthiness are the following: (POS PSY) *Before I started practicing yoga I believed in its positive psychological effects*; (PSY) *I can feel positive psychological effects of yoga*; (PHY) *Before I started practicing yoga I believed in its positive physical effects*; (POZ PHY) *I can feel positive physical effects of yoga*; (INSOMNIA) *Since I started practicing yoga, I have stopped suffering from insomnia*; (NERV) *Since I started practicing yoga, I have stopped experiencing nervousness*; (HEAD) *Since I started practicing yoga, I have not had any more headaches*, (BACK) *Since I started practicing yoga, I have not had any backpains*; (PRESSURE) *Since I started practicing yoga, my blood pressure has returned to normal*; (CONCENTR) *Since I started practicing yoga, I have improved my concentration skills*; (MOOD) *Since I started practicing yoga, I have been in a better mood*; (SATISFY) *Since I started practicing yoga, I have been more satisfied with myself*.

The predictive variable *How many years have you been practicing yoga* (YP) is set against the set of criteria variables referring to psychological, somatic and subjective sensations which can be attributed to mental stability, and relates to positive psychological and physical effects of practicing yoga, fewer occurrence of insomnia, fewer headaches and backpains.

The respondents were able to circle several responses that were ranked according to the Likert scale in the following manner:

Response Completely False (RCF) = 1 point
Response Partly False (RPF) = 2 points
Response Undecided (RU) = 3 points
Response Partly True (RPT) = 4 points
Response Completely True (RCT)= 5 points

Statistical analysis

Some statistical methods have been used in the intent to achieve the set goals: descriptive analysis (N-number of respondents, AS-arithmetic mean, minimum and maximum results, SD-standard deviation), analysis of frequencies (F) and percentages (%). In further statistical interperetation, regression analysis has been used in which predictive variables represented the survey questions associated with psychological, somatic and subjective sensation whereas criteria variable represented a time frame referring to the months or years of yoga practicing.

Results and discussions

Table 1: Descriptive parameters of variables

	AS	Minimum	Maximum	SD
Y	45.47	15	69	11.72
YP	2.69	1	5	1.53
PSY	4.02	1	5	1.02
POS PSY	4.52	1	5	0.82
PHY	4.26	1	5	0.93
POS PHY	4.54	2	5	0.69
INSOMNIA	3.30	1	5	1.04
NERV	3.68	1	5	0.91
HEAD	3.43	1	5	1.06
BACK	3.64	1	5	1.10
PRESSURE	3.35	1	5	0.90
CONCENTR	3.75	1	5	1.07
MOOD	4.25	1	5	0.90
SATISFY	4.49	1	5	0.87

Table 2: The total share of frequencies and percentages:

	PSY		POS PSY		PHY		POS PHY	
	f	%	f	%	f	%	f	%
1. RCF	2	2.47	1	1.23	2	2.47	0	0
2. RPF	7	8.64	3	3.70	3	3.70	1	1.23
3. RU	8	9.88	2	2.47	6	7.41	6	7.41
4. RPT	34	41.98	22	27.16	31	38.27	22	27.16
5. RCT	30	37.04	53	65.43	39	48.15	52	64.20

Table 2 shows the frequencies of positive psychological and physical effects after practicing yoga. The variable *I can feel positive psychological effects of yoga* shows the greatest frequency in which 65.43% of respondents circled "Completely True". Second comes the variable *I can feel positive physical effects of yoga* in which 64.20% of respondents answered "Completely True".

Table 3: The total share of frequencies and percentages

	INSOMNIA		NERV		HEAD		BACK	
	f	%	f	%	f	%	f	%
1. RCF	4	4.94	2	2.47	4	4.94	3	3.70
2. RPF	11	13.58	4	4.94	8	9.88	10	12.35
3. RU	35	43.21	26	32.10	33	40.74	20	24.69
4. RPT	19	23.46	35	43.21	21	25.93	28	34.57
5. RCT	12	14.81	14	17.28	15	18.52	20	24.69

The results from Table 3 show us variables referring to the psychological and medical status of respondents after praciticing yoga. The variable *Since I started practicing yoga, I have not had any backpains* has the greatest positive effect, in which 24.69% of respondents answered "Completely True" and 34.57% of them answered "Partly True". The variable *Since I started practicing yoga, I have stopped experiencing nervousness* yields 43.21% of answers "Partly True" and 17.28% of answers "Completely True".

Table 4: The total share of frequencies and percentages:

	PRESSURE	PRESSURE	CONCENTR	CONCENTR	MOOD	MOOD	SATISFY	SATISFY
	frekv.	%	frekv.	%	frekv.	%	frekv.	%
1. RCF	3	3.70	4	4.94	2	2.47	2	2.47
2. RPF	5	6.17	0	0	0	0	1	1.23
3. RU	43	53.09	34	41.98	13	16.05	5	6.17
4. RPT	21	25.93	17	20.99	27	33.33	20	24.69
5. RCT	9	11.11	26	32.10	39	48.15	53	65.43

Table 4 leads us to the conclusion that the variable *Since I started practicing yoga, I have been more satisfied with myself* in which 65.43% of respondents answered "Completely True" has the greatest positive effect. The variable *Since I started practicing yoga, I have been in a better mood* in which 48.15% of respondents answered "Completely True" also has a significant positive effect on phychological condition.

Table 5: Regression analysis of the effects of predictive variables on the criteria variable(How long have you been practicing yoga?)

	r	Part r	Beta	t(74)	p
POS PSY	0.24	0.27	0.32	2.40	0.02
PHY	0.12	0.11	0.11	0.99	0.33
POS PHY	0.24	0.19	0.21	1.70	0.09
INSOMNIA	- 0.02	- 0.23	- 0.29	- 2.03	0.05
HEAD	0.11	0.17	0.22	1.48	0.14
BACK	0.07	- 0.18	-0.21	- 1.53	0.13

(r – correlation coefficient, part-r – partial correlation coefficient, Beta – standardized partial regression coefficient, t(df) – t-value of significance test of regression coefficient (df – degrees of freedom), p – level of significance of t-test, R – multiple correlation coefficient, R^2 – determination coefficient (% of interpreted angular deviations), F(df1, df2) – F value of significance test of multiple correlation coefficient, p – level of significance of F - test)
Multiple R = 0,39; R^2 = 0,154; F (6, 74) = 2,25; p = 0,04

The results of regression analysis provided in Table 5 point to a significant statistical effect of predictive variable *How long have you been practicing yoga?* on the criteria variables (p=0.04).

Among all criteria variables the ones that have the greatest correlation with the predictive variable are questions (POS PSY) and (POS PHY), whereas the predictive variable has the greatest effect (Beta) on criteria variables (POS PSY) and (INSOMNIA) in which $p < 0.05$.

The results may be explained by the fact that the respondents who have been practicing yoga for a longer period have fewer discomforts and feel better physically and psychologically.

Conclusion

The research on the subjective sensation of psychophysical changes in health condition and the improved quality of life while practicing yoga has demonstrated that practicing yoga several times a week has major physical and psychological effects on health and particularly on the decrease of discomforts caused by stress for this sample. In every day life yoga has positive psychological and physiologic effects which can be seen in a considerably lower occurrence of headaches, backpains and insomnia. The results of regression analysis have demonstrated that the longer the respondents have been practicing yoga, which is on average 2.69 years i.e. almost three years, the fewer are their medical problems, insomnia occurrences and greater are positive psychological effects.

Since an increasing number of illnesses, discomforts and deaths is being brought on directly or indirectly by unhealthy living habits, in other words by psychophysical unbalance, the search for as efficient as possible methods for their prevention and therapy are being seeked. This unbalance is manifested in the complications such as hypertension,

diabetes, insomnia, nervousness, spinal disfunction, headeaches, poor concentration, depression etc. which all have serious impact on health status.

If we look into the basic goals of wellness such as preserving health, maintaining balance, achieving harmonious and productive way of life and overall healthiness, we may suggest that yoga fits perfectly in this concept. Yoga represents a positive wellness programme since it affects all aspects of human health: physical, emotional, mental and spiritual. It may be practiced by people of all ages, both sexes, varying health condition and it may be adapted for practice indoors or outdoors, for work in groups or individual practice. This is why we recommend yoga as a therapy and prevention of many discomforts, illnesses and problems incurred by stress and unhealthy living habits, so that full health and the quality of life might be achieved.

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INTERPRETATION OF THE EXERCISE INTENSITY IN CLASSICAL PILATES AND PILATES BODY TECHNIQUE

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Abstract

This paper helps in the establishment of the exercise intensity in classical pilates, emerged from rehabilitation, and pilates body technique, which combines the positive effects of classical pilates and aerobics for a complete health-recreational approach. The absence of the aerobic exercise zone in classical pilates, required a specific number of changes in the very execution of exercises and the structure of the class. The first major breakthrough based on professional scientific experience regarding classical exercises, is represented by the additional pilates body technique, developed by Ana-Marija Jagodić Rukavina, author of this paper, a professor of physical education and a former dancer. These two techniques are analysed, according to the exercise intensity, criteria important for analysing the time spent in the specified moderate zone (own zone), calculated with Polar monitors.

Key words: *pilates, exercise intensity*

Introduction

There are two main reasons why various forms of bodily activity have an increasing number of course takers, through which they also become an important economic category. The first reason is for the improvement of health, as well as lessening and reducing back pain in a relatively short time period. The second reason relates to the reduction of body weight and the prevention of obesity.

The modern age, with a truly diverse offer of recreational activities, should produce sufficient room for satisfying individual needs and in that manner reduce ailing states and improve overall quality of life. Intensity and calorie usage of two relatively new recreational activities will be compared in this paper. One emerged from rehabilitation (classical pilates), and the other is a newer technique (pilates body), which combines the positive effects of classical pilates and aerobics.

Classical pilates is a method of body shaping, developed by Joseph Pilates 90 years ago. The technique was developed to make and keep the body and the mind healthy, according to the principle of mental muscular communication. On entering the world of recreation, Pilates' philosophy has made significant progress, since it is directed at training the body and the mind to act jointly towards achieving complete physical fitness. In classical pilates, there is no meditation or keeping of the bodily position like in yoga, there are no isolated muscular exercises like in the gym and in callenetics, and there is no standing position and more dynamic exercises like those in aerobics. Basically, the classical pilates technique, with its significant differences in relation to the other recreational exercise techniques, stands out in terms of: turning on the so called "power house" as the basis and start point for each exercise, the activation of the deepest muscular layers, prominent precision of dynamic movement, education of the people exercising regarding constant mental involvement during the exercise time, as well as balanced interaction of power and flexibility.

The first major breakthrough based on professional scientific experience regarding classical exercises, accepted in the field of rehabilitation, and also recreation during last decade, is represented by the additional pilates body technique, developed by Ana-Marija Jagodić Rukavina, author of this paper, a professor of physical education and a former dancer.

The absence of the aerobic exercise zone, or exercise of sufficient intensity from classical pilates, required a specific number of changes in the very execution of exercises and the structure of the class. Pilates body technique was developed to facilitate optimal physical health, because it simultaneously develops strength, flexibility and endurance. It is a "non-impact" type of training, but due to its specific dynamicity (especially in first 15 minutes of the class-standing position), it is still an activity of moderate intensity, in which, the heart's frequency goes above the low-intensity training level of the classical pilates and yoga.

Main distinction between these two techniques are in: *number of exercises* (600 clasical pilates; 2 000 body pilates), *in usage of positions* (sitting and lying positions are mostly used in classical pilates; standing positions with others are obligatory in body technique), and *in intensity* (classical pilates rarely exceeds HF of 110; in body pilates average HR is 120). The basis for this research lies in the awareness that the people attending classical pilates must partake in a more dynamic type of bodily exercise in order for them to have a balanced programme, directed at all components of health state (Nieman, 1998), and they are: skeletal state, psycho-motor state, cardio-respiratory state and body composition.

Today's faster way of life rarely allows for setting apart of time for personal recreation more than three times per week, which is a minimum prescribed by ACSM 1998.(*frequency*:3-5 days per week; *intensity*: 60-90 % of max. HF; *duration*: 20-60 continuous minutes; *mode*: walk, run, row, group exercise). In relation to this, IDEA published an article (Kennedy, 2005), in which it shows that the most frequented exercise class was 30 minutes long, due to the lack of time of the attendees.

This paper with the other research in that field helps in the establishment and defining of additions that the body technique has introduced to persons exercising for a complete health-recreational approach.

Materials and methods

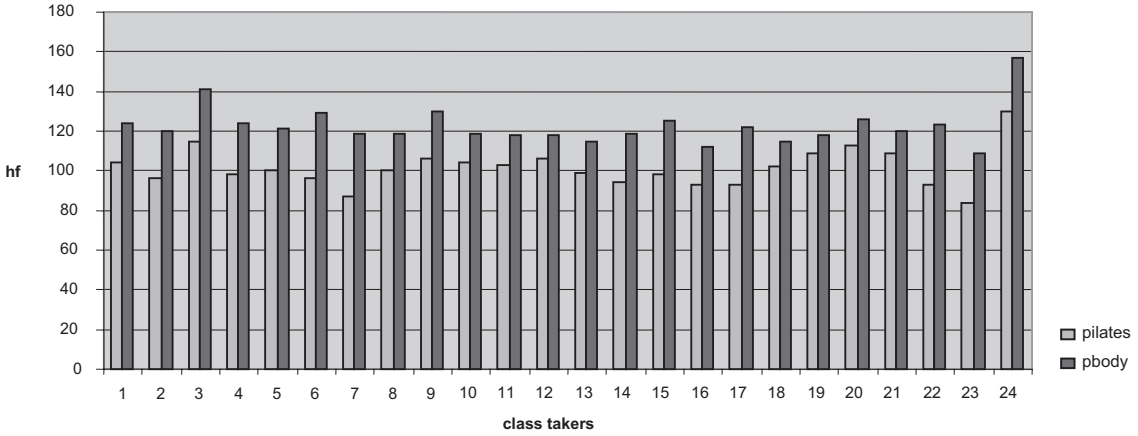
A sample of 39 female subjects was divided into a younger age group (21 to 40 years) and middle aged age group (41 to 60 years). The younger age group comprised of 24 and the older of 15 subjects. Each group was individually subjected to two day testing, carried out in Pilates Body Studio. On the first day, the female subjects performed classical pilates exercises in a 40 minute period, during the afternoon hours. The programme was conducted via a 42 inch plasma television, while the selection of exercises was for the exercisers with intermediate (intermediate mat work) experience, with Moira Sttot as the instructor. After two days, during the same time of the day, pilates body programme was conducted, also intermediate in intensity with pilates body technique instructors, recorded exclusively in the interest of completely objective testing in te 40 minute period.

Before the commencement of exercising, each subject received a heart rate meter (Polar m62), into which personal details were recorded (year, height, weight, sex) and according to the formula (Hrmax = 220-years of age), the desired heart frequency zone was calculated (target HR zone) of each female subject separately. Each heart rate meter showed individual time spent in the zone and the average heart frequency in relation to the total execution time of 40 minutes. In this paper, these are the two basic variables that will be graphically analysed with the aid of discontinued distributions.

Results and discussion

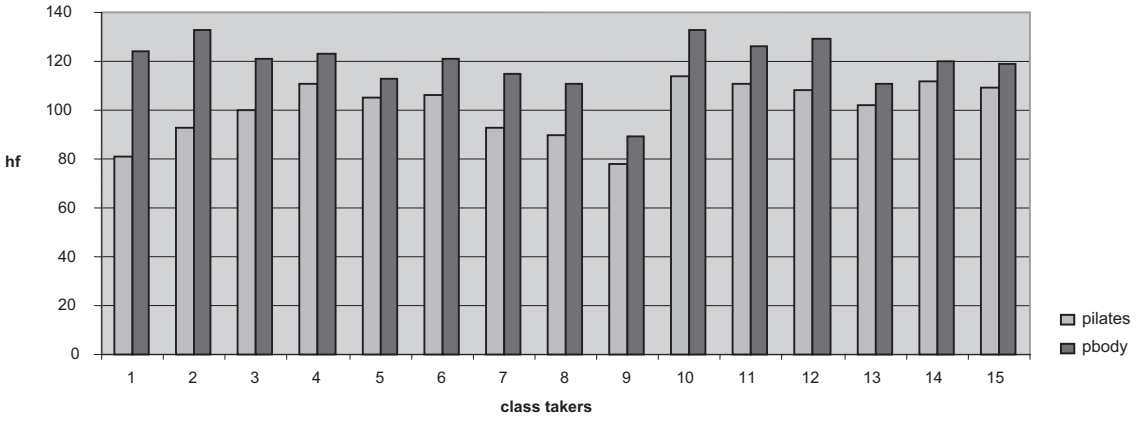
As the sample was divided into two different age groups, the results will also be analysed in this manner. The first variable that we describe relates to the average heart frequencies (HF) during the 40 minute exercise period of the younger age group (21-40). Due to physiological changes that arise because of aging, it needs to be pointed out that the 60% limit of maximal HF for the mentioned age group is located in the interval of 110 to 119 beats per minute. In view of that, using histograms, table 1 shows average individual heart frequencies achieved in classes of classic pilates and classes of pilates body technique.

Table 1. Average heart frequency values for the younger age group (21 to 40) measured using polar monitors during 40 minutes



It is to be expected that none of the average HFs drops below 80 beats as is the case in yoga. In classical pilates, the average HF for the younger age group is around 100 beats per minute, while in the pilates body class, it rises above 120. From the above stated, we can conclude that the majority of attendees of the classical pilates were under their 60% HF, while majority of the female subjects in the pilates body class achieved a loading little above 60% of HF. According to traditional views, exercising is recommended between 60 and 75% of the individual's heart rate reserve, which is considered to be safe, rational and efficient zone of intensity for achieving improvement in cardio-respiratory capacities. As that zone is somewhat lower in the middle aged population (41-60), also measured under the same conditions, table 2 shows average HF values for the middle aged in the 40 minute interval of the classical and pilates body class.

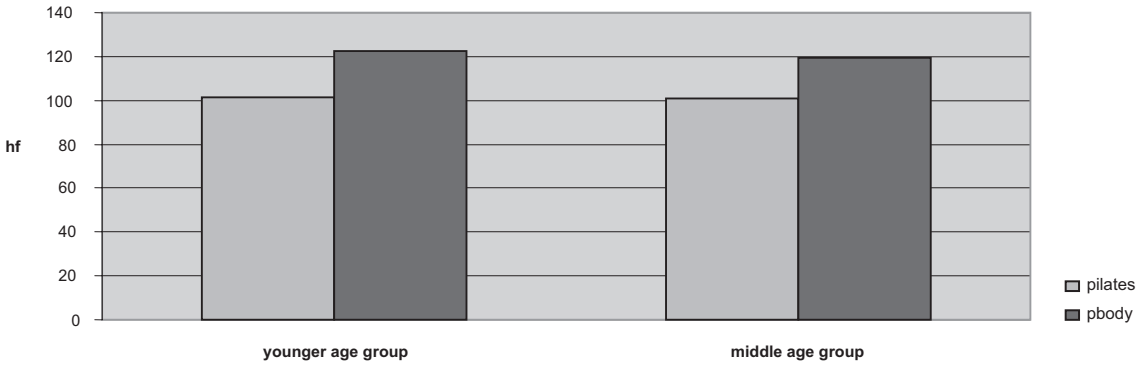
Table 2. Average heart frequency values for the middle age group (41 to 60) measured using polar monitors during 40 minutes



It is important to point out that in both groups, during the class of classic pilates, the average HF was around 100 beats/min., however, due to their older age, the 60% limit of the reserve heart rate is reduced to a range between 96 and 110. That is why the middle age population finds itself at the very 60% limit of the intensity of exercising in classes of classical pilates. In comparison to the pilates body class, their average HF is somewhat below 120 beats per minute.

As is evident in table 3, differences according to age in average HF in both programmes were not been noticed.

Table 3. Comparison of the average hf during the 40 minute exercise of classical and pilates body class for the younger and the middle aged groups



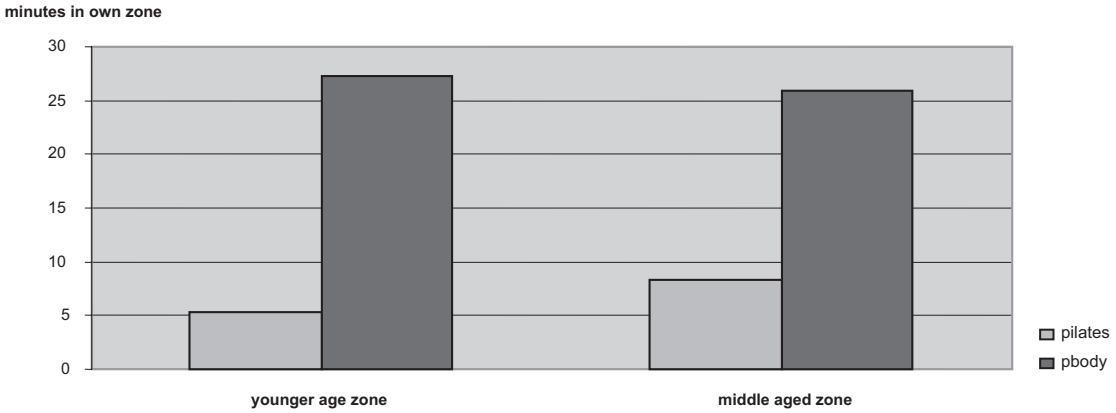
If the heart rate is at 50-60% of maximal HF, intensity of the activity that the exerciser is performing is low. An example of such intensity is a class of classical pilates for the younger age group (which doesn't mean that specific exercises were not hard for them, but they were performed at a too low intensity for improvement of their cardio-respiratory abilities).

Furthermore, if the heart rate is at 60-70% of maximal HF, intensity of exercise is above the moderate exercise zone, the best for reducing body weight and the safest for improving fitness level. According to the average HF indicators, majority of the class takers in both age groups fall precisely into that zone in classes of pilates body.

The next important variable, directly linked to the previous is the time spent in the specified moderate zone (own zone), calculated with Polar monitors, according to individual anthropological dimensions of the class takers and heart frequencies in the complete 40 minute exercise period. This variable is used to find how long the class takers of both programmes find themselves in moderate personal exercise zones. If the time indicator of personal exercise zone is below 15 minutes, it means that the chosen activity is not achieving the wanted intensity, because it is either too low or too high stimulant for the specific age group. Performing moderate (aerobic) activity, 20 to 60 minutes in duration, three times per week is traditionally recommended, and is considered sufficient for improving functional abilities and control of the body's composition.

Table 4 shows a drastic difference in the time spent in the zone of moderate (aerobic) exercise between classes of classic pilates technique and that of the pilates body.

Table 4. Comparison of the average own zone during the 40 minute exercise of classical and pilates body class for the younger and the middle aged groups



It is important to emphasise that for the recreational population, be they younger or middle aged, classical pilates most often represents low intensity training with the optimal exercising zone under 10 minutes, out of the whole 40 minute class. Pilates body class satisfies the recommendations for the intensity of exercising prescribed by numerous world health institutions (FIMS, WHO, ACSM…) because 25 to 30 minutes of aerobic zone is maintained.

Conclusion

According to the foundations by the World Health Organisation (WHO), for achieving optimal physical health, a new, non-invasive pilates body technique was developed by Ana-Marija Jagodić Rukavina, combining the positive effects of aerobics and classical pilates. Its continually wider usage in Croatia and Slovenia, as well as exceptionally positive response from recreational population on the one hand and educated, future pilates body instructors on the other, is the reason for forming its professional basis, which would explain some of the differences in comparison to the classical school and offer the recreational population yet another programme.

In whole, this paper shows the differences in intensity between the classical pilates and pilates body technique on a recreational sample.

For the majority of recreational population, classical pilates represents low intensity activity, inside which, a low 5 to 8 minutes of aerobic exercise zone is achieved. That is why, if they wish to achieve optimal physical condition, all those taking classes of classic pilates should supplement their activity with some form of more intensive exercise.

The individuals that attend classes of pilates body technique, exercise at moderate intensity, inside which, 25 to 30 minutes of aerobic zone is maintained, which is the optimal exercise zone according to the recommendations from world health associations and organisations.

Just like classical pilates, pilates body is a technique that is applicable to the broader population, from adolescent to older ages. In order to achieve all the positive changes of health fitness, the frequency of attendance of pilates body technique must be 3 times per week.

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SPORTS-RECREATIONAL POTENTIAL IN CROATIAN FIVE STAR HOTELS ACCORDING TO INTERNET*

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Abstract

The purpose of this research was to establish the diversity of sports-recreation in Croatian five star hotels. In the sample there are 11 hotels which are geographically grouped in three regions, and each of these regions is very appealing for tourists. The data of each hotel was found on the Internet, and after that every activity was classified according to the following division: 1) water activities 2) wellness programs 3) sports games programs 4) individual sporting and recreational activities 5) leisure time activities 6) outdoor activities 7) extreme sports-recreation programs 8) sports animation. Hotels Ambasador and Croatia provide the widest and the best offer. As the number of tourists who wish to spend their free time actively, in a certain destination, is growing every day, development strategy in Croatia should be based on a high number of high quality hotels, which will provide wide sports- recreational potential

Key words: *tourism, sports activities, guests, classification*

Introduction

In this paper the emphasis is on sports, or on the potential of sports-recreational . Today sport is present in all activities connected with free time, relaxation, health and holidays. Sport is increasingly introduced in tourism, resulting in various types of tourism. But still sport does not have the position or the significance that is should have.

The purpose of this research is to analyze sports-recreational potential in Croatian five star hotels.The data was collected by searching through the web pages on the Internet. This research also gave us the whole insight in hotel capacity with regard to the category and the characteristics of the regions in which five star hotels are situated. In Croatia there are 677 hotels which are classified in five categories (table 1). Since Croatia is a tourist country in development, the number of hotels will increase in the future, as will the quality, which can be seen in a growing number of four and five star hotels. Of all the hotels, only 11, or 1,5%, are of the highest category. Croatia is abundant with world famous and admired natural landmarks, as just a few countries in the Mediteran. Croatia should aim for quality, and in some tourist centers with long tradition, even to elite tourism. Without additional 20, 000 beds with four or five stars we will lose the race with our competition, because the number of demanding tourists who want this kind of accommodation, is growing each day. We have 250 one or two star hotels, but it is getting harder for them to find clients. Just to compare, in Italy there are 250 five star hotels, and in Croatia only 11 (Verković, 2005). So it is important to increase the number of high quality hotels with a suitable offer.

Table 1. Number of hotels according to categorization

Category	*	**	***	****	*****	All together
Number of hotels	48	202	340	76	11	677

Source: http://www.croatia.hr

In Zagreb there are 34 hotels of different categories, and only three of them are five star hotels. Our capital takes up a quarter of our country's population and it is the centre of all major social, political and economic events during the whole year. This old mid-European town is also business, academic, cultural, artistic and sport center of Croatia. Near Zagreb, there is the fourth hotel from this region, Bežanec Castle.

The following three hotels are situated in Opatija which is, together with its riviera, famous for its beauty and tradition in tourism, dating from the period of Habsburg monarchy. Beautiful nature, parks, old Austrian villas, promenades by the sea and exquisite beaches attract European and worldwide tourists for more than 160 years. Opatija is the leading tourist destination in Croatia when it comes to congress tourism. Numerous festivals, concerts and other cultural and sporting events are worth visiting during the whole year.

The highest number of five star hotels is in the extreme south of Croatia. This area is interesting for tourists because of Dubrovnik, an old town which was built in the ancient 7th century. It is a worldwide cultural heritage monument whose sights are under the protection of UNESCO, and it catches the attention of many tourists and tourist ships. Dubrovnik

** Young researcher award*

is listed on all Adriatic cruise maps. Its surroundings is also interesting, there are two national parks nearby, Kornati and Mljet. The center of Konavle, a beautiful district on the south of Croatia, is Cavtat, a town with the biggest five star hotel in Croatia, named "Croatia".

As a small tourist country Croatia should base its offer on the following advantages which will motivate tourists to choose it as their destination (Avelini-Holjevac, 2002):

- Undestroyed nature
- Healthy food
- Entertainment
- Sports

Methods

The data about 11 five star hotels in Croatia was collected on the Internet. Most hotels have their own web page, with numerous links important for the visitors, for example, location, rooms, connection, services, gastronomy, and what is most interesting for us, sports and entertainment. But, sports- recreational potential for some hotels was not so easy to find, so I had to search for that information on the pages of the agency that sells their board and lodgings, while some hotels, like the Ambasador, have special attachments within their offer, where you can find the data about the length of the trekking track, the height of the starting point, the equipment necessary for some activities, and many other details.

The sample of entities is made by all the sports or activities of sports recreation that can be found on those pages. That sample does not cover all the possible sports or activities of sports recreation for people to be involved in, or the activities that are possibly present in the hotel but are not presented on the Internet.

Diversity of activities and sports, in which tourists take part in outside their permanent residence, confirm the fact that active relaxation has became the choice of a great number of guests. Variables are defined based on the existing theories in kinesiology in the field of sports recreation. Eight variables were used (Bartoluci and Andrijašević, 1999; Trkulja Petković, Ciliga and Pavičić, 2004): 1) water activities 2) wellness programs 3) sports games programs 4) individual sporting and recreational activities 5) leisure time activities 6) outdoor activities 7) attractive/extreme sports-recreation programs 8) sports animation. Every sports activity, based on assessment of the author, is categorized in one of the variables.

Recreation activities have several meanings (Berc-Radišić, 2004):

a) they make the stay in a hotel and in a certain destination more interesting and complete
b) they contribute to preserve and improve physical and mental abilities and the complete health status of tourists
c) they increase the attraction of hotels, and the interest of tourists for hotels
d) they increase the income of hotels

Results

Based on the Internet research there is an evident difference in sports-recreational offer from hotel to hotel. The complete sports-recreational offer of each hotel with all the activities is presented in table 3.

The emphasis here will be on those activities which are new, specific for a certain hotel, and could be very interesting for tourism in Croatia.

1) Water Activities

Water activities include school and training such as swimming, sailing, rowing, renting of the equipment of diving, kayaking, water skiing, tours and excursions. Hotels situated on Adriatic coast are in advantage in comparison with inland hotels, because some activities are possible to perform only on big bodies of water such as sailing or diving or exclusively on the sea. These activities hotels usually leave to the local organizer, who then conducts them in the hotel's premises. There is a diving centre in almost every hotel, and they also offer many different recreational activities (Ambasador, Croatia, Dubrovnik Palace). Sailing and windsurfing is only offered in Ambasador, while boat excursions are only conducted at Mozart in Opatija.

2) Wellness programs

As the word itself says, this includes activities with a well known good feeling. Here are listed activities which we do in our free time, and because of that there are no strict rules for doing them. All these activities influence our psychophysical abilities if they are conducted through a longer period of time. Wellness and fitness activities have been included in the offer for years, and are acceptable to most hotels, but not all of them are of the same quality. The Ambassador has three welness programs (Relax, Antistress and Meditation and Yoga). In almost every hotel there is a fitness gym (Croatia, Dubrovnik, Palace, Excelsior, Grand villa Argentina, Millenium, Sheraton, The Regent Esplanade, Westin).

3) Sports Games Programs

Cooperation between the members of the team is very important for these kinds of programs, because the result depends on that cooperation. The goal is to win against the rival team, or to reach a certain achievement which is judged according to aesthetic criteria. These programs stimulate the development of interpersonal relationships, friendships and diminish the feeling of loneliness. The most common activity is beach volleyball, which is present at most destinations (Ambasador, Croatia, Bežanec Castle, W.A. Mozart). Of all other sports games, we only have basketball in hotel Croatia.

4) Iindividual Sporting and Recreational Activities

In distinction from the previous category here the result depends only on the abilities and skills of the individual. Activities that can be performed here do not depend on other people, or on the space, time and duration. These sports are available in following hotels: riding (Ambasador, Bežanec Castle), tennis (Ambasador, Croatia, Dubrovnik Palace, Millenium, Bežanec Castle). When it comes to other sports, you can play table-tennis in Croatia, and you can relax with badminton in Bežanec Castle.

5) Leisure Time Activities

When on vacation, your goal does not always have to be to win or to make a good result. The goal can be the activity itself, pleasure, relaxation, having fun, or a good feeling. Here activities can be divided on those with kinesiological character (e.g. bocce) and with sociological character (eg. chess). Three hotels have archery (Ambasador, Croatia, Bežanec Castle). In "Croatia", besides with bow and arrow, you can also shoot with air-gun. There are billiards in Croatia, Bežanec Castle and Excelsior. In Croatia we have bocce and darts.

6) Outdoor Activities

In today's way of life people often use every chance to go to the country, to escape from the urbanization and to go to nature, so these programs are very popular in our destinations. These programs are used very often, because they do not require any other equipment except clean environment. You can find walking and jogging paths in Croatia, Dubrovnik Palace and W. A. Mozart. You can also jogg in Regent Esplanade. If you want to rent and ride a bike, then you should come to Bežanec Castle and Mozart. In the Ambasador you can try one new activity- trekking, while Bežanec Castle offers moped rides.

7) Attractive/Extreme Sports- Recreational Program

What is interesting and attractive in these programs are the excitement as well as danger. Each day more and more of these activities appear, but there is even a greater number of consumers. When it comes to this programs, only two hotels have attractions in their offer. For example, if you want to enjoy in the panoramic hot-air balloon flight, or spend your day hunting, then Bežanec Castle is the right place for you. The Ambasador, thanks to two animators in its team, has a very good offer of team building program, which includes activites like paintball, fire, the wall, cobweb, orientation games, treasure hunt, water balloons and paragliding.

Table 3. Complete sports- recreational offer

Ambasador	1) Diving, Windsurf, Sailing 2) Fitnesss, Wellnes (Relax, Antistress, Meditation and Yoga) 3) Volleyball 4) Tennis, , Riding 5) Archery 6) Treking, Biking 7) Team Building (Fire, Paintball, The wall, Cobweb, Water balloons, Terasure hunt, Orientation games, Paragliding 8)Two sports animators
Croatia	1) Water sports (Diving, Water skiing, Kayaking, Rental scooter) 2) Gymnasium, Massagge, Morning gym, Aqua aerobic, Aerobic 3) Beach volleyball, Basketball 4)Tennis, Table tennis 5) Darts, Billiards, French balls, Target shooting (Rifle, Archery) 6) Walking, jogging 8)One sports animator
Dubrovnik Palace	1) Dive center 2) Fitness, Gym, Jacuzzi, Thalassotherapy centre, Sauna 4) Tennis 6) Jogging, Walking
Bežanec Castle	3) Volleyball 4) Riding, Tennis, Badminton 5) Billiards, Archery 6) Bikes, Mopeds 7) Flying a hot-air balloon, Hunting by arrangment
Excelsior	2) Fitness, Gymnasium, Jacuzzi, Massagge and Beauty treatments, Turkish bath, Steam room, 4) Pool table
Grand villa Argentina	2) Fitness, Aquatic activities, Wellnes centre, Sauna 8) Energy Clinic staff
Millenium	2) Fitness, Underwater massagge, Whirpool, Wellness program, Finnish sauna, Steam bath, Solarium, Massagge 4) Tennis
Sheraton	2) Fitness, Whirpool
The Regent Esplanade	2) Health club, Saunas, Fitness room 6) Jogging
Westin	2) Solarium, Fitness rooms, Massagge, Heated indoor pool, Sauna
W.A. Mozart	1) Water skiing, Banana skiing, Boat excursion 3) Beach volleyball 6) Biking, Walking, Jogging

8) Sports Animation

Large hotels should have organizers and animators of recreational activities. Their main duty would be to make sure that all recreational activities are in function and to meet the needs and satisfaction of the guests.They are also the best way for the hotel-manager to get the feedback from the guest when it comes to sports- recreation but also for everything else. In the Ambasador two leaders created very good, modern and attractive sports-recreational offer, which every hotel would be proud of. In "Croatia" there is also sports animation and a weekly practice program, with nine activities, which are organized and conducted by one sports animator. In Grand villa Argentina the staff of Energy Clinic will take you through fitness exercises and help you with your water exercises.

Discussion

In Croatia there are 677 hotels which are classified in five categories, and only 11 of those are five star hotels. These 11 hotels are grouped in three regions, each of which is specific in its own way: Zagreb, Opatija and Dubrovnik. Since the competition in tourism is growing every day, Croatia should increase the number of four and five star hotels, and not just in these three regions, but in the whole country.

Going through the web pages we were trying to get to know and to emphasize the position of activities of sports-recreation in each hotel. Two hotels which have the widest and the best offer are the Ambasador and Croatia. The acknowledged differences take us to the conclusion that the same programs can not be conducted in every hotel, but each hotel needs to make its own original sports-recreational offer according to financial possibilities, position of the hotel, guests interests, and available specialized staff.

It is necessary to work out a startegy which will coordinate the criteria of the development of the hotel itself, but also of its sports-recerational programs. Specialized staff must have the key role in creating these kinds of programs which will enable quality and meaningful stay in a hotel.

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SPORTS RECREATION IN TOURISM AND SPORT TOURISM (AN EXAMPLE FROM HUNGARY)

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Abstract

Sport, tourism and recreation. All three terms have their own particularities, as any other social phenomena. They all have their own subjects, but comprise several common features as well. These common features form the base of my lecture. Health is the most important value. This statement is well known for everybody, yet we do so little to keep healthy. In connection with health and free time activities a special attention is paid to recreation, sport and to tourism. When comparing these activities we can find common elements, which could also realise in sport tourism, as a possible means of recreation. In my study I have gathered – based on the literature available for me– the sport activities pursued during tourism, which I compare with the results of my own surveys carried out on sport tourism.

Key words: *body culture, health, harms of civilisation, motivation, demand*

Introduction

When talking about sport tourism, brief historic outline of the development of body-culture and tourism has to be done. What social and economic backgrounds made it possible to develop at present day's stage. Looking back, it is not easy to decide which activity type existed before the others. But one thing is sure, according to the historiographers all three phenomena are as old as mankind, since their roots go back to prehistoric and ancient times.

The origin of body-culture dates back to those ancient times of the human development when all physical and intellectual activities served nothing more but mere existence (Kun, 1990). Whether it was the constant struggle with the nature (and in what way) that made our ancestors create exercises is not known even for the historiographers. They can only state that "sport is eternal", and that sport "was created together with mankind" (Kun, 1990). Later the magic preparations for hunting resulted in the activities that were later called exercises. These ceremonies took place in the people's free time, as we would call it today.

In those times mankind lived in perfect harmony with the nature. The types of exercises as we mean them today have developed slowly, and in the meantime the need for recreation has also emerged. It was in the 17th century that this idea was born, when John Locke said that the right of recreation and holiday is justified only for active people. At the same time he formed the basis of the later recreational movement's approach to active relaxation (Kun, 1990). Locke believed that "… the holiday and the amusement … does not mean inaction, but an ease to the exhausted body by giving new directions to our activities." Here we can find the essence of recreation: sustaining and regaining the ability to work, and to produce. "**Recreation** …is the culture of how to spend the free time, …creating wellness and welfare. Its means are the dance, the hobbies, … and the most diverse types of sports. Its objective is the preservation of health, and the stabilisation of the optimal intellectual and physical abilities" (Kovács T. Attila, 1998). The purpose of recreation is a healthy way of life, which results in a high-standard way of life while preserving health.

Similarly to body culture (to sport and recreation), tourism also roots in the ancient times, since the primary motivations of tourism were already present. Ancient "tourists" were eager to get to know the traditions and customs. Motivations have constantly widened during history. Trips for medical treatment, religious pilgrimages, the travels of guild-servants and the aristocracy all prove that the urge to discover the world, to search the "different" have always been present during history, though with different emphasis. The primary motivation of modern people of taking part in tourism is also to search for the "different". Technical development has enlarged the choice of possible destinations, so in the 21st century, based on their social backgrounds, tourists can travel from the depth of the seas to the universe itself. This technical development has enlarged the possibilities, on the other hand has influenced negatively the people's natural residential area and health. Environmental destruction, harms of civilisation, and health protection all urge modern people to leave their everyday life (based on their social background), and to become a tourist for a certain period of time, and then to arrive home relaxed, and full with experiences.

There are some common elements and features of recreation, sport, tourism and sport tourism as well. While travelling, tourists wish to satisfy various demands and the motivation of their demands. Based on the motivations we distinct different types of tourists (e.g. sporting tourist, shopping tourist) and different types of tourism (e.g. professional tourism, sport tourism). As to my study, it is sport tourism motivated by sport activities that has an important role in recreation, since they have many common features in objectives, in motivations etc.

The definition of sport tourism is not widely spread in the Hungarian terminology. Although the phenomenon itself existed in the ancient times as well (let us think of the messengers, the competitors and the watchers of the ancient Olympic Games), it has become a subject of research only recently.

The phenomenon I call sport tourism is often referred to as active tourism or recreational tourism by certain researchers (Michalko, 2003). But the definition of sport tourism includes the previous two ideas as well, since in my definition *sport tourism* is active or passive participation in sport activities in the form of tourism at the destinations, where the tourist arrives with leisure or business motivation.

What motivates people to participate in sport tourism? Primarily the changes in the way of life. The active way of life and the leisure sports, fitness and wellness are becoming more and more popular in Hungary as well. People wish to extend these regular exercises to the period of holidays as well, or maybe pursue a certain sport only in that time. Or maybe they wish to participate in sport events as a fan. Whether active or passive sport tourists are the travellers, their activity is surely more considerable than in the case of the former "relaxation" tourism.

Sport- and recreation-motivated travels have increased considerably in the past 15-20 years. So certain theoreticians (the theoretic experts of tourism) consider recreation, besides tourism, as a certain type of industrial sector. According to some estimations recreation means a yearly expenditure of $300 trillion, and the number of companies providing recreational products is also increasing (Cavlek, 2002).

According to the European Travel Monitor the most popular holiday activities are as follows: 1. swimming; 2. resting; 3. sunbathing; 4. pursuit of experiences 5. relaxation.

In Germany, which is a leading tourist resource power in Europe, the number of wellness-motivated travels has increased by 125% between 1999 and 2002, and the number of travels ensuring participation in fitness programs has increased by 51%.

In February 2001 in Barcelona, during the "World Conference on Sport and Tourism" several points have been pointed out as the mutually advantageous effects of sport and tourism on social development and the development of human values.

German, Holland and French surveys have shown the considerable increase of sport-related holidays. The most popular recreational sports in Germany are hiking 76 %, swimming 37 %, cycling 22 %, in Holland hiking 24%, alpinism 19%, mountaineering 9%, and in France diving 36%, mountaineering 21% and cycling 10%.

It is clearly visible that the open-air sport facilities stand at the first places in all three countries, and they mostly differ from the activities at the permanent place of living. In Croatia the most popular sports are sailing, diving, rafting, rowing, golf, and tennis (Cavlek, 2001).

Active and passive sport tourism are new trends in tourism, also in Hungary. Sport related travels are often not motivated only by the sport facilities themselves but by the popular sport events world-wide, such as the Olympic Games, Football World Cup, ATP tennis competitions, world championships, Formula-1 and other international competitions. It is difficult to estimate the number of watchers and fans arriving at the destinations, but these so-called passive sport tourists also constitute a considerable part of sport tourism. Certain analysers believe that sport and tourism will be a key element of the New World culture to come along.

Among the young snowboard, other board-sports are already very popular world wide too. Sociologists dealing with tourism have already identified the new trends, according to which the emphasis will move from traditional sports to the direction of special adventurous sports. Adventure tourism is a special type of sport tourism, where the given sport requires more or less risks and considerable physical and spiritual fitness, e.g. rafting and diving.

A tendency can also be traced in the connection between sport and tourism, namely between the sports pursued at destinations and the competition sports. The close relationship between sport and tourism often results in tourism working as a kind of incubator for new sports, which are favoured by the young. As the popularity of these sports grows, they become competition sports, like mountain-bike (Cavlek, 2001). Tourism trends of the world are also present in Hungary, since sport is already one motivation (5 %) of Hungarian tourists. (Heti Turizmus, 2001. Nov.30).

Methods and results

My research work was made among tourists, taking part in sport tourism in Hungary. Two special regions of the country were examined, namely the Szigetköz (375km^2) and the Írottkő Natur Park (107 km^2) in the foots of the Alps. I am going to present the results of my own survey on the possibilities of sport tourism in the two mentioned regions in Western Hungary. Two surveys were carried out in July-August, in the year 2000 and a control survey in 2004, with the financial support of MSTT, by voluntary questionnaires among the tourists spending their holiday in the region. Data was processed by the method of SPSS for Windows.

The geographic characteristics are different in the two areas, so the sporting activities also differ. The watery areas of Szigetköz in Kisalföld offer different recreation facilities for sport tourists than the hilly, mountainous and wooded landscape of Alpokalja.

The tourists in both areas judge sport positively in their everyday life (Table 1).

Table 1. The role of sport in the everyday life of tourists

The role of sport in the everyday life	Szigetköz		Írottkő Nature Park	
	Very important %		Very important %	
	2000 n = 193	**2004** n = 104	**2000** n = 107	**2004** n = 162
Health preservation	38,9	45,4	49,5	45,5
Keeping physically fit	35,2	40,5	39,2	42,3
Keeping intellectually fit	29,0	26,8	28,0	33,9
Profession	4,7	12,7	2,8	11,6
Relaxes (physically)	10,9	15,3	14,9	19,4
Relaxes (intellectually)	21,8	11,7	20,5	29,0
Trains for persistence	20,7	35,6	15,8	40,0
Spending free time (active)	26,9	30,7	17,7	39,8
Watcher or fan (passive)	4,1	17,7	6,5	15,1
A means of figure-shaping	17,1	19,8	13,0	28,6
Creating human relations	15,5	9,6	15,8	23,0
Rehabilitates	5,2	4,5	2	12,2
Other	3,1	16,7	4,6	6,7

The health-preserving role of sport is considered the most important in both areas. In Szigetköz 38,9 %, in Írottkő NP 49,5% subjects believe so. 35,2-29,0% and 39,2-28,0% consider it as a means of staying in good physical and intellectual condition. Sport stands at the fourth place in both areas as a means of spending the holiday actively (26,9 % and 17,7 %).

The importance of passive sport tourism in the everyday life, when watching a sport event is 4,1 % in Szigetköz, and 6,5% in Írottkő Nature Park.

The general state of health of tourists can be considered good in both areas. Their most frequent problems are stress and allergies. (Table 2).

Table 2. Health conditions of tourists

Health conditions of tourists	Szigetköz Permanent problems %		Írottkő Natúrpark Permanent problems %	
	2000 n = 193	**2004** n = 104	**2000** n = 107	**2004** n = 162
Loco-motor disorders	3,1	8,0	6,5	11,4
Cardiovascular problems	1,0	1,2	5,6	2,4
Indigestion	2,6	3,6	0,9	3,1
Respiratory problems	2,6	-	0,9	4,0
Allergy	8,8	14,4	7,5	3,0
Problems with the nervous system	0,5	-	0,9	2,5
Bad general state of health	-	1,3	-	1,6
Dizziness	0,5	-	1,9	1,6
Stress	8,8	5,0	11,2	6,1
Other	-	20,0	0,9	-

The most popular domestic sport activity is cycling (daily or regularly) both in Szigetköz (35,2 %) and in Írottkő Nature Park (70,9 %).

Cycling seems to be the most frequent sport activity at the place of permanent living of the tourists. The researchers of leisure time also say that the most considerable part of free time will be spent on cycling by West-Europeans. Realising this fact the Austrian Burgenland has already become a paradise for cycling tourists. In the early nineties a huge number of bicycle roads were built and road-systems originally for agricultural and forestry use were also connected to these new roads.

In the surveyed areas those sport activities are dominant that suit the recreational characteristics of the given areas. Cycling is in a favourable position but the quality of Hungarian bicycle roads and services are far below the necessary level. (Table 3).

Table 3. Sport activities of tourists in Szigetköz and the Írottkő Nature Park

Sport activities of tourists	Szigetköz %		Írottkő Natúrpark %	
	2000 n = 193	**2004** n = 104	**2000** n = 107	**2004** n = 162
Kayak/canoe	52,8	77,4	-	-
Horse-riding	19,2	15,1	19,4	6,3
Cycling	18,2	17,0	47,2	82,8
Swimming	18,1	30,2	2,8	7,8
Tennis	10,4	1,9	16,7	1,6
Hiking, touring	3,6	9,4	47,2	21,9
Ball games	3,6	-	-	4,7
Fishing	2,6	1,9	-	-
Skittles	-	-	11,1	-

Besides the knowledge of demands and sport activities it is also important to know which market segments of tourists are interested in and ready to buy these services, so that the area could make preparations for welcoming the tourists. (Table 4).

Table 4. The division of sport tourists and their market segments

Division of tourists	Szigetköz %		Írottkő Natúrpark %	
	2000 n = 193	**2004** n = 104	**2000** n = 107	**2004** n = 162
Active sport-tourist	69	50	33	33,3
Passive sport-tourist	5	8,7	1	15
No sport-tourist	26	41,3	66	51,6
Intellectual	72	57,7	79	67,3
Physical	15	34,6	15	19,1
Pensioner-student	13	7,6	6	13,6
Average age (years)	**33,2**	**31,36**	**32**	**31,52**
City, capital city resident	88	80,8	83	82,7
Village, farm resident	12	19,2	17	17,3
Average days of staying	**5,1**	**5,95**	**3,55**	**4,98**

Discussion

Today we see the world from a different perspective. It is evident from the results of the surveys that people like to spend their holidays (partly or completely) doing some kind of sport activity. That is the reason that all kinds of adventure sports are becoming more and more popular, which are elements of the open-air sport activities. These new experiences help to reshape our new, individual way of life, which also reflects in our everyday life. In this way we can enjoy a higher quality life. In Hungary not too much happened in the tourism field in the two examined region, as for the services. But the increasing number of sport tourists indicates a possible way for the tourists' suppliers to move on. The popularity of the active, sportive lifestyle must bring about a higher quality sport-related supply of destinations, and the tourism training of sport professionals.

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WHERE DO CHILDREN GET INFORMATION ABOUT HEALTHY LIFESTYLE?

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Abstract

Healthy lifestyle, which includes enough physical activity and appropriate eating habits (nutrition), is essential for children's physical and emotional development. Childhood is a period where habits start to shape. These habits transform into values, which start to shape our behavior in different fields. The main purpose of this research was to discover where children get information about drugs, nutrition and physical activity. We intended to find differences between boys and girls. The sample included 832 children from 10 Slovenian schools: 220 boys and 209 girls from 4th grade (age: 10 yrs. ± 4 months) and 219 boys and 184 girls from 7th grade (age: 13 yrs. ± 3 months). We found out that girls and boys got the majority of information about healthy lifestyle in primary social environment - family, which is followed by secondary social environment - school. Differences between boys and girls showed that boys had better perception of noticing factors from actions, radio, TV and press, while girls on the other hand prefer personal contact in transferring the information. Therefore, they communicate more easily with parents and teachers.

Key words: *children, lifestyle, health, physical activity, drugs, nutrition*

Introduction

This research is based on the data collected in the research project »Health enhancing motor/sports activity in Slovenia« (Završnik, Pišot, Fras, Zaletel Kragelj, Strel, Sila, 2001-2004). The research project was supervised by the Science and Research center Koper, University of Primorska, Slovenia. The lack of healthy lifestyle is a growing problem in Slovenia and also in other countries worldwide. This is somehow not surprising because technological progress forces us to change our way of life. This progress has at the same time positive and negative impact. Negative influences strongly affect our health, which weakens and our physical development is getting threatened (Pišot, Završnik, 2002). The change of lifestyle from active to passive endangers physical and emotional health. Passive lifestyle weakens our health and causes numerous chronic diseases, such as: obesity, osteoporosis, arteriosclerosis, arthritis, high blood pressure, stroke etc. (Agita Mundo, 2002) and numerous emotional problems, for example stress, anxiety, depression (Fras, Zaletel-Kragelj, & Mavčec-Zakotnik, 2003; Fox, 1999). Physical activity, healthy food and some genetic factors help us gain bone mass in childhood and adolescence. Greater bone mass reduces the probability for emerging the osteoporosis and related problems in elderly age and reduces the back-pain (Koprivnikar, 2005). Children's passive lifestyle is often related to eating disorder like anorexia or bulimia. The research »Epidemic tracking of anorexia and bulimia in Slovenia from 1989 to 1999« showed that eating disorders (especially anorexia and bulimia) in Slovenia had been increasing. The level of hospitalization has evidently increased by 3.5 times. The most susceptible are girls from 10 to 14 years and from 15 to 19 years. (http://www.gov.si/zzvkr/dejavnosti_org_izobraževanj_motnje_hr.htm).

Cardiovascular diseases (Fras, 2002) are globally spread and experts believe that roots of this problem are already set in childhood. If we add alcohol, cigarettes and unhealthy food, the probability for these diseases appears to rise. Therefore a healthy lifestyle, which includes enough physical activity and healthy nutrition, is essential for children's normal physical and emotional development.

The World Health Organization (WHO) and world public in general are more and more devoted to investigate and change our lifestyle. Besides health problems the passive lifestyle is also related to social and economical problems. Poor health condition leads to spending resources in different ways. If we know that good health and effective work go hand in hand, we can expect that stronger or more developed economy will produce healthier population. Shonkoff and Philips (2000) suggest that early education (which includes pre-reading, pre-math, social skills and physical activity) is an investment that pays off. They also believe that adults, who participate in high-quality early childhood educational programs, are less likely to be school dropouts, dependent on welfare or arrested for criminal activity.

Childhood is a period where habits start to shape. These habits transform into values, which start to shape our behavior in different fields. Environment defines our lifestyle. Drobne and Mohar (2004) emphasize that lifestyle develops in close relationship with living conditions. The main purpose of this research is to find out where children get information about drugs, nutrition and physical activity etc. Do they get this information from their family, school, health workers, media, literature...? We intend to find differences between boys and girls.

Methods

Subjects: The sample included 832 children from 10 Slovenian schools: 220 boys and 209 girls from 4th grade (age: 10 yrs. ± 4 months) and 219 boys and 184 girls from 7th grade (age: 13 yrs. ± 3 months). Their parents signed the agreement to allow their children to participate in this research (Završnik, e.a., 2005).

Variables: For the purpose of this research the following variables from questionnaire were used: gender, drug acquaintance, nutrition acquaintance, physical activity acquaintance. As regards the source of information the following variables were used: family environment, school, health workers, radio and television, literature, press and actions (for example: advertisement actions, "healthy school", "healthy city"…).

Statistical analysis: Pearson chi-square test was used to find differences between groups (girls and boys). Alpha level of $P<0.05$ (two-sided level of significance) was considered significant.

Results

Figure 1 shows that girls (3.74 on the scale from 1 to 5) and boys (3.52) get the majority of information about nutrition from family environment, followed by school and then from health workers. However, statistically significant differences between gender and nutrition acquaintance were found at family environment, school and actions. Other variables showed no significant differences between boys and girls. It is interesting that boys get on average more information about nutrition from actions (2.2) than girls (1.8). Advertisement actions etc. have obviously greater effect on boys than on girls.

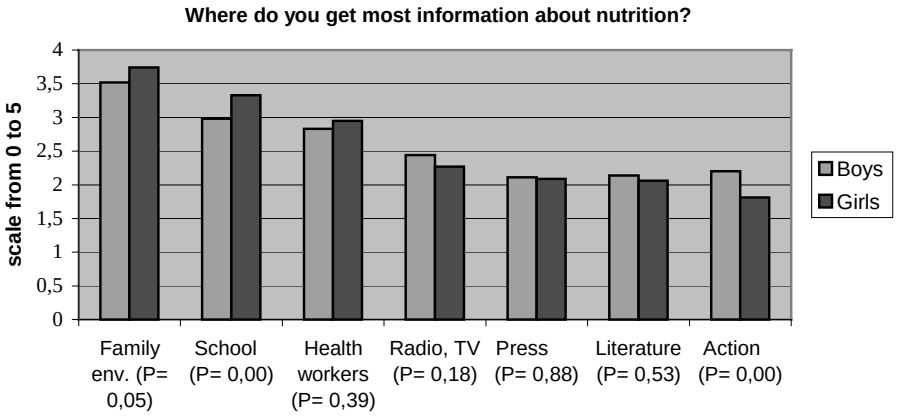

Figure 1: Correlation between gender and nutrition acquaintance

Girls (3.4) get most information about physical activity from school while boys (3.0) from family environment (figure 2). The third source of information for both boys and girls is health workers. Statistically significant differences between gender and physical activity acquaintance were found at school, literature and actions (figure 2). Literature (2.16) and actions (2.30) got better scale marks by boys than by girls (1.87 for literature and 1.81 for actions). The possible explanation of this could be that boys have better visual perception or different way of transferring the information than girls. Girls get obviously the most information about healthy lifestyle from parents and teachers.

Daily physical activity of at last moderate intensity for one hour per day is important for child's development, health and physical fitness and for the formation of such behavioral patterns which assure regular physical activity throughout his life (Pišot, Jurišević, Završnik, 2002, Pišot, Završnik, 2002).

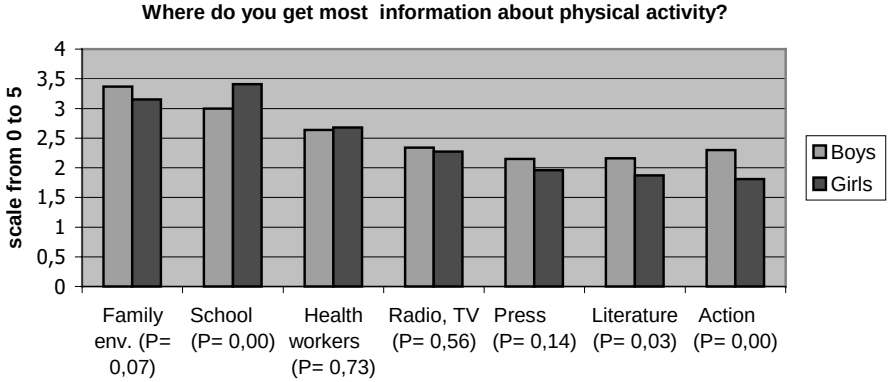

Figure 2: Correlation between gender and physical activity acquaintance.

Results show (figure 3) that girls get more information about drugs from family environment (2.63), followed by school (2.62) and then from health workers (2.2). Boys get most information about drugs from radio and TV (2.13), followed by school (2.06) and then from family environment (2.05). At the same time significant differences between gender and drugs acquaintance were found at family environment, school and health workers. Girls get on average more information about drugs from these three sources of information than boys.

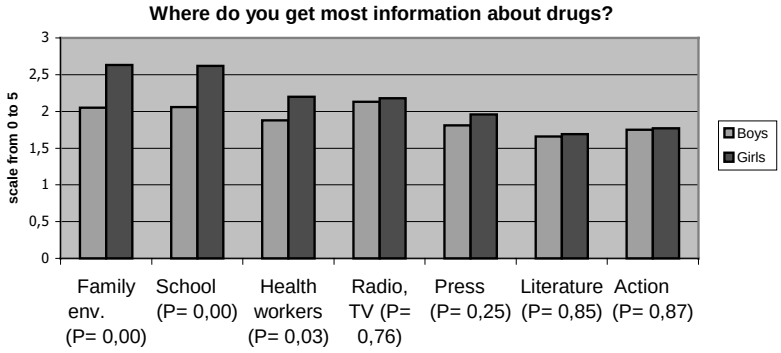

Figure 3: Correlation between gender and drug acquaintance.

Discussion

We discovered that there are differences between boys and girls concerning factors, which influence healthy lifestyle. We found out that girls and boys get the majority of information about healthy lifestyle from primary social environment - family, followed by secondary social environment - school. These findings contribute to the WHO which established that the most important environment for child′s development is family, particularly important role plays communication with parents. Friends and school were also recognized as very important factors.

It is interesting that boys have better perception of noticing factors from actions, radio, TV and press. We believe girls prefer personal contact in transferring the information. Therefore, they communicate more easily with parents and teachers.

The findings show the sources of information about healthy lifestyle for children. Children put family and school at the top of the list. However, the question about effective informing is rising. The studies show that families are overloaded with work and have less and less time for children′s education. 73.3 % of parents are not aware of how their sons spend Saturday night and 30 % do not know where their daughters are. School is becoming a place where children can easily get drugs (15% of pupils from Koper confirmed this statement) (Institution for Healthcare Koper) (Sučić-Vuković, Ražman, Benčič, Krota, & Stergar 2003). Without proper encouragement there exists a great danger for children to copy bad behavior and habits. 15% of pupils said that marihuana could be easily bought in school (Sučić-Vuković and co., 2003). Last ESPAD research had showed that in comparison to year 1999 the use of marihuana and inhalants had risen (Jerman, 2004).

The main finding of this research is that family, school, health workers and radio and television play the major role in informing children about healthy lifestyle. We believe that family as primary environment is the first on the list, which educates and directs children to the right way. Therefore, its role is crucial. School, health workers, radio and television represent secondary environment, which gain on importance as the children grow. The influence of both environments, together with genetic factors, are linked together, but in reaching the final level of development, the child's own activity also plays a very important role.

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BUSINESS TOWERS EMPLOYEES INTERESTS IN WELLNESS PROGRAMS

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Abstract

A modern life style and work process characteristic (constant sitting and intellectual effort) affects not only quality of life but also causes huge economical losses. Possible solution is health promotion program, and one of the most comprehensive is wellness. The goal of this paper was to determine physical recreation habits and interests in wellness programs of business tower employees. Sample was composed of 79 examinees, all employees of Bank and Insurance Company that are located in a business tower. They answered the questionnaire composed of 33 questions which were divided in 4 groups. Frequency analysis showed that 36% of examinees have no exercise habits and 92% would like to participate in wellness programs near their workplace. Preferable activities are massage, swimming, beauty programs, pilates and outdoor activities. The results of this survey show, that among the examinees is a high degree of understanding of the influence of physical activities and relaxation on health, so we can justifiably expect that they will be the regular participants in the programs for health improvement.

Key words: *wellness, quality of life, health promotion programs, workplace.*

Introduction

Technology and informatization development brought to a decrease in energy component in a human's working process. Main characteristics of a work process today are constant sitting and intellectual effort accompanied by stressful situations. Leisure, without suitable physical activities that should be compensatory, increases the risk of different health problems and psychosomatic diseases such as hypertension, neurosis, insomnia, metabolism dysfunction, spinal ache, etc. If not treated, stated disorders might have severe consequences manifested as hart attack, stroke, etc.

In developed western countries, health issues caused by modern life style have not only affected reduction of life quality, but also caused huge economical losses. Thus, for instance, USA citizens spend over 1 trillion dollars on healthcare, the equivalent of 13,5% of the gross domestic product. Healthcare coverage per person totals almost $4,000 per year. Lifetime costs are estimated at $225,000 per person. (Fries et. all, 1993).

In order to cut losses, different strategies have been developed and one of the results was a health promotion program at workplace.

So, today, more than 81% of American businesses with 50 or more employees have many different forms of health promotion program. (WELOCA, 2005.). These programs are usually held in fitness and wellness centres that are often integral part of business tower.

Promotion and health care program, which is becoming more and more popular, is called **Wellness**. "Wellness implies overall health concept and includes all health movement areas, from physical exercising, nutrition, relaxation and stress control to satisfaction and happiness" (Metz, K.,1999). This type of approach fulfils modern man's needs and enables him to reach the new quality of life.

Taking into consideration the fact that currently in Zagreb few business towers are being built where a few thousand people will be working, it would be wise to consider an implementation of health promotion programs in that future business centres. Above mentioned gets its full meaning when we take into consideration that Croatia, a country in transition, is trying to keep up with developed western countries. This results with business model acceptance where informatization in all fields of business is common.

To get realistic overview of employees physical recreation activities and their interests in possible programs, we have conducted this research.

Therefore, this paper is written to define:

1. regularity in employees physical recreation and their free time sports activities
2. interests in potential wellness centre activities where health promotion programs could be conducted.

Methods

Sample

Sample is composed of 79 people, 56 female and 23 male, average age 36 years (stand. dev. 9.59). All entities are employees of a Bank and Insurance Company whose workplaces are in business towers, so this sample can be considered representative for business towers employees population. The youngest is 20 and the oldest is 56 years old, 48% is married, 39% is single and the rest are either divorced or widowers. In average they have 1 child 48% of the entities have no children. Their monthly income is over 5 thousand kunas in average, which is more than Croatian standard, 25% have medium level education, 12% college education, and 53% university education. According to the stated characteristics, the examinees differ significantly from the population in Croatia, which could have been expected taking into consideration that the survey was performed on the employees of a Bank and Insurance company.

Variables

The sample of variables consists of 33 variables divided into four logical groups:

1. Regularity and contents of recreational exercising
2. Interest for wellness contents
3. Examinees opinion about significance of some factors for health
4. General data.

Data processing methods

The examinees have filled questionnaire that consisted of 33 questions. After gathering, the data were processed by statistic application Statistica for Windows 5.0. The variables included in the analysis were described using "Descriptive statistic" and "Frequency tables" module. The parameters of central tendency and dispersive parameters were determined within descriptive statistics.

Results

	Count	Percent	Cumulative Percent
I don't exercise	23	29,5	29,5
1	11	14,1	43,6
2	29	37,2	80,8
3	8	10,3	91,0
4 and more	7	9,0	100,0

Figure 1. How often do You excercise?(times in a week)

Figure 1. shows the regularity of physical recreational exercising of examinees. It can be seen that 23% of the examinees do not practice recreational exercises at all. Among 13% of examinees who exercise only once per week, and their most often activity is walking, so we can conclude that 36% of examinees have almost no habit of recreational exercising.

	Count	Percent
Soccer	7	8,860759
Aerobic	7	8,860759
Pilates	8	10,12658
Yoga	2	2,531646
Weight training	9	11,39241
Walking	10	12,65823
Tennis	2	2,531646
Badminton	1	1,265823
Other	14	17,72152
Missing	19	24,05063

Figure 2. What kind of activity do You practice most often?

Figure 2. shows that the majority of examinees are included in fitness programs (30%) including pilates, aerobics, and weight training. Recreational sport also have an important role (12,5%) including football, tennis and badminton, and the participants of these programs are all male.

Other activities exercised by the examinees are fishing, calinetics, cycling, skating, corrective gymnastics, and combat skills.

The second group of variables gives the insight into the interest for wellness programs. The analysis of the frequency of answers (Figure 3.) shows that 7,5% of examinees would not like to participate in programs of wellness centres, which is good taking into consideration the percentage of 36% of examinees who do not have developed habits of spending their free time actively.

	Count	Percent	Cumulative Percent
Don't want to participate	6,0	7,8	7,8
1	5,0	6,5	14,3
2	**37,0**	**48,1**	**62,3**
3	23,0	29,9	92,2
4 and more	6,0	7,8	100,0

Figure 3. How often would you like to participate in wellness center programs? (in one week)

The majority of examinees wishes to participate in programs 2 times per week (47%), and large number even 3 times per week (29%). This is being good indicator that there is a great interest and need for such programs among this population.

Referring to the question, in what part of the day they would like to use the services of the centre, 49% of the examinees answered that they would like to participate in these programs immediately after working hours. This points out that it is significant that the centre is near the working place.

In order to get the insight into the interests for particular programs of the potential wellness centre, the examinees gave marks form 1 to 5 for each program. The mark 1 indicated entirely negative attitude, and the mark 5 outstanding preference towards particular programs. Based on the analysis of the answers (Figure 4.) it could be determined that there is a great preference towards the contents of physio-prophylaxis, among which various kinds of massages dominate. Among other programs, swimming (3.5), outdoors activities (3,4) and pilates (3) excel. Recreational sport and weight training programs have lower marks (Figure 4.)

	Mean	Confidence lim. of mean -95,000%	Confidence lim. of mean +95,000%	Std.Dev.	Std. Error
Pilates	**3,00**	2,65	3,35	1,48324	0,18
Aerobic	2,51	2,18	2,85	1,421806	0,17
Cardio fitness	2,84	2,50	3,17	1,388764	0,17
Weight training	2,76	2,42	3,10	1,418672	0,17
Sports yoga, corrective gym.	2,71	2,36	3,06	1,446105	0,17
Swimming	**3,56**	3,21	3,91	1,48066	0,18
Team sports	2,70	2,35	3,06	1,496609	0,18
Outdoors activities	**3,42**	3,08	3,76	1,383334	0,17
Tennis	2,81	2,44	3,18	1,536568	0,18
Badminton	**3,39**	3,06	3,71	1,375699	0,16
Massage	**4,22**	3,96	4,47	1,055372	0,13
Sauna	**3,45**	3,06	3,84	1,598139	0,20
Solarium	2,94	2,52	3,36	1,739737	0,21
Beauty programs	**3,36**	2,96	3,75	1,659716	0,20

Figure 4. Average grade, confidence interval of meant, standard deviations and standard error for each activity

The analysis of answers in the third group of variables gave insight into the attitude of examinees towards the importance of particular items for personal health. The examinees gave marks from 1 to 5, grading the importance of particular items. The mark 1 indicated the absence of importance, and the mark 5 high importance of particular items for health.

	Mean	Std.Dev.
Physical activity	4,49	0,66
Relaxation	4,51	0,78
Regular diet	4,53	0,72
Avoiding of stressful situations	4,58	0,68
Often doctor visits	3,23	1,17

Figure 5. Average grades and standard deviations for health importance factors

On the question, do you think that you are under stress, 39% of examinees answered affirmatively, and 52% considered being occasionally under stress, therefore it is not surprising that the examinees consider the item “avoiding of stressful situations” the most important for their health.

Discussion and conclusion

The employees can be characterized as belonging to younger mature age (36 years at average). Taking into consideration that the majority of examinees are practically at the early stage of their business career, and that the main characteristics of their working hours are sitting and intellectual efforts, we can expect the occurrence of health problems in the future. Health difficulties have multiple negative influences resulting from the diminution of the quality of the life, which leads to lower productivity and large economic losses in the sense of the expenses of health insurance and increased number of sick-leaves. These consequences could be avoided, if there was a system taking care about the health of employees. Construction of wellness centre as the constituent part of business building, in which the adequate programs would be performed, would surely be the first decisive step towards reaching of this aim.

When choosing the contents of the program, two larger groups should be considered, and these are relaxation and adapted sports programs.

As the majority of examinees consider being under stress occasionally or often (91%), relaxation and anti-stress programs should be the constituent part of sports recreation. Such programs are created primarily from various kinds of massages, sports yoga, sauna, steam bath and Jacuzzi.

Among adapted sports programs, swimming got the highest mark (3.56) and 60% of examinees gave these activity marks 4 and 5. Considering the benefits of swimming for health, the construction of swimming pool within wellness centre would be multiply justifiable.

The next item to be noted is high grade of the outdoor activities (3.4). The good answer for satisfying these needs of employees would be organizing weekend excursions and team-building programs in nature.

The other physical recreation activities, except for pilates, did not get high marks, therefore the thorough consideration of possible innovations would be required, i.e. improvements of the existing and the creation of new programs which would be more in accordance with the needs of modern man.

The results of this survey show that among the examinees there is a high degree of understanding of the influence of physical activities and relaxation on health, so we can justifiably expect that they will be the regular participants in the programs for health improvement.

Understanding that the working organization is healthy and productive just as equally as its employees are healthy and productive, indicates the necessity of quality programs for health improvement.

Considering comparatively small number of examinees, this survey indicates the main guidelines, and is only the beginning of the work on the much bigger project. The goal of the project will be to investigate physical recreation habits, needs and interests of business people for wellness programs at the level of the whole Croatia, as well as the possibilities for conducting quality programs for health promotion.

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SPORT-RECREATIONAL HABITS, INTERESTS AND ATTITUDES OF TOURISTS IN THE MIDDLE ADRIATIC SUMMER RESORTS IN CROATIA

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Abstract

The aim of the research was to analyze sports and recreational habits and interests of tourists and the role of sports recreation in tourism. The study was conducted by means of a questionnaire on the sample of 87 examinees. Although 71% of examinees consider the sports activity an integral part of a tourist offer, only 35% of them choose a holiday resort by its sports and recreation acivities offer. Out of season special sports and recreation programmes attract 22% of examinees. The sports recreation in tourism is getting more and more important, but in Croatia it still serves to complement the existing tourist offers.

Key words: *tourism, interests, sport, recreation*

Introduction

People are motivated to travel in different ways. Travelling for recreation is pretty widely spread. The findings of tourist offer in the world's leading market have shown that recreational tourism ranges highly on the top of current tourist traffic. Although tourism and sport are regarded as two different social and economic phenomena, they have many closely related aspects with a man as a common goal.

Both research and practice have proved that sports facilities and programs are unavoidable factors in current tourist offer development.

Sport and tourism are dynamically interconected, and sport in it's wider sense dominates as an active component in tourism (Andrijašević, 1997).

Sport in contemporary tourism does not only become the content of stay in a patricular tourist destination, but it very often turns out to be the main motif for traveling to certain destinations (Bartoluci, 2004).

In the year 2001 the same percentage of tourists choosing "sports, recreation and fitness" as a motif for a visit to Croatia as a summer holiday destination, were the same as in 1997 (10% of guests in 2001 in relation to 10,7% guests in 1997). This reflects sports and recreation offer in Croatia (Weber et al., 2001).

Problem

Tourist season in Croatia is connected with holidays of its neighbouring countries. It includes regularly summer holidays, therefore the season covers the period from June to September, according to tourist agencies data. The rest of the year the accommodation capacities of hotels and private accommodation are not used at all.

The research in Croatia shows that sports and recreation tourism have comparative advantages in relation to other forms of tourism, which should dictate the strategic orientations of tourist development (Bartoluci and Čavlek, 1998).

Goal

The aim of the investigation is to determine sports and recreational habits of examinees (guests) and their sports and recreational needs during holidays, as well as the interest in accommodation capacities outside summer season.

Study methods

The investigation was conducted with 87 examinees aged from 14 to 75 accommodated in the "Miran" hotel in Pirovac and "Zora" hotel in u Primošten in the period from July 27 to August 10, 2003.

Table 1. Structure of examinees

	Austria	Belgium	Check rep.	Croatia	France	Germany	Italy	Poland	Slovakia	Slovenia
Male	3	1	0	3	2	22	20	0	1	1
Female	2	1	1	2	0	13	14	1	0	0
TOTAL	**5**	**2**	**1**	**5**	**2**	**35**	**34**	**1**	**1**	**1**
AGE	40,6	43	41	35,2	33,5	52,2	34,9	34	43	48
Second.educ.	5	0	1	3	2	27	28	1	1	1
Univer.deg.	0	1	0	2	0	6	6	0	0	0
MR.SC/A	0	1	0	0	0	2	0	0	0	0

34 women and 53 men are of the average age of 40.5. Examinees' qualifications: 69 secondary education, 15 of university degree and 3 examinees with master degree.

Examinees' sports and recreational habits

Table 2. Sports and recreation habits of examinees at home

	Total		Male		Female	
	Yes	No	Yes	No	Yes	No
1. Do you pursue any sports at home?	54	33	31	22	23	11
2. Name the sport, you pursue						
Tennis	11		8		3	
Cycling	10		7		3	
Swimming	10		6		4	
Football	9		8		1	
Walking	7		3		4	
Gymnastics	5		1		4	
Aqua gym	4		1		3	
Fitness	4		2		2	
Jogging	3		2		1	
Horse riding	3		2		1	
Aerobics	2		0		2	
Roller-skating	2		0		2	
Basketball	2		1		1	
Volleyball	2		1		1	
Bowling	2		1		1	
Dance	2		2		0	
Other sports	9		5		4	
3. How often (days in week)?						
1-2	25		15		10	
2-3	21		13		8	
3-4	5		3		2	
4-5	2		0		2	
>5	1		0		1	

As it is seen in the Table 2. 62.1% examinees pursue sports at home, 58.5% men, and 67.6% women. In this questionnaire women seem to be more active than men. The most pursued activity of examinees at home is tennis, cycling and swimming, football, etc.

Most examinees, even 28.7% practice 1-2 times a week. This is a minimum that can be taken for a recreational sport. 2-3 times a week is to be found with 24.1% examinees, 3-4 times a week is practised by 5.7%, 4-5 times a week only 2.3% and over 5 times only 1.1% of examinees.

Sports recreation in holiday resorts

As expected, 71.3% examinees prefer active holiday and consider sports activity as a constituent part of a tourist offer, but only 35.6% of examinees choose their holiday according to the offer of sports and recreational programs. Therefore we have state that the majority of examinees regard the sports activity as a part of a tourist offer, but some other factors influence the selection of a holiday resort.

According to the TOMAS 2001 investigation, the major motives are:

1. holiday and relaxation at the seaside – 91.1%;
2. amusement– 36.1%;
3. natural beauties – 32.5%;
4. new experience and adventures – 20.2%;
5. sports, recreation, fitness – 10.0%.

Only 64.4% of examinees are acquainted with an offer of sports and recreational programs in their place of living. Women are, as wee see, better informed than men, which can be connected with the fact that more women go in for sports than men. 52.9% of examinees are satisfied with the sports offer of their respective holiday resort.

Although most of the examinees considered sports program as a part of tourist offer, very few were ready to come outside season. Hence, it can be concluded that the sports program is an important part of tourist offer, but still most important are sun, sand, and the sea.

Table 3. Interest in sports recreation

	Total			Male			Female		
	Yes	No	Don't know	Yes	No	Don't know	Yes	No	Don't know
1. Do you consider the sports activity as a part of a tourist offer?	62	19	6	36	13	4	26	6	2
2. Do you prefer an active rest to a passive one?	62	25		37	16		25	9	
3. Do you consider sports and recreation as vital for your holiday place choice?	31	51	5	21	30	2	10	21	3
4. Are you acquainted with the offer of sports and recreation contents at home?	56	25	6	30	19	4	26	6	2
5. Are you satisfied with the sports offer in the centre where you make the holiday?	46	17	24	28	9	16	18	8	8
6. Would you pursue the sports recreation special programmes outside the tourist season?	19	45	23	14	26	13	5	19	10
7. Are you interested in health improvement programmes?	63	17	7	36	13	4	27	4	3
8. Would you take part in the guided programmes?	47	32	8	26	21	6	21	11	2
9. Which of the mentioned programmes would you like to join?									
a) overall improvement	30			19			11		
b) reduction of overweight	33			19			14		
c) improvement of mobility system	27			20			7		
d) improvement of breathing system	21			12			9		
e) improvement of blood and artery system	17			10			7		
f) aesthetical	22			11			11		
g) antistress programme (autogenious training, yoga)	37			19			18		
h) profilactic programme (sauna, massage, baths)	52			32			20		

TOMAS 2001 quotes that 70% and more guests choose the following: 1. swimming, bathing; 2. pastry shop visit, "cafe"; 3. restaurant; 4. walk in nature. Tourists are in the first place prone to relaxation.

Wellness offer has been becoming increasingly popular recently. Wellness means "live healthily and enjoy fully". The best indicator of wellness program demand is an income of pure wellness-journeys TUI-Gruppe, which in 2003 increased 30% in relation to the previous year.

A major interest was displayed by our examinees. Even 95% showed an interest to join one or more programs. The examinees look in the first place for relaxing programmes to rest from the stressful way of living. Such an interest should lead to the increasing advertising of such programmes and to development of healthy tourism also outside the tourist season.

Table 4. Activities the examinees want to pursue in holidays

	Total	Male	Female
Activities in nature			
promenades	40	26	14
walking	38	22	16
cycling	33	23	10
riding	20	12	8
jogging	15	8	7
mountaineering	11	9	2
orientation in nature	6	5	1
Outdoor activities			
beach volleyball	27	17	10
tennis	23	15	8
aqua aerobic	23	7	16
aerobic	20	8	12
football	16	14	2
breathing exercises	16	7	9
basketball	10	7	3
rollerblading	10	4	6
Extreme sports			
paragliding	20	12	8
bungee jumping	6	4	2
alpinism	5	4	1

	Total	Male	Female
Activities on water			
swimming	57	35	22
diving	28	18	10
sailing	18	13	5
surfing	15	10	5
waterpolo	9	6	3
Indoor activities			
dancing	30	13	17
aerobic	20	9	11
yoga	17	8	9
fitness	16	9	7
Low intensity activities			
mini golf	31	20	11
archery	17	10	7
boules	16	15	1
bowling	14	9	5
rifle shooting	14	12	2
picado	8	3	5

Table 4. points out the dominance of swimming which is a usual summer activity. Besides swimming most examinees chose relaxing activities like promenading, walking, cycling, mini golf, dancing, diving, etc.

Sports and recreation offer can be reached in different ways. There are many examples. Besides the beach maintenance the swimming paths should be marked along with the distance between the markers for the information of swimmers. Marked cycling and walking paths in nature should be increased, far from crowded beaches. Mini golf tournaments should be organised which could stimulate people to socialise in this way. Diving becomes more and more popular. Diving schools and diving excursions for experienced tourists could attract a better quality of tourists. Each program could be extended with construction of playground for volleyball on sand, bowling places, sailing and surfing schools, aerobics in open air, etc.

It is not possible to satisfy all the tourists' appetites, but their interesting area should be investigated. In this way their stay will be made nicer and more interesting, and they will be stimulated to come again next year in early season and postseason.

Conclusion

Results of the research are identical with the world trends of sports and recreational aspects of tourism. A sport in modern tourism is becoming more and more vital in holiday resorts. However, the tourist do not show enough interest for the out season offer in Croatia. Most tourists visiting Croatia are interested in sun, air and sand and sports and recreational programmes are only supplementing a standard tourist offer of holiday resorts. In order to attract tourists outside season we should take the example of developed countries. The best example is Austria with a winter season for skiing and a summer season for the tourist inclined to mountaineering and village tourism. In a similar way tourists could be attracted to Croatia taking actively part in tradition of fishing, vine growing and other activities connected with our county's culture and climate. These are programmes we can offer also outside the tourist season as a way of escaping from everyday life.

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YOUNG PEOPLE'S LIFESTYLE AND PREFERENCES IN SPENDING LEISURE TIME

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Abstract

Students' leisure time covers the time out of their required learning programme, but it also includes a versatility of students' commitments organized according to their own needs and tendencies. Leisure time organisation (Andrijašević, M., (2000); Leisure time and game,7) is influenced by various factors of which the prominent ones are studying duties, social environment, personal habits and needs, responsibility, as well as many other elements built-in by a student in his/her leisure time program. With this regard, the intention of this research was to determine students' habits out of their everyday obligations.

The research has been made in the city of Zagreb territory on the sample of 417 high schools students of both sexes. For research purposes a questionnaire was polled out giving answers on students' spending their leisure time apart from their student obligations. Moreover, their preferences to sport and recreation programs during their both everyday life and summer vacation were identified. The research included the establishment of the way in which students spent their leisure time and of their preferences to sports and recreation activities in which they would like to take part during their vacation.

The results obtained are important for kinesiology who need information on students' leisure time wishes and requirements referring to kinesiological programs. For that matter, students' answers may be helpful in creation of programs adapted to students' interests and needs.

Key words: *student, leisure time, leisure time activities, summer/winter vacation.*

Methods and results

The research was made by means of a questionnaire, the sample including 417 respondents, wherefrom 212 male and 205 female students of some Zagreb University faculties. Their average age was 21. The poll questionnaires were collected at the end of first semester of 2005 in the city of Zagreb territory, at the places most frequented by students, i.e. in the Students' Center in the National Library and in students' restaurants. 45% of the respondent sample covered by the poll lives in their own flats, 19.8% in dormitories and 17% in rented flats and rooms.

The analysis of answers to the poll questionnaire used 21 variables covering variables of socio-demographical features of the respondents (sex, age, residence), the way of spending leisure time and students' preference for sport and recreation programs and activities during their leisure time and summer/winter vacation.

The data were processed by Statistics 5.0 package and frequencies and percentage for each separate variable were calculated. The students' routine life covers the time spent studying and their leisure time activities. Those are also the main ground for estimate regarding time spent in certain types of activities. The average time of studying shows that 27% of students spend more than 3 hours studying, 17% of them spend 2 hours and 16.0% of them not more than 1 hour. The students' estimates on time spent studying cannot be taken as representative, as the poll questionnaire was applied in January and February examination periods. After their faculty obligations and time spent studying students choose the contents of their leisure time which they spend following their own wishes and interests. According to data provided by this research, it is students' opinion that they have 3 and more hours of leisure time (Table 1).

The variable describing the most frequent way in which students spend their leisure time (Fig. 1) in this sample has shown the highest interest for going to coffee shops (26%) and watching TV (23%). The said activities show that young people mostly spend their leisure time in keeping company and passive watching. From time to time students engage in sport as a recreation, what may partially refer to sport and recreation activities within the physical fitness and health program for faculties or dormitories.

A substantial number of students (12%) spend their leisure time surfing on Internet. A smaller number of them (6%) spend it reading professional literature required for their studies (Oaks, T. (1998). Age, Generation and Life-Cycles: London Current Sociology, 48-49).

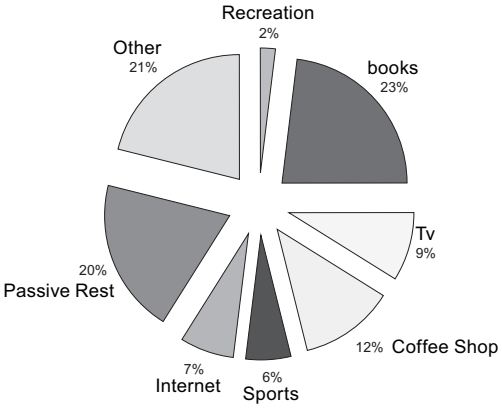

Fig.1 Ways of Students' Spending Leisure Time

As for cultural events, students of Zagreb University spend 63% of their leisure time for going to cinema and 50% for going to coffee shops. In contrast to the sedentary type of spending leisure time, 32% of students engage in sports from time to time, 22% do it regularly and 26% do not engage in any physical/sport activity at all. From the total student sample 37% of respondents have been active in a sport activity more than 4 years, 20% of respondents do not practice any physical activity and 9% have been practicing it during last 6 months. The data show young people lifestyle which in large percentage lacks any active type of spending leisure time.

Students' sport activities (Fig. 2) in their leisure time show an increased sedentary lifestyle, demonstrated in 21% of students who do no engage in any sport or recreation activity. As for the type of recreation, students prefer cyclical an individual ones such as swimming, jogging, cycling (23%), followed by sport games (20%), fitness (12%) and aerobics (9%). Students have given negligible importance to corrective gymnastics and pilates.

Table 1.

Descriptive Statistics									
Name of variable	Valid N	Mean	Median	Minimum	Maximum	Variance	Std.Dev.	Skewness	Kurtosis
ACCOMMOD.	417	2.8896882	4	1	4	1.68	1.2980437	-0.4632732	-1.5771365
STUDYING	417	3.4796163	4	1	5	1.97	1.4023304	-0.4494087	-1.0749079
LEISURE	417	3.4316547	3	1	5	1.15	1.0745104	-0.1781739	-0.657015
EVENT	417	1.5827338	1	1	100	23.9	4.8909738	19.684795	396.81031
OUTGOING	417	1.9182692	1	1	5	1.85	1.3596785	1.1542972	-0.2385931
LEIS. SPORT	417	2.8369305	3	1	4	0.89	0.9442529	-0.4095166	-0.7350066
DURATION	417	2.9256595	4	0	5	4.67	2.1610046	-0.302909	-1.6887487
VACATION	417	3.0431655	3	1	101	47.2	6.873378	13.765665	194.14925
TYPE	417	1.2709832	1	1	3	0.39	0.6247671	2.1066881	2.8792248
STUDIES	417	1.3045564	1	1	3	0.47	0.6834608	1.9343798	1.9608209
IMPORTANCE	417	1.4268585	1	1	3	0.49	0.7003076	1.3383763	0.3260801
SEASIDE	417	1.6714628	1	0	4	0.72	0.8463587	1.113519	0.5545078
MOUNTAIN	417	1.8609113	2	0	4	0.65	0.8085077	0.4505852	-0.5383161
LEADER	417	1.764988	2	1	3	0.22	0.4727396	-0.6182326	-0.1652416
LEARN	417	3.0215827	3	0	5	0.91	0.9542488	-0.6769621	-0.2953687
DESTIN.	417	1.940048	2	1	4	0.98	0.9897324	0.2849685	-1.5994105
YOUNG	417	2.028777	2	1	3	0.63	0.7961063	-0.0515653	-1.419344
AGE	417	21.671463	21	18	33	6.25	2.5009567	1.0877181	1.3768881

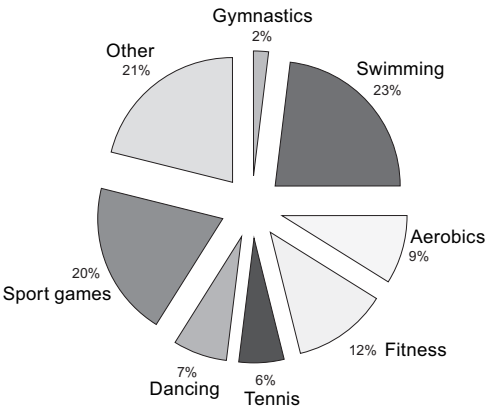

Fig 2. Student's sport activities

After termination of an academic year, i.e. having finished with lectures, examinations and commitment related to their faculties, more than 26% of students take vacation longer than one month. No less than 25% of students take 2 weeks of vacation, while the smallest group (20%) takes 3 weeks. The largest percent of students (63%) prefers holidays at the seaside, what has to do with tradition and habits. Only 6,5% of students would like to have rest in mountains.

Students give weight to a high-quality rest and 82% of them believe that it has positive influence on the quality of life, health and, consequently, studying. Sport activities show to be important for the good rest of the majority of students (69.5%), while 18.2% do not consider them important and 12.2% do not know if they are important or not. P.W. Darst (2001:27-29) believes that students have to be offered various activities which will be adapted to their interests, wishes and needs, regardless to their ethnic or social backgrounds.

Sport and recreation activities which students would like to engage in at the seaside and in the mountains have been classified according to model described by Petković, D., Ciliga, D., and Pavičić, L. (2004); Kinesiology, 2:239-247, which

divides them into team activities, contact sports, individual and recreation activities, as well as into activities taking place outdoors and attractive (dangerous) ones. Following the students' response showing its presence, passive rest has been added to these activities.

If we analyze the seaside activities (Fig. 3), we will note that students are interested in team sports (the majority in volleyball), but also in individual ones such as swimming, what is logical, as besides the sea the most frequently there is a ball as a usual equipment. Students have given the least importance to contact sports and passive rest.

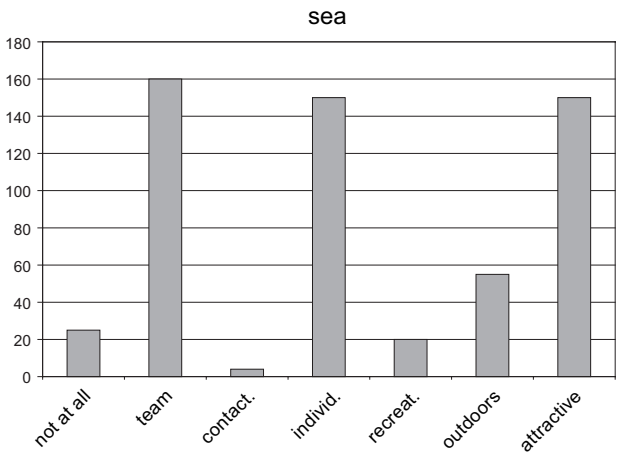

*Fig. 3.**

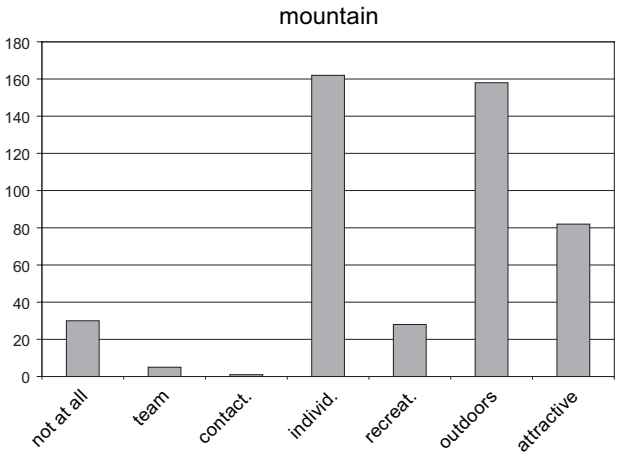

*Fig. 4.**

** vertical line means number of student who have interests for sports in sea and in mountains*

As for activities which students want to engage in the mountains (Fig. 4), the majority is interested in individual ones, in ones taking place outdoors and in attractive ones. The lowest interest is shown in contact sports and the reason for it may be attributed to relaxing and quiet surroundings offered by mountains. Students have no noticeable need for leading or animating in sport activities (59%), they prefer to manage by themselves and freely choose the activity. 30% of them are of opinion that tourist centers in Croatia are inadequate, 27% are not aware of their existence and 24% believe that Croatia has high-quality tourist centers.

Conclusion and discussion

For the need of this research the analysis of poll questionnaires has been made for 417 students of various Zagreb University faculties. The average age of students was 21, it might be said young 2nd and 3rd academic year students, but with a considerable experience. The most important questions to be determined by this poll were the extent of sport and recreation activity being part of students' leisure time as well as the prevailing ways of students' spending their leisure time. The most important behaviour model covering the majority of students has been noted, and that is wish for companionship and conversation taking place in coffee shops or watching TV. Students' daily routine includes relatively short time for studying, not much time for reading, but the majority of them are using Internet. This is understandable, as young people have more and more access to Internet, which students mostly regard as pastime, but also as a way to complete their knowledge. As per students' estimate, as an average they have more than 3 hours of leisure a day, but they spend it in the sedentary way. The majority of students engages in sports from time to time, what is not adequate for maintaining and improving their physical condition. Students' preferences in sports are swimming, jogging, cycling and then sport games, fitness and aerobics. An extremely large number of students (21%) does not engage in any sport activities.

During summer vacation students give more attention to sport and recreation activities as a kind of relaxation from studying and stress accumulated during the academic year. The sports they want to practice at the seaside are team games, mostly volleyball, and individual activities such as swimming. As for attractive activities they prefer diving, sailing, water skiing and surfing. Their minor interest are contact sports and passive rest.

It can be said that Zagreb students' interests are similar to the ones of young people throughout Croatia. Specifically, the culturological fact indicates assembling of young people in coffee shops, what has become a sociological phenomenon, something that for twenty-odd years past was reserved for middle aged people has now became a usual occurrence and place where young people meet. Is it a transient stage and how much is it desirable? The question will be answered by themselves and by the society. However, we can emphasize that a sedentary lifestyle is accompanied with many negative effects.

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HOW DOING SPORTS DURING LEISURE TIME INFLUENCE THE SUBJECTIVE PERCEPTION OF STUDENTS' OWN HEALTH AT THE UNIVERSITY OF ZAGREB, CROATIA

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Abstract

This research was conducted by a survey on a sample of 615 students of the University of Zagreb, Croatia. The purpose was to determine how much leisure time per day students from different faculties have and also how much of that time they spend on various sport activities and how much on other types of entertainment. We wanted to determine the percentage of students that do sports and to find out if there is any statistically significant correlation between doing sports during leisure time and the students' subjective perception of psychosomatic and health disturbances. The said correlation showed to be significant only in female sample.

Key words: *survey, sport activity, psychosomatic and health disturbances.*

Introduction

If we take a look at the life of a modern man today, we could easily notice that he lives in a world in wich hypokinesis dominates. Science and technology's growth in general sped up life pace and seemingly made it easier, not allowing people to completely adapt to it (Andrijašević, 2000). From Monday to Monday, from morning till the evening all our activities are routinised and planned in advance. Sedentary life style is becoming more common every day. People sit behind their steering wheels, their computer or their remote control. Although movement activity is a well-known natural way of life preservation and its limitation itself affects adversely the entire anthropological status, still we do not consciously make use of it. The modern way of life pushed people out of psychophysical balance, undermined their health and made them subservient to hypokinesis and diseases such as stress, cardiovascular - respiratory and locomotor's system diseases, as well as psychical diseases (Nagyova, Šimonek 1997). Therefore, the return to a balanced state is a logical need. Leisure time belongs to the spare time category, i.e. to the time outside working hours/school, which serves for fun, amusement or personal interests and as such should be organized and adjusted to students' needs and interests (Dragutinović, 1985). The level of overall daily activity as well as leisure time activity depends on an entire series of inner and environment-dependant factors but also on habits acquired in school days, so we asked ourselves do our students possess sporting habits?

The conducted survey contains questions related to leisure time, sports and the appearance of certain psychosomatic and health disturbances.

Similar researches were conducted by Dragutinović, S. (1985), Nagyona, L. & Šimonek, J. (1997), Salita, J. (2002), Majerič, M. et al. (2002), Gošnik, J. et al. (2002).

Methods

The sample of Participants

Research participants consist of 615 students of the University of Zagreb, Croatia (229 male and 386 female). The students attend the Teaching Academy, the Faculty of Electrical Engineering and Computing, the Faculty of Mechanical and Naval Engineering, the Faculty of Science. The average age of the questionnaire respondents is 19,57.

Procedure

Statistic for Windows, version 5.0 was used for processing data. Descriptive analysis was used to determine the arithmetic mean (AS) and standard deviation (SD); frequency tables (F) and percentage analysis (%) to determine the ratios between genders; T-test for independent samples (t-values, p-threshold of significance) to determine statisticaly significant differences among genders followed by multiple regression analysis.

Sample of variables

The sample of independent variables consisted of answers to 5 questions that are related to the amount of leisure time and doing sports. Questions are: *How much daily time do you spend studying?* (**STUDTM);** *How many hours of free time do you have daily?* **(FREETM);** *Do you do any sport now?* **(SPNOW);** *How long have you been practicing sport?* **(HOLOSP);** *How many times a week do you do sport*? **(SPWEEK).** Five possible answers were offered, scaled from lowest to highest value, out of which the participants could circle only one.

Dependant variables are related to answers to questions: *Did you experience any subjective health disturbances?* (**SUBDIST)** and *Do you have any health problems*? **(HLTDIST).** The offered answers to the first question refer to psychological, subjective experience which can be related to psychic stability, i.e. tension presence, uneasiness, unreasonable fear, fatigue, lack of time, insomnia, use of medications and anger. The participants were able to circle more than one answer so 8 frequencies were obtained. "0" is added in cases of uncircled answers and "1" for circled answers. The total variable is the sum of the circled answers. Furthermore, "0" represents students without disturbances, while "8" represents students that circled all offered answeres. In the second dependent variable questions refer to physical pain presence or health disturbances which the participants identified as pain in the neck, thoracal or lumbal part of the spine, leg and feet pain, high or low blood pressure, high blood sugar, obeseness, heart diseases and alergies. The participants were able to circle more than one answer. Total variable was calculated in the same manner as the previous one. The distinguishing gender, age and faculty variables were added.

Results and discussion

Table 1. Students that do sports

Students that do sports – by faculty	**Yes**	**%**	**N_{all}**	**%**
Teaching Academy	93	55,69	74	44,31
Faculty of Electrical Engineering and Computing	11	100	0	0
Faculty of Mechanical and Naval Engineering	81	71,68	32	28,32
Faculty of Science	172	53,09	152	46,91
$Total_{all}$	**357**	**58,05**	**258**	41,95
Students that do sports – by gender	**Yes**	**%**	**N_{all}**	**%**
Female	192	49,75	194	**50,25**
Male	165	**72,05**	64	27,95
Students that do sports - by time of excercise	**N_M**	**%**	**N_F**	**%**
Last 6 months	46	20,09	189	**48,96**
1 year	18	7,86	56	**14,51**
2 years	6	2,62	21	5,44
3 years	9	3,93	24	6,22
4 years	13	5,68	19	4,92
5 years	137	**59,83**	77	19,95
Students that do sports- by the frequency of practice per week	**N_M**	**%**	**N_F**	**%**
0 times per week	11	4,80	50	**12,95**
1 time per week	79	34,50	192	**49,74**
2 times per week	54	23,58	82	21,24
3 times per week	46	20,09	47	12,18
4 times per week	23	10,04	11	2,85
5 times per week	16	6,99	4	1,04

Number of entities (N), percentage (%)

Table 1 gives us an insight into very interesting results. Although '*Students that do sports – by faculty'* results in the table show relatively high percentage of students that do any sport activity (58,05%), a great contrast between genders is noticeable. Every second female student does some sport activity occasionally or recreationally, while among male students that percentage is even higher (72,05%). Furthermore, 59,83% of the male students did certain sport activities during last 5 years 2-3 times a week (43,67%), while 63,47% of the female students did sports during last 6-12 months 1 time a week only (i.e. since they enrolled at the university since most of the participants are freshmen). This kind of data shows that unlike male students, female students do not possess sport habits. Furthermore, they are limiting themselves on doing sports only as part of the P.R. subject which is insufficient to start the transformation processes needed for preserving and enhancing human physical capabilities.

Table 2. T-test difference analysis among male and female students in independent variables

Variables	N_F	AS_F	SD_F	N_M	AS_M	SD_M	t	df	p
STUDTM	386	**2,07**	1,28	229	1,06	1,09	**9,97**	613	**0,00**
FREETM	386	1,60	0,89	229	1,95	1,11	-4,24	613	**0,00**
SPNOW	386	0,49	0,50	229	0,72	0,44	-5,55	613	**0,00**
HOLOSP	386	1,63	2,00	229	**3,46**	2,09	**-10,76**	613	**0,00**
SPWEEK	386	1,45	1,02	229	2,17	1,32	-7,51	613	**0,00**

Number of entities (N), arithmetic mean (AS), standard deviation (SD), T-test value (t), test degrees of freedom (df), error size (p)

T-test gave us differences between male and female students in independent variables. Results in table 2 show statistically significant differences among male and female students in all variables, because p-level of significance is 0,00. The highest value of T-test was obtained in the variable *How long have you been practicing sport?* ***(HOLOSP =(-10.67))*** among male students and *How much time a day do you spend studying?* ***(STUDTM = 9.97)*** among female students. From this data we can conclude that male students spend more leisure time doing sport while female students use their leisure time to study some more.

As the results of T-test analysis show significant differences between genders, multiple regression analysis is used for each particular gender separately. Table 3 results show statistically significant influence of independant variables on subjective health disturbances in female students sample (p=0,00). Out of all independant variables the highest correlation with subjective health disturbances has a question *How many hours of free time do you have daily?* ***(FREETM).*** The calculated regression coefficient of this variable is statistically significant (p=0,00). This correlation can be explained with the fact that female students who have less leisure time have more subjective health disturbances (negative correlation). On the other hand, results do not show any statistically significant influence of independant variables on health disturbances in the sample of female students.

Table 3. Multiple regression analysis of the influence of independent variables on health disturbances of female students

SUBDIST						
Female students	**r**	**Part-r**	**BETA**	**t(380)**	**p-level**	
STUDTM	0,06	0,03	0,03	0,71	0,47	**p<,007**
FREETM	-0,16	-0,15	-0,15	-3,06	**0,00**	**R_2** = ,0404
SPNOW	-0,06	-0,09	-0,11	-1,81	0,07	**F(5,380)**= 3,203
HOLOSP	0,04	0,08	0,10	1,68	0,09	**Std.Er:** 1,346
SPWEEK	0,01	0,02	0,02	0,42	0,67	
HLTDIST						
Female students	**r**	**Part-r**	**BETA**	**t(380)**	**p-level**	
STUDTM	0,06	0,05	0,05	0,97	0,33	**p<**,170
FREETM	-0,04	-0,03	-0,03	-0,60	0,54	**R_2** = ,007
SPNOW	-0,11	-0,10	-0,12	-1,97	**0,04**	**F(5,380)**=1,560
HOLOSP	-0,07	-0,02	-0,02	-0,41	0,68	**Std.Er:** 1,054
SPWEEK	-0,02	0,03	0,04	0,76	0,44	

Correlation cofficient (r), partial correlation cofficient (Part-r), partial standardized coefficient of regression(BETA), t-value of regression coefficient of test significancy (t), error size (p-level), coefficient of multiple correlation (R), coefficient of determination (R_2), value of multiple correlation coefficient of test of significancy, test treshold significancy (p).

Unlike in female students, chosen dependant variables in male students sample do not show any statistically significant influence on subjective health disturbances nor on health disturbances (independent variables) as it is shown in table 4.

Table 4. Multiple regression analysis of influence of dependant variables on health disturbances of male students

SUBDIST						
Male students	**r**	**Part-r**	**BETA**	**t(223)**	**p-level**	
STUDTM	0,07	0,05	0,06	0,88	0,37	**p<**,61510
FREETM SPNOW	-0,05	-0,01	-0,01	-0,26	0,78	**$R_{ع}$**= ,01571
HOLOSP	-0,09	-0,04	-0,04	-0,62	0,53	**F(5,223)**=,71187
SPWEEK	-0,08	-0,04	-0,05	-0,66	0,50	**Std.Er:** ,96038
STUDTM	-0,06	-0,01	-0,01	-0,23	0,81	
HLTDIST						
Male students	**r**	**Part-r**	**BETA**	**t(223)**	**p-level**	
STUDTM	0,04	0,05	0,05	0,80	0,42	**p<**,08208
FREETM	0,04	0,08	0,08	1,21	0,22	**$R_{ع}$**= ,04257
SPNOW	-0,14	-0,05	-0,06	-0,86	0,38	**F(5,223)**=1,9835
HOLOSP	-0,17	-0,10	-0,12	-1,58	0,11	**Std.Er:** ,75062
SPWEEK	-0,11	-0,04	-0,05	-0,72	0,46	

Correlation cofficient (r), partial correlation cofficient (Part-r), partial standardized coefficient of regression(BETA), t-value of regression coefficient of test significancy (t), error size (p-level), coefficient of multiple correlation (R), coefficient of determination (R_2), value of multiple correlation coefficient of test of significancy, test treshold significancy (p).

Conclusion

The primary interest of this research was to reveal how much leisure time students dedicate to sport activity as well as how and if the choices they made influence their own perception of their subjective state and health. A survey with questions related to ways of spending leisure time was conducted on the sample of 615 male and female students of the University of Zagreb, Croatia, average age of 19,57. The results of the survey show significant differences between male and female population. Female students seem to have more health problems. They dedicate most of their leisure time to studying and they do not posses sporting habits because they have been involved in doing sport activities only for the last 6-12 months up to 1 time a week. Their subjective health disturbances correlate to the amount of available leisure time, so they feel more psychosomatic disturbances as they have less leisure time available and as they do less sports. The discouraging fact is that every second female student often uses medicaments (42%) to feel better. Although hypokinesis and stress are today's common disease, they are inappropriate for such a young population. Unlike their female colleagues, male students posses sporting habits and they spend most of their leisure time doing various sport activities 2-3 times a week during last 5 years. In male sample no significant subjective health disturbances were detected which can be related to their sport involvement.

In conclusion, we belive it would be necessary to do more detailed researches and expert analysis and than introduce adequate issues in terms of content and organisation with respects to the interests of students (Majerič, 2002). Also, more attention should be given to creation of students' sporting habits for the purpose of advancing the quality of life. A constant, well adjusted sport-recreational activity needs to become a part of a daily agenda among young generations. Special attention should be dedicated to sport programs for the female students that are showing no interest whatsoever for sport activities.

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CHILDREN'S SATISFACTION WITH THE PROGRAM IN "THALASSOTHERAPIA"*

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Introduction

"Thalassotherapia Crikvenica" is a special institution for the treatment and rehabilitation of problems with respiratory organs and rheumatism. Thanks to exceptionally favorable climatic and geographic conditions, the city of Crikvenica began to organize health tourism services as early as the end of the 19th century (the year of 1895). (Crnčić-Samsa, 1998). The treatment of children in Thalassotherapia entails the following:

- Inhalation therapy, including IPPB therapy
- Hyposensibilization according to alergogram
- Physical therapy with emphasis on respiratory exercises
- Medicaments therapy

Besides treatment, sports-recreational activities as well as other activities (arts, culture…) also play an important role in the Center. These activities are performed in order to make the children's free time all the more interesting and fulfilled. The importance of sports-recreational activities needs not be specially emphasized if we take into consideration that regular physical activity; active play and sports present a way towards better health. Some benefits are listed as follows (Milanović, 1997):

- Sport activity enables each person to satisfy basic human needs for movement, play, safety, order and system, belonging, self-respect and self-actualization
- Sport and sport activity significantly influence the psychosomatic development and state of children, young people and adults
- Engaging in sports enables an improvement in quality of life – the foundation of mental and physical health and improvement

Žugić (1996) states that sports are an important part of socialization, and have a significant role in re-socialization – breaking the habit of alcoholism, cigarettes, narcotics – and claims that sports-recreational activities take a very important part during leisure time "active attitude towards the entire world".

The goal of this paper is to analyze the data regarding the satisfaction of children with the program in Thalassotherapia in order to organize additional sports-recreational activities during free time in the best possible way. The data was obtained by means of a questionnaire. In addition, one of the goals is to find out the opinion of the children about the program within the center as a whole (from medical treatment to accommodation, food, and personnel).

Methods

Questionnaire poll

The sample consisted of 120 subjects aged between 13-15. They hail from various regions of Croatia and all had problems with respiratory organs. The condition for inclusion into the research was voluntary filling out of the questionnaire.

Variables sample

By filling out the questionnaire subjects answered 12 questions. The questionnaire consisted of four sections. The first four questions were general questions regarding gender, age and dwelling. The second section of the questionnaire regarded the way in which the children spend their free time and their motives for coming to Thalassotherapia. The third section entailed questions concerning suggestions for improvement of activities (primarily sports-recreational), and the final section was their evaluation of the entire program.

Methods of data processing

Basic statistical parameters were applied for the processing of gathered data; frequency (f) and percentage (%). All collected data is displayed in tables and graphs.

* *Young researcher award*

Results and discussion

Most subjects were from the Zagrebačka County (as many as 55%). The remaining 45% were mostly children from the Karlovačka County (11%), Osječko-baranjska County (10%) and Brodsko-posavska and Požeško-slavonska counties (8%). The least children are from the South of Croatia. This was expected if we take into consideration that Zagrebačka County is the most populated and the most polluted, and that the contents of air there is most unfavorable for persons with respiratory problems. Another reason is the desire to spend time on the seaside, which has positive effects upon health, yet also serves as a convenient location for a vacation and all kinds of sports-recreational activities. It is for these very reasons that fewer children from counties near the sea were expected.

By observing Table 1 one can note that there are no great differences in the way boys and girls spend free time. The children spend most of their free time in front of a television set and hanging out with their friends. Many of them engage in sports in their free time, which is positive because the children accordingly have interest for sports-recreational activities at the center as well. The motives for coming and the way in which children spend free time are tightly connected (fun and being with friends is one of the basic priorities for children).

Table 1. Children's free time activities

	1. Reading	2. Watching TV	3. Arts and culture ctivities	4. Sports	5. Playing with friends	6. Computer or "Play station"	7. No special activities
boys	9	51	0	39	46	39	1
girls	21	47	11	32	52	24	0

The interests for provided sports activities differ with boys and girls, and more interest for sports-recreational activities is notable with boys. Boys mostly prefer soccer, table tennis and basketball, while girls prefer volleyball, badminton and dodge ball. General well-known sports are of great interest for the children (volleyball, soccer, basketball…). It is interesting to note that water sports are less attractive for children. The reasons for this may lie in insufficient familiarity with these sports, as well as their rules and dynamics. The interest of girls for soccer is surprisingly big, which indicates its great popularity (Figure 1).

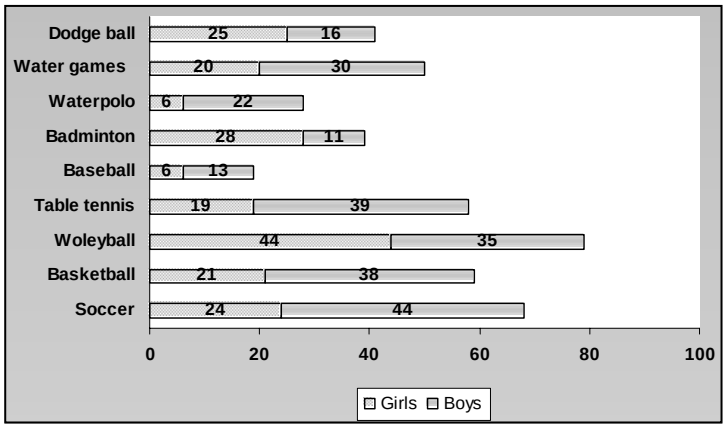

Figure 1. Sports preferred by boys and by girls

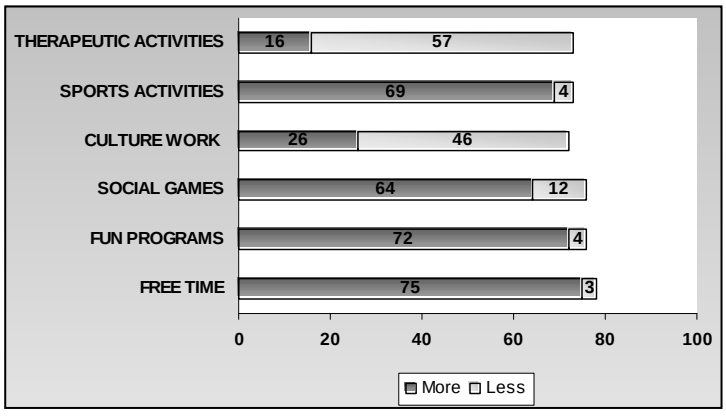

Figure 2. Suggestions to improve the offered activities

The obtained results shall help us organize most of the sports-recreational program with sports that are of greatest interest to the children, and decrease the ones that are not of interest to them (i.e. baseball). Water activities should continue to be included despite the fact that children do not prefer them to a great extent. The children should be taught about the therapeutic effects of water upon their health.

Figure 2 indicates that the subjects wish a decrease of the therapeutic program and the culture workshop in order to replace the time with sports activities, social games and fun programs. It is obvious that the scope and difficulty of therapy makes the children long for rest and more free time.

The satisfaction of the subjects with the program as a whole and the activities that are offered by Thalassotherapia is confirmed by Figure 3, which indicates that as many as 79% of them would once again return to Thalassoterapia.

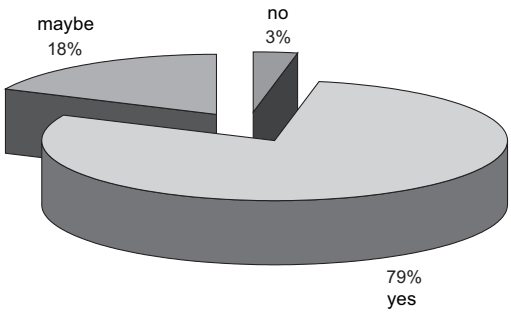

Figure 3. Subjects that would return to the Center

Conclusion

Data obtained by means of the basic statistical parameters (percentage and frequency) indicate the following:

- There are no significant differences in the way boys and girls spend free time
- Motives for arrival and the way in which children spend free time are tightly connected
- Boys have a greater interest in sports-recreational activities
- Children's interest in generally well-known sports is great, while water sports are less attractive
- Most of the children are satisfied with the program as a whole and would return again

In the scope of the obtained results we may conclude that the sports-recreational activities fulfill the children's desires and interests to a great extent. This manner of questionnaire polls should continue to be done in order to improve and conceive programs that are in accordance to children's interests.

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ACTIVE SPORTS HOLIDAYS IN SLOVENIA*

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Abstract

Until now the majority of researchers of sports tourism have focused their research on the tourist, meaning, on the demand. According to the model constructed by Planina, Mihalič (2002, pg. 29) there is another element besides the demand of tourism, which is the supply. With this in mind we embarked on a research amongst providers of active sports holidays and asked them about a typical tourist or client. We divided them into segments. We learnt that in Slovenia the majority of those offering tourist services deal with short-length stays. We also researched the supply and the demand and learnt that the providers expect the demand to be highest for skiing and cycling. In the largest of the segments the activities most frequently offered are swimming (water sports), tennis (racquet sports), the usual team sports and skiing. However, the demand for these sports is not growing. Amongst the activities which are in lesser demand but have been defined by the providers as growing, are mountain biking and golf.

Key words: *sports tourism, supply and demand, segmentation*

Introduction

Lately, there has been a lot of talk about holidays with a content. A lot has been written about sports tourism as such, different writers have divided it into segments (Gibson 1998, Standeven and De Knop, 1999). Hudson (2003) even claimed that sports tourism comprises many different types of tourism. In the category of sports tourism we can find adventure tourism, health tourism, outdoors tourism, spectator tourism, competitive tourism, recreational tourism, educational tourism and business tourism (Hudson, 2003, pg. 3). Holloway (1996) divided tourism into holiday tourism, business tourism and other tourism. Sports tourism can be divided into travel for the needs of commercial tourism and sports business tourism (Standeven and De Knop, 1999, pg. 12). The WTO defined sports tourism as tourism for those people who have a special interest in places where they can practice their favourite sport. Sports tourism also includes trips made with the purpose of attending a sports event (WTO, 2004, pg. 5). Most authors dealt with sports tourism from the aspect of the consumer or tourist. They searched for a typical tourist who practices sport whilst on holiday (using socio-demographic data), how much he or she spends and how he or she travels. In 1999, in the US "The American Travel Association" produced a study on how many trips made by domestic tourists were connected to sport. They discovered that between 1994 and 1999 75.3 million adult Americans travelled for or because of sport, either as spectators or active participants (Gibson, 2003, pg. 206). In 1998, a Canadian research on travel showed that 37% of domestic tourists travelled with the purpose of sport. Gibson established that a typical active sports tourist is highly educated, male, aged between 25 and 34, with an above-average income. Upon his own initiative he opts to travel far to participate in his favourite sport, there is a possibility he practices sports after he retires, and he tends to have more than one active sports holiday (Gibson, 1998, pg. 162). British Mintel International (2003) came to similar conclusions. The WTO in cooperation with the International Olympic Committee produced a research on sports activities on holidays among French, German and Dutch tourists (travelling outside their own countries). They discovered that in 1999, 55% of Germans participated in sports activites on holidays (of those 34 % were very active and 66 % less active) (WTO, IOC, 2001).

The majority of the above mentioned authors focused on the tourist, that is on the tourist demand. But according to the model constructed by Planina, Mihalič (2002, pg. 29) there is another element in the system of tourism, that is the offer/supply. Our research focused on the supply, because it is impossible to persuade the tourist to participate in sports when the supply does not fulfill his/her demands. If at a certain tourist destination there are no sports facilities/activities or they are unsatisfactory, it is illogical to believe that the tourist will pursue sports and that the demand for sports activities will increase. So in our research we asked providers of tourist services what levels of demand they have experienced and what type of tourist is their typical client. In this way we wanted to discover whether the supply of active sports holidays in Slovenia is large enough and whether it satisfies the needs of active sports tourists. This group of tourists have been labeled by the majority of author the fastest growing segment of the tourist industry (Gibson, 1998; Seddighi and Theoracharous, 2002, Hudson, 2003, pg. 1, Hinch, Higham, 2001, pg. 45). Sports is very hard to define (European Sports Charter, 1993), so it is also difficult to say who an active sports tourist is. The providers of tourist sports activities also have their own

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set of rules. This was the starting point for our investigation and we analysed the optimal supply of active sports holidays in Slovenia. We were also interested in the contents, that is the sports disciplines offered in Slovenia.

Purpose of research

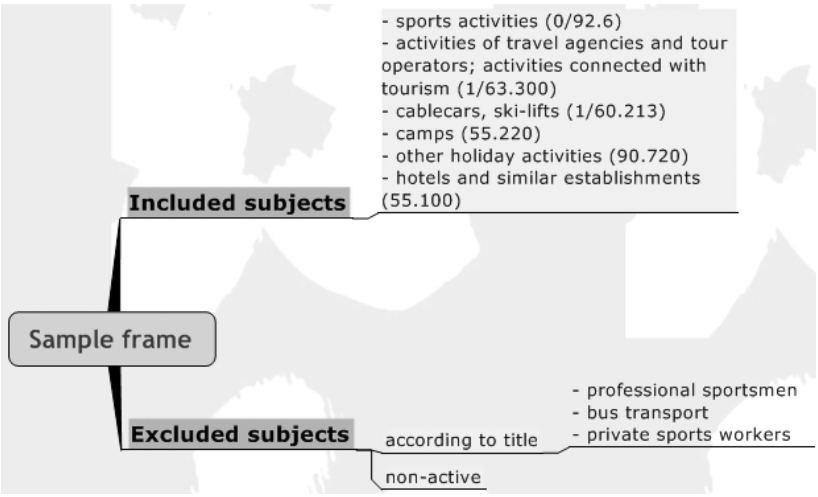
The market of sports activities in Slovenia is not yet systematically regulated so conseqently there is no compiled data specific for this particular discipline of tourism. With this purpose we have carried out a research among the providers of sports tourism as we wanted to get a picture of the Slovenian sports activities market. The basic question the research asks is: Who offers these sports activites? With this in mind we paid particular attention to create the right sample frame.

The primary purpose of the research is the question: What is happening on the sports activities market? We wanted to produce a list of providers and the facilities/activities they provide. The second and the main purpose was to define sports activity providers into segments according to the structure of their guests (tourists or daily visitors). This research also highlights the potential future development of indivudual sports activities for each segment and defines those which are growing in the opinion of the providers.

Methods

Sample frame

Because of the fact that in Slovenia there is no official data on the supply of sports activities we were forced, when setting the sample frame, to take in a wide spectrum of organisations, registered as the type of business that could potentially offer sports activities to tourists.



Source: IPIS

Image 1: Sample frame

The procedure of setting the sample frame was as follows.

First it was necessary to define the initial data base we were going to operate with and in which we were going look for our sample. We used the data base of the Business Register of Slovenia (IPIS). We included all the organisations which could in any way be connected with sports activites and all sport activities in tourism. In other words, all the subjects with the appropriate business code were chosen, except for those who had in the title »professional sportsman, bus transport or private sports worker«. In this way we obtained 7485 subjects which fulfilled our criteria.

This group represents the entire supply of sports activities in Slovenia. It also includes those which are subject to membership, meaning not open to the general public. The list offers an insight into the market of sports activites in Slovenia which we can look at from a regional perspective and in regard to the size of organisation.

Image 2: Structure of subjects according to STB regions

Tourist destination / region	Frequency	Percent	Cumulative percent
Julian Alps	513	6.9	69
Coast and Carst	1013	13.5	20.4
Pohorje and surroundings	1392	18.6	39.0
Ljubljana and surroundings	1682	22.5	61.5
Savinjska region	809	10.8	72.3
Pomurje region	569	7.6	79.9
Dolenjska and Bela Krajina region	706	9.4	89.3
Gorenjska	593	7.9	97.2
Zasavje region	208	2.8	100.0
Total	7485	100.0	

Image 3: Structure of subjects according to size of enterprise (Slovene business legislation standard)

Type of enterprise	Frequency	Percent	Cumulative percent
Large	12	0.2	0.2
Medium sized	28	0.4	0.5
Small	801	10.7	11.2
Sole Trader	466	6.2	17.5
Association	6178	82.5	100.0
Total	7485	100.0	

The analysis showed a strong presence of associations. In the category of associations we included sports associations, clubs and unions and in the category of small enterprises we inluded small as well as micro enterprises. Sports associations represent the largest share of the sports tourism market in Slovenia. The question arising now is what kind of role they play in the supply itself.

Sample and representation

In the sample we included all large and small enterprises and 200 associations. Other subjects were evenly included according to STB regions. The size of the final sample was n=540. We weighted the sample to make it representative regarding the size of the subjects and the activities.

Results

We asked each provider of sports activities about the structure of their guests. These indicators then served as the basis for segment analysis. We used K-Means cluster analysis in order to define the segments of the providers and divided them into four separate segments. This proved to be the most appropriate segmentation.

Segmentation of providers of active sports holidays

Each provider described the structure of their guests. We used the statistical method of centroids (*k-means*) to divide them into four segments regarding their characteristics.

- **Subjects with guests with short-length average stays** (41%): The large majority of guests in this segment are daily visitors, the main season is summer and they stay elsewhere overnight.
- **Subjects with mainly daily visitors – non-overnight guests** (36%): The majority of visitors come for a day. Hardly any of them stay for a night - they do not rent any accomodation.
- **Subjects with weekly and mainly foreign tourists –** (15%): Hotel guests, mostly staying up to 14 days, aged 25- 40.
- **Subjects with long-term guests, summer season mainly** (9%): They all stay in rented accomodation for 14 days or more.

Supply and demand for the activities

Each provider described the sports activities offered and gave a general opinion as to which activities are growing in demand. The ratio between supply and demand is shown in the following graph.

Supply versus demand (image 5)

Sports activities which are most frequently avaliable are also in the highest demand. The providers expect the highest demand for cycling and skiing. Tennis is frequently available but the expected demand is not quite as high. Golf is rated as above average as far as demand is concerned but the supply is only average. The same applies for mountain biking but to a lesser extent.

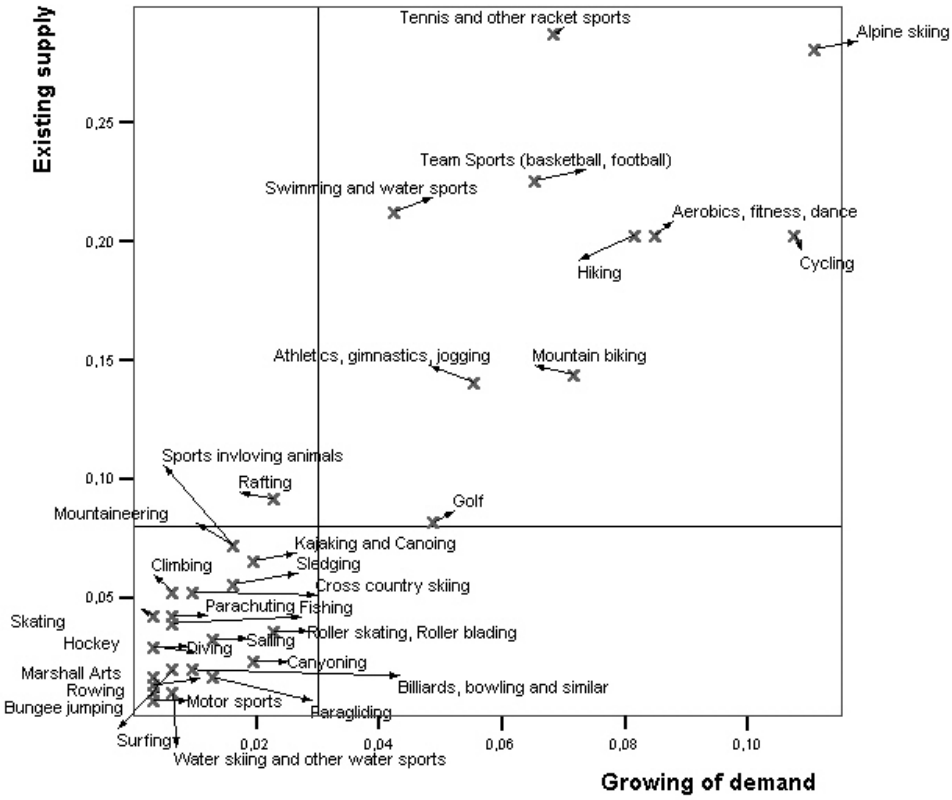


Image 5: Supply and demand

Supply according to segments of providers

We also analysed supply versus demand within individual segments.

- **Providers with guests with short-length average stays** (41%): The activities most frequently offered in this segment are *swimming* (water sports), *tennis* (racquet sports), usual *team sports* and *skiing.* The demand for these sports is not growing. Other activities frequently offered are mountain biking, athletics with jogging and **hiking**. According to the opinion of the providers the demand for hiking is growing the fastest.
- **Providers with mainly daily visitors – non-overnight guests** (36%): The activities most frequently offered in this segment are *tennis* (racquet sports), usual *team sports* and *athletics with jogging.* The demand for these sports is on average not growing. Other activities frequently offered but not in growing demand are hiking and skiing. Demand is growing for **aerobics (fitness, dance)** and **cycling**. These sports are also frequently offered.
- **Providers with weekly and mainly foreign tourists –** (15%): The activities most frequently offered in this segment are *tennis* (racquet sports), usual *team sports*, *skiing*, *hiking* and mountain biking. Swimming (water sports) is an activity which is frequently available but the demand is not growing. Demand for these sports on average is not growing. Activities frequently offered for which the demand is growing are **aerobics (fitness, dance)** and **cycling**.
- **Providers with long-term guests, summer season mainly** (9%): The activities most frequently offered in this segment are *swimming with water sports* and *usual team sports.* Aerobics (fitness, dance) and horse riding and hunting are present to a lesser extent. On average the demand is not growing for any of these activities.

Limiting the research

We already realised when setting the sample frame that the strongest factor in supplying sports activities in tourism are sports associations. They are the largest and the most active group in the providers market. If they were excluded from our research the results would most probably be different. The associations do not directly offer sports activities to tourists but they actively participate in this. If we were only interested in what the businesses offer we would need to limit the sample.

Conclusion

In this research we included all the organisations which could in any way be connected with sports activities and all sports activities in tourism (main activity, hotels, camps, cablecars, agencies). Among those defined as potential providers of sports activities 76% do actually provide them. Among all of them 50% also offer activities to tourists and daily visitors and 7% have thought of doing this in the future. The providers were divided into four segments: 1. Providers with guests with short-length average stays (41%) 2. Providers with mainly daily visitors – non-overnight guests (36%) 3. Providers with weekly and mainly foreign tourists (15%) 4. Providers with long-term guests, summer season mainly (9%)

Tennis, skiing, swimming and other water sports, team sports, hiking and cycling are activities that are most frequently offered, but the providers do not expect a growth in their demand. These activities are well developed in Slovenia and the supply satisfies the demand so there is no need for their growth. That need will only appear when the demand rises. The biggest demand, among other activities that are frequently offered, is expected for cycling and also for aerobics (fitness, dance) and hiking. Mountain biking and golf are in shorter supply but a growing demand for them is expected by the providers. That is true especially for golf for which the demand is above-average and the supply is relatively limited. Consequently, investments in tourism should be made in these activities. The providers who have foreign guests mainly offer jogging (athletics, gymnastics), hiking, swimming and other water sports. Tennis and other racquet sports, team sports, cycling and mountain biking are more in demand by domestic guests. The share of alpine skiing is the same for both types of guests.

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COMPARISON OF FREE TIME BETWEEN CHILDREN IN CROATIA AND CHILDREN IN SLOVENIA WITH EMPHASIS ON SPORT ACTIVITIES

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Abstract

Free time is the time, which is freely chosen by children. Due to negative effects of sedentary lifestyle, it is desired and highly recommended that children practise sport in their free time as much as possible. The purpose of our investigation was to find out how 10-year-old pupils in primary schools in Ljubljana (Slovenia) and Zagreb (Croatia) spend their free time and how actively they participate in sports. We used a questionnaire, which had already been used for investigating the quality of sport education in the first three years of 9-year primary school (Štemberger, 2003). The questions included in the questionnaire are of closed ended, the children answered on the 3-level Likert-type scale.

By using the selected methods, the set hypotheses were verified. The results show that the free time of the Croatian children is more frequently devoted to "the pleasures" provided by up-to-date technology, whereas the Slovenian children are more engaged in the activities of interest and sport activities.

Key words: *free time of pupils, sport participating, comparison of pupils between Ljubljana and Zagreb*

Introduction

In a broader meaning, free time means the entire time outside the professional (paid) work, while in a stricter meaning, it means only the time which is individually freely chosen (Ledermann, 1977 –v Lešnik, 1982). According to this definition, free time of pupils is the time when pupils do not attend classes or perform any tasks related to school, and the time when they do not have work at home. In short, this is the time, which children freely choose. During this time, a child freely selects contents and activities, which suit his/her tendencies and wishes (Novak et al., 1995).

Some sociologists distinguish between three types of free time activities:

- spontaneous activities – an individual initiates such activities without any premeditation or organization, on the basis of momentary impulse or internal need and ends them whenever he/she gets tired of them. Such activities are for example various games, walks, chats;
- consumer activities – the activities which offer entertainment to an individual and, consequently, fulfilment of his/her interests and needs (reading books, newspapers, watching TV, listening to the radio, visiting concerts and sport events);
- organized activities – the activities which require active participation of an individual. They are target oriented, planned and organized activities. An individual initiates them wilfully and with a certain purpose, interest and expectations (activities of interest, linguistic schools, sport clubs) (Novak et al., 1995).

Each of the above mentioned activities contributes to the quality of free time. Some of these activities do not have any intentional educational effect, however, educational effects can be unpredictable and accidental. From the child's personality development and his socialization viewpoints, these effects might be or might not be positive.

In order to provide useful and proper spending of free time, schools organize lots of activities for their pupils. But the question is how many of these activities have a sport content (particularly in the first classes of primary school) and how many children are actually included in such activities of interest with a sport content.

In adolescence, when many young people yield to the temptation of alcohol, drugs, tobacco, the value and importance of sport activities is still more important. It is not only about the physical training, but also about the development of positive values and useful spending of free time (Berčič and Ažman, 2002/a; Berčič and Ažman, 2002/b; Tomori et al., 1998; Hočevar, 1999; Knific, 1999). That is why we were interested in how the pupils from Ljubljana and Zagreb spend their free time with emphasis on sport activities.

Objectives

The purpose of the investigation was to find out how actively the selected pupils practise sport in their free time and to define the differences in spending free time or practising sport between the pupils living in different towns and countries.

Hypothesis

H 01: In dependence of the town and country in which children live, statistically characteristic discrepancies in spending free time and practising sport appear.

Sample of pupils

250 pupils from three primary schools in Ljubljana (Slovenia) and four primary schools in Zagreb (Croatia) were included in the survey - 132 from Ljubljana (71 boys and 61 girls) and 118 from Zagreb (53 boys and 52 girls). All pupils were born in 1995 and attended the 3rd class of 8-year primary school or the 4th class of 9-year primary school in Ljubljana and the 3rd class of 8-year primary school in Zagreb.

Description of instruments and sample of variables

Questionnaire for pupils

In our investigation, we used the questionnaire based on the questionnaires for education and learning quality definition and assurance (Modro oko, 2001), revised and adapted for the field of sport education in lower classes of primary school. The questionnaire had been used already in the investigation of the sport education quality in the first three years of 9-year primary school (Štemberger, 2003). The questions in the questionnaire are of closed ended, the pupils answered on the 3-level Likert-type scale. The questionnaire for pupils included 59 variables and encompassed the following fields:

- home work and free time of pupils,
- activities of interest and out-of-school activities,
- sport practising outside classes,
- sport equipment,
- sport participating – frequency.

Reliability of the questionnaire was checked by using the Cronbach Alpha.coefficient which is .6543.

Data processing methods

In accordance with the objective and hypothesis, the following data processing methods were used:

- to define basic characteristics of individual samples, the basic statistical method, i.e. distribution of answers by frequency and percentage;
- to define discrepancies between the investigated pupils, the causal non-experimental method of pedagogical investigation, i.e. the hypothesis independence hi^2 test (by considering that 20% of frequencies can be under 5 but no one under 1; in that case the likelihood ratio was used). The limit of statistical relevance was considered $f<0.05$.

Results and explanation

The results are presented descriptively as well as the fields in which statistically characteristic discrepancies between the pupils from Ljubljana and those from Zagreb are apparent.

In the set of questions related to **home work and free time**, statistically characteristic discrepancies appear between the children from Ljubljana and those from Zagreb. This is due to higher values of the answer given by the children from Zagreb to variables *Watching TV, video* (f = 0.000; 86.4% pupils from Zagreb, 51.1% pupils from Ljubljana); *Playing computer games* (f = 0.003; 41.5% pupils from Zagreb, 27.3% pupils from Ljubljana); *Talking and playing with friends* (f = 0.017; 66.9% pupils from Zagreb, 49.2% pupils from Ljubljana); *Learning and doing homeworks* (f = 0.047; 93.2% pupils from Zagreb, 83.7% pupils from Ljubljana); *Making phone calls* (f = 0.000; 50.0% pupils from Zagreb, 18.3% pupils from Ljubljana). The pupils from Ljubljana more frequently *Read books* (f = 0.002; 35.6% pupils from Zagreb; 56.2% pupils from Ljubljana) and *Practise sport* (f = 0.003; 57.6% pupils from Zagreb; 68.5% pupils from Ljubljana).

In the set of questions related to **spending free time before and after classes**, statistically characteristic discrepancies appear between the children from Ljubljana and those from Zagreb due to higher values of the answer "frequent" given by the children from Zagreb to variables *A matter or two which had to be done today are postponed to tomorrow* (f = 0.040; 16.1% pupils from Zagreb, 8.5% pupils from Ljubljana); *I go to bed too late and I am tired the next day* (f = 0.000; 45.8% pupils from Zagreb, 21.5% pupils from Ljubljana).

We can state that neither of these two facts is related to school but exclusively to the family and its education of children.

In the set of questions related to **the activities of interest organized in school**, statistically discrepancies appear between the children from Ljubljana and those from Zagreb due to higher values given by the children from Ljubljana

to variables *Sport-related activities of interest* (f = 0.000; 54.4% pupils from Ljubljana, 22.2% pupils from Zagreb); *Art-related activities of interest* (f = 0.005; 13.1% pupils from Ljubljana, 6.1% pupils from Zagreb); *Technical education* (f = 0.024; 3.8% pupils from Ljubljana, 1.7% pupils from Zagreb); *Computer science* (f = 0.000; 9.2% pupils from Ljubljana, 0.0% pupils from Zagreb).

The interest for computer science is probably the result of the new educational system in Slovenia, which requires that each class has a computer. So we can expect the increased number of offered activities of interest in the field of computer science.

The pupils from Zagreb engage in *the activities in the field of mother-tongue* (21.7%) more frequently than the pupils from Ljubljana (6.1%) (f = 0.001).

In the set of questions related to **the out-of-school activities of interest**, statistically discrepancies appear between the children from Ljubljana and those from Zagreb due to higher values given by the children from Ljubljana to variables *Music-related activities* (f = 0.029; 24.0% pupils from Ljubljana, 11.1% pupils from Zagreb) and due to higher values given by the children from Zagreb to variable *Religious education* (f = 0.000; 50.0% pupils from Zagreb, 35.9% pupils from Ljubljana).

In the set of questions related to **out-of-school sport participation**, statistically discrepancies appear between the children from Ljubljana and those from Zagreb due to higher values given by the children from Ljubljana to variables *Skating* (f = 0.001; 36.9% pupils from Ljubljana, 27.4% pupils from Zagreb); *Skiing* (f = 0.000; 38.9% pupils from Ljubljana, 11.1% pupils from Zagreb); *Biking* (f = 0.004; 56.2% pupils from Ljubljana, 39.7% pupils from Zagreb); *Mountaineering* (f = 0.000; 18.3% pupils from Ljubljana, 6.0% pupils from Zagreb); Skating (f = 0.000; 19.1% pupils from Ljubljana, 4.3% pupils from Zagreb).

In the set of questions related to **sport equipment which the pupils have at home**, statistically discrepancies appear between the children from Ljubljana and those from Zagreb due to higher values given by the children from Ljubljana to variables *Rollers* (f = 0.001; 90.2% pupils from Ljubljana, 73.7% pupils from Zagreb); *Scooter* (f = 0.016; 80.3% pupils from Ljubljana, 66.9% pupils from Zagreb); *Skates* (f = 0.000; 59.1% pupils from Ljubljana, 16.9% pupils from Zagreb); *Swing* (f = 0.025; 71.2% pupils from Ljubljana, 57.6% pupils from Zagreb); *Badminton racquet* (f = 0.018; 72.7% pupils from Ljubljana, 58.5% pupils from Zagreb); *Skiis/Board* (f = 0.000; 77.3 pupils from Ljubljana, 22.9% pupils from Zagreb); *Helmet* (f = 0.000; 88.6 pupils from Ljubljana; 57.6% pupils from Zagreb).

In the set of questions related to **participation in sport**, statistically characteristic discrepancies appear between the children from Ljubljana and those from Zagreb due to higher values of the answer given by the children from Ljubljana to the variable *Practising sport in the week* (f = 0.001; 63.6% pupils from Ljubljana, 47.0% pupils from Zagreb). Since the pupils in Ljubljana have the possibility of staying in school after classes still in the 3rd class, they can engage in sport activities organized in school. Whereas the pupils in Zagreb are more dependent on their families and are more left to themselves after classes (from12 noon). This may be one of the reasons for the obtained results.

Discussion

The obtained results show that the pupils in Zagreb devote more time to "the pleasures" provided by up-to-date technology (TV, video, computer games, phone calls) and to learning and doing homeworks. Since they have no additional options to select, they select whatever is available. In Slovenia, the educational system has been changing and one of the most important things of 9-year school is that pupils should do and learn as much as possible in school in order to be able to spend free time properly and usefully (playing, reading, practising sport…). It is interesting that pupils living in Zagreb admit that they go to bed too late and are tired the next day due to watching TV or playing computer games.

We can assume that more pupils living in Ljubljana are included in the sport- and art-related activities, technical activities and the activities related to computer science also due to more diversified offer of these activities in primary schools in Ljubljana.

Unorganized, not guided activities, such as rolling, biking, skiing, mountaineering and skating are more popular between the children in Ljubljana than between the children in Zagreb. This popularity can be attributed to the fact that they have necessary sport equipment at home, as well as the tradition and conditions in particular towns. Thus, for example, mountaineering, trekking and skiing are Slovenian national sports, in which a great number of adult people are also engaged. Namely, Slovenia can boast with natural treasures, which enable participation in these sports. Skating is becoming popular again among children due to many free-of-charge skating-rinks, which are open all day and which even offer skating equipment for hire, usually free-of-charge. Besides, transfer from rollers to skates and vice versa is high and it is expected that most children who practise rolling also want to practise skating (successfully). Location of skating-rinks in the centre of Ljubljana and in the shopping centres highly contributes to popularization of this sport in recent years.

Why are more pupils in Ljubljana than in Zagreb engaged in the sport activities organized in school? Why are more pupils in Ljubljana practising different sports? Why are more pupils in Ljubljana practising sport also during week-time?

These are the questions which require analysis. We assume that this can be attributed to:

- the educational system in Slovenia which enables that a sport teacher can teach together with a class teacher;
- the educational system in Slovenia which offers sport classes within the regular classes;
- new educational system in Slovenia which offers to children the possibility of doing more homework at school and less at home;
- the option to stay in school after classes offered also to the pupils in the 3rd class;
- the better choice of sport activities provided to children after leaving kindergarten;
- the intensified promotion of exercising, wholesome food and sound lifestyle in general in Slovenia in the recent years.

In any case, the programs for children should be planned, professionally guided and also analyzed, so that their effect would not be only accidental. In the middle of the last century, the experimental program of physical and health culture was carried out in Croatia. Although it gave very good results in various segments and even in the fields, which are dealt with in our paper, the program did not come to life. At the moment, the educational reform is going on in Croatia. The reform will probably change the present situation, which is not satisfactory, as can be seen also from the results obtained in our investigation.

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COMPARISON OF RECREATIONAL ROWERS AND RUNNERS ACCORDING TO SOME MORPHOLOGICAL AND FUNCTIONAL-MOTOR TRAITS

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Abstract

The aim of this investigation was to determine the differences between recreational rowers and runners. The sample consisted of 48 males aged 35-65 years who take part in recreational rowing as well as 27 males of the same age who take part in recreational running. Using the EUROFIT battery of tests the following dimensions were determined: body fat percentage, waist-to-hip ratio, body mass index, flexibility, hand grip, repetitive power, explosive power, tapping, balance and maximum oxygen uptake. The investigation showed recreational rowers to be heavier and taller than runners and to have a higher percentage of muscle tissue as well as fat tissue. In addition, rowers demonstrated a higher muscle force and were dominant in the explosive strength dimension. Runners, on the other hand, scored better in relative VO_2max indicator.

Key words: *rowing, running, sports recreation, middle age*

Introduction

Cyclic aerobic activities are of special importance in sports recreation primarily because of their positive influence on the aerobic capacity. A high level of aerobic power includes healthy and efficient oxygen transportation system (primarily respiratory and cardio-vascular systems), which is considered to form the basis of human health (Nieman, 1990). Besides walking, running is probably the most common recreational activity, while rowing is - because of its specific needs in terms of equipment - still pursued by few people and those who do take part are primarily former rowing competitors, as was the case in this study.

Methods

The aim of this research was to compare two groups of males aged 35 – 65 years, one primarily active in recreational rowing and the other in recreational running, and identify the differences between them in terms of some morphological characteristics and functional-motor abilities. The sample consisted of 48 males aged 35-65 years who take part in recreational rowing as well as 29 males of the same age who take part in recreational running at least twice per week at a prescribed target heart rate which was selected to be between 70-85% of the maximal heart rate over at least 75% of the training duration (60 min). Only the subjects that reported regular attendance for at least 12 months prior to the testing were evaluated. The variables used in this research were chosen from EUROFIT battery of tests (Oja & Tuxworth, 1995) to allow the present research to be compared with some similar research done previously in Croatia (Heimer et al., 2004) and Europe. Based on the accepted assumptions on the relations between physical activity and human health, four sets of tests were selected. The tests evaluate morphological, muscular-skeletal, motor and functional traits.

Table 1. Overview of variables with abbreviations, measuring units and evaluated dimensions

Tests	Abbr.	Measuring unit	Evaluated dimension
Body mass index	BMI	Index value	Height to weight ratio
Waist-to-hip ratio	WHR	Index value	Distribution of body fat
Body fat percentage*	%FAT	Percentage	Quantity of body fat
Hand grip	HG	Kilopond	Muscle strength
High jump	HJ	Centimeter	Explosive power
"Sit and reach" test	SAR	Centimeter	Flexibility of the trunk
Balance test	BAL	Number of reps	Balance
Tapping test	TAP	Number of cycles	Speed of repetitive movements
Sit-ups test	SUT	Number of cycles	Repetitive trunk power
Astrand test	AST	Ml/kg x min	Aerobic power

*According to Durnin & Womersey, 1974.

The testing for the purpose of this research was done in the Sports-Diagnostic Center of the Faculty of Kinesiology at the University of Zagreb. The results of testing were imported in Statistica for Windows 6.0 software and the differences between the chosen variables in rowers and runners were determined by means of discriminative analysis. The variables contributing the most to the discrimination were also determined. Since the observed sample groups did not differ significantly in age, it was possible and methodologically justified identifying the differences.

Results and discussion

Table 2. Means with standard deviations in all the observed variables for both of the sample groups

	MEAN and SD (rowers N = 48)	MEAN and SD (runners N = 29)
Body height	184.13 ± 6.33	177.43 ± 7.03
Body weight	91.49 ± 13.18	76.49 ± 9.50
BMI	26.95 ± 2.82	24.32 ± 2.68
WHR	0.95 ± 0.05	0.93 ± 0.05
%FAT	22.44 ± 3.70	20.00 ± 4.74
HG	65.10 ± 10.62	54.48 ± 7.60
HJ	40.73 ± 7.24	36.52 ± 6.56
SAR	5.06 ± 7.98	4.41 ± 9.38
BAL	1.54 ± 1.13	1.56 ± 1.12
TAP	48.40 ± 4.98	46.41 ± 4.78
SUT	25.02 ± 4.47	24.04 ± 5.15
AST	40.88 ± 8.22	46.22 ± 11.29

Table 3. Chi-square test for discriminative function

Eigenvalue	Coef. of canonical correlation	Wilks' Lambda	Chi-square	df	p-level
0,530	0,588	0,654	28,904	10,000	0,001

Chi-square test shown in *Table 3.* shows that the discriminative function in this case differentiates the two observed sample groups with a statistically significant margin. F test in *Table 4.* shows that variables HG and SUT statistically significantly ($p<0,05$) discriminate the observed sample groups. *Table 5.*, factor structure matrix, shows the contribution of particular variable to group discrimination. It can be noticed that variables HG and BMI significantly contribute to group discrimination (rowers achieve significantly higher values in those variables); variables HJ, %FAT (rowers achieve higher values) and AST (runners achieve higher values) contribute slightly less, but still significantly, while the contribution of other variables to the group discrimination is very small or negligible.

Table 4. Summary of discriminative analysis between rowers and runners aged 35 - 65

Variables in the model: 10 Wilks' Lambda: ,65374 approx. F (10,64)=3,3899 p< ,0013						
	Wilks' Lambda	Partial Lambda	F-remove (1,64)	p-level	Toler.	1-Toler. (R-Sqr.)
BMI	0.655	0.998	0.103	0.750	0.231	0.769
WHR	0.667	0.980	1.304	0.258	0.570	0.430
%FAT	0.671	0.975	1.642	0.205	0.268	0.732
HG	0.696	0.939	4.154	**0.046**	0.358	0.642
HJ	0.654	1.000	0.029	0.865	0.388	0.612
SAR	0.663	0.986	0.882	0.351	0.815	0.185
BAL	0.659	0.992	0.542	0.464	0.902	0.098
TAP	0.654	1.000	0.004	0.949	0.615	0.385
SUT	0.695	0.941	4.038	**0.049**	0.614	0.386
AST	0.686	0.953	3.129	0.082	0.686	0.314

Table 5. Factor structure matrix with the position of group centroids (variables that contribute significantly to group discrimination are printed in bold)

	Discriminative function
BMI	**-0.634**
WHR	-0.257
%FAT	**-0.398**
HG	**-0.735**
HJ	**-0.402**
SAR	-0.051
BAL	0.008
TAP	-0.271
SUT	-0.139
AST	**0.378**
Centroids: rowers: - 0.539; runners: 0.957	

The factor structure matrix (*Table 5.*) clearly shows that rowers (centroid on the negative pole) achieve numerically higher values in all the observed variables except for the balance and aerobic power. In variables aimed at evaluating body composition (body mass index. waist-to-hip ratio and body fat percentage) higher values fundamentally mean lower abilities and worse health because they represent a higher body mass for a given body height, higher body fat and health-wise a less desirable distribution of body fat. The dominant discrimination dimension in discriminating the two observed sample groups involves hand-grip, i.e. muscle strength. A significant contribution to the group discrimination can also be attributed to two of the three dimensions for estimating body composition, body-mass index and body fat percentage, motor dimension explosive power of the lower extremities as well as aerobic power. Significantly better results obtained by rowers in the hand-grip test which pertains to the muscle strength of the fist and the lower arm muscles can be easily accounted for on two grounds. Firstly, rowers are by constitution stronger and more massive than runners. Secondly, manipulating the oar and skull handle while rowing, which primarily involves lower arm and fist muscles surely contributes to developing the strength of those muscle groups (Boland, 1991). Runners, on the other hand, use hands exclusively for maintaining dynamic balance while running.

Two out of three dimensions for evaluating body composition (body mass index and body fat percentage) also stand out in terms of their contribution to the group discrimination. The difference is especially prominent in body mass index which indicates the appropriateness of body mass in relation to a given body height. The significant difference on the rowers' side can be accounted for on the basis of morphological demands placed by participation in (competition) rowing. In other words, the importance of body mass, i.e. total muscle mass is essential. It enables the rower to apply higher force using his oar, while body height and other variables evaluating the longitudinal dimensionality of skeleton, such as arm span, arm length and leg length, enable the rower to use the longer lever and achieve a longer stroke. It is exactly these demands that place rowers among athletes of above-average height and weight.

In terms of the morphological characteristics of rowers and runners, it is to point out that, as opposed to running where individuals are battling their own body mass and where body fat presents ballast, in the rowing boat that is not the case because the boat "carries" the rower's mass, which accounts for the higher values of body mass index and waist-to-hip ratio (although it didn't prove significant in this analysis) and the body fat percentage. In terms of motor dimensions, their contribution to discrimination is especially strong in explosive power. The fact that rowers achieve better results in this test is harder to account for and is somewhat surprising. Although both activities are based on aerobic power and dimensions such as speed, explosiveness and agility are not of utmost importance, the very structure of the rowing stroke which involves leg movement similar to that in specified test still seems to contribute to that difference.

Finally, aerobic power stands out in terms of its contribution to group discrimination of the two observed sample groups. The difference in this dimension is on the runner's side, but it is important to mention that relative VO_2max was the measuring unit. Although running and rowing are activities which demand and develop aerobic power, the previously mentioned higher body mass still puts rowers in an inferior position when it comes to relative VO_2max.

Conclusion

By means of discriminative analysis the difference between recreational rowers and runners was proven. The discriminative variables between two observed sample groups were aerobic power (defined as the relative maximum oxygen uptake); body mass index and body fat percentage; as well as muscle force and explosive power. The results of discrimination analysis lead to the conclusion that recreational rowers are heavier and taller than recreational runners and that they have a higher percentage of lean muscle mass as well as a higher percentage of body fat. In addition, rowers exert a higher muscle force and are dominant in the dimension of explosive strength. On the other side, as a consequence of lower body mass and emphasized aerobic characteristics of their activity, runners are dominant in aerobic power as measured by relative VO_2max.

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ANALYSIS OF PERSONALISED FITNESS PROGRAMME'S IMPACT ON STRENGTH IMPROVEMENT

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Abstract

In our institution the Personal fitness programme is a programme made according to the individual characteristics of every participant consisting of floor and swimming pool as well as exercises on fitness and cardio machines. Prior to entering one must complete a medical examination, a body fat analyser test and fill the questionnaire; a kinesiologist assesses the participant by doing the maximum strength test and heart rate monitoring evaluation. According to the results an individual personal programme is defined lasting an average of 3 months 2-3 times a wk for 90 min. The studied group consisted of 76 females, 52 males, aged 13-68y (42±13) drafted either because of an age that in itself might have given suspicions of silent diseases or had a long period of physical inactivity after illness or injury. The initial results of the maximum strength test total score were improved by 21% with no major adverse effects requiring an interruption of the programme.

Key words: *personal fitness programme, maximum strength test, individual programming*

Introduction

Poliklinika O.Z. Nemetova provides different health related programmes: personal fitness programme, individual recreation, pilates, postpartum exercises, physical rehabilitation programmes, swimming and aqua-aerobics. A Personal fitness programme (PFP) is made according to the individual characteristics of every participant. It means that groups can be set irrespectively of age, sex or medical status differences, because during training every participant will apply their own aerobic and weight load intensity according to the exercising programme made for them individually by a kinesiologist. The PFP consists of floor and swimming pool as well as exercises on fitness and cardio machines. Participants are drafted into our Fitness centre either because they were performing medical examination in the Clinic and heard about our exercising programmes, finished physiotherapy by us and wanted to continue exercising, or enrolled because of the individual approach we provide in writing a personal exercising programme. Motives for starting a medically approved personal exercise regime are either because they have reached a certain age where silent diseases might be suspected or had a long period of physical inactivity after illness or injury making higher the probability of sport-related complications and drop-out if they were to embark upon some kind of uncontrolled recreational exercising.

Prior to entering PFP the participants must complete a medical examination, fill the questionnaire and do a body fat analyser test. If the required medical criteria are met a kinesiologist assesses the participant by doing the maximum strength test and wirst-watch hearth rate monitoring evaluation. According to the results, the kinesiologist, for each participant individually, writes an exercising programme defining weights on the machines, aerobic intensity on cardio machines and selects exercises in the kinesiotherapy gym and swimming pool.

This presentation will focus on the PFP exercising programme's influence on strength improvement.

Methods

The group studied consisted of 138 participants, 76 female / 52 male, aged 13-68 y (42±13 y). All medical examinations, tests, and individual programmes are done in-house.

A general check up is preformed to obtain medical history and physical status, while the questionnaire provides the sport and exercising ability related history of potential locomotory deficiencies, together giving us the information on possible signs of silent diseases (hypertension, arhytmia, circulatory disorders, diabetes, arthritis/arthrosis etc.). The questionnaire is presented in tbl.1.

Body fat analyser test provides body composition analysis if it is necessary to make a body-weight reducing programme. Nutritionist's advice is also available. The body fat test form is presented in tbl.2.

The maximum strength test provides information about the strength of muscle groups as measured on fitness machines. After defining the movement tested, the kinesiology estimates the weight and the participant performs the maximum number of repetitions (2-22) until loss of movement coordination, after which the 1RM (repetition maximum) is calculated by the formula:

ESTIMATED WEIGH x 100 % = 1 RM

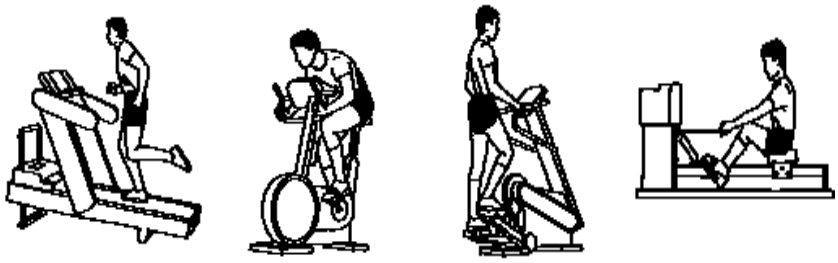
% MAXIMUM STRENGTH TEST

The program lasted an average of 3 months of continuous exercising, 2-3 times a week for 90 minutes. At the end of the program the test was repeated.

The tests muscle-group form & score estimation chart are presented in tbl.3 & 4.

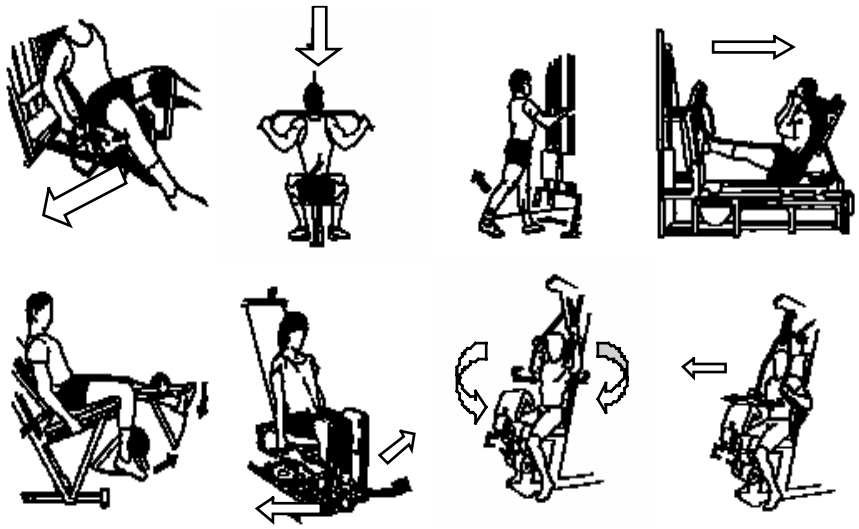
PERSONAL FITNESS PROGRAMME (example): CARDIO MACHINES:

WARM UP: 10 minutes CARDIO WORKOUT: 20 minutes



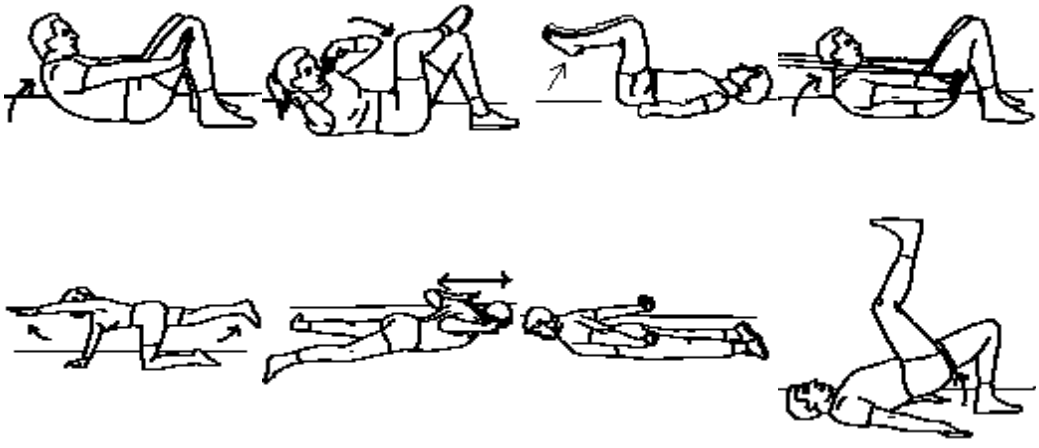
FITNESS MACHINES: (Suitable for handicapped persons)

Weight can be adjusted from 0 to 5, 8, 10, 12, kg and so on.



FLOOR EXERCISES:

Floor exercises are conducted in the kinesitherapy gym that is equipped with mats, balls, rubber bands, weights, ankle weights and sticks. The floor workout lasts for 10 minutes.



Swimming pool relaxation and stretching exercises:
The pool is 12 x 5 m and 1, 2 m deep, water temperature is 30oC; duration 30 minutes.

The whole program lasts 90 minutes.

Our individually programmed PFP is unique because it combines medical examinations, testing used to evaluate the participants initial and final capacity, gym, fitness machines and swimming pool exercises, with close physician and kinesiology supervision and collaboration.

Results

Statistical analysis of strength improvement shows that the initial results of the maximum strength test total score (sum of scores of all individual tests) were improved by 21 %. The initial results of the individual muscle group tests in Kg are shown in table. 5. Percentage improvement of individual muscle groups are shown in table 6. The health related drop-out rate was nil.

Discussion

No relevant similar research results were available, nor any literature directly related to the maximum strength test was found.

The scope of our individually tailored PFP was to permit beneficial recreational sporting activity to all those that might have some health factors that would put them at risk of related injury if they enrolled in group exercising without an kinesiologist guidance.

The 21% overall strength improvement may seem modest when compared to healthy young athletes that achieve much higher results in programmes of similar duration, but this was on the average a middle-aged group with some of the participants not in top health shape even for their age.

cause the adductors and abductors that are in the same region had an improvement of 17%. That is probably due to the fact that the machines for other groups permit testing muscles isolated from others (sitting machines) while the gluteus machine is the only one where the tested movement is done standing thus requiring the work of antigravitational muscles (legs and back); it stands to reason that an overall improvement of their strength was added to the improvement of the gluteus muscles permitting their falsely better-then-average performance.

The improvements could be divided in three categories: minimal (10-12%); medium (15-21%) and good (29-32%). A very modest improvement in the triceps and quadriceps (two quite different muscles) may be the consequence of two different factors; either the programme was insufficiently demanding (in weight or number of repetitions), making it too conservative in the desire not to induce health related drop-out, or the reluctance of the participants to perform some of the exercises they found uncomfortable, with the instructors not insisting on them for the same reason as above.

Since the primary goal was continuous beneficial recreational activity, without insisting on achieving top performance, in our opinion we reached it fully in this group: we did not have a single drop-out related to overuse injury or other health related issues.

Concluding, we can say that the improvement was a result of combined exercises that all formed a personal fitness programme individually tailored for each participant and thus best suited for avoiding sport related health problems in an at risk-group.

Table 1: Questionnaire

Name, surname: Age:
Address: Tel. /mob. E-mail:
CIRCLE

1.	Did your doctor ever suggested that you have any heart difficulties, And based on that limited your physical activities?	yes	no	
2.	Are you involved in any physical activity?		yes	no
3.	If yes, which?			
4.	If yes, how often?			
5.	Did you experience any chest pain during physical activities?	yes	no	
6.	Did you ever loose balance or conscience during physical activities?	yes	no	
7.	Did you experience 5? and 6. without participating in physical activities?		yes	no
8.	Do you take blood pressure medication recommended by a doctor?	yes	no	
9.	Do you take heart medication recommended by a doctor?	yes	no	
10.	Are you aware of any medical problem you might have that you want to inform the kinesiology?		yes	no

11. If yes, which medical problem do you have?

Signature
Date

Table 2: body fat test form

Name, surname:_____
Higher (((cm Weight (((kg M F
Age ((Date ((((((
Hour ((,((min.

TEST RESULTS
Total body fat.....((,(% ((kg
Fat free tissue.....((,(% ((kg
Total body water.....((L
Base metabolism(BMR).....((((kcal
Target body fat ((% Target weight (((kg

Table 3: muscle-groups test form

MACHINE NO.	MUSCLES	ESTIMATED W.	ATTEMPT	1 RM	40%	50%
1. ADDUCTOR M.	adductors					
2. LAT M.	latissimus dorsi					
3. DELTOIDEUS M.	deltoideus					
4. GLUTEUS M.	gluteus					
5. LEG PRESS M.	quadriceps					
6. QUADRICEPS M.	quadriceps					
7. ABDUCTOR M.	abductors					
8. PEC DEC M.	pectorals					
9. BENCH PRESS M.	pectorals					
10. TRICEPS M.	triceps					

Table 4: muscle-groups test score estimation chart

%	REPETITIONS	%	REPETITIONS
100	1	79	12
95	2	78	13
93	3	77	14
90	4	76	15
89	5	75	16
87	6	74	17
85	7	73	18
83	8	73	19
82	9	72	20
81	10	71	21
80	11	70	22

Table 5: individual muscle group initial results in Kg

ADD	LAT	DELT	GLU	LEG PRS	QUAD	ABD	PEC	BNCH PRS	TRIC	
max	90	62	53	52	170	74	98	88	78	97
min	20	8	5	10	35	6	29	9	8	15
avg	55	27	19	25	94	23	62	30	31	38

Table 6: individual muscle group percentage improvement

ADD	LAT	DELT	GLU	LEG	QUAD PRS	ABD	PEC	BNCH	TRIC PRS
21	29	32	40	16	12	17	17	15	10

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EFFECT OF TAI CHI ON BONE MINERAL DENSITY AND DYNAMIC BODY BALANCE AMONG ELDERLY MEN WITH OSTEOPENIA OR OSTEOPOROSIS

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Abstract

The purpose of this study was to assess the effect of 18-week Tai Chi training on bone mineral density and dynamic balance among men with osteopenia or osteoporosis.

The study covered subject aged 60.0 to 82.1 years. We identified 49 men who had osteopenia or osteoporosis. The participants were randomly assigned to either the Tai Chi group (N=25) or control group (N=24). The Tai Chi group participated in a 18-week exercise class held twice a week in the morning (45 minutes each session).

Femoral bone mineral density (BMD) was measured using the densytometric diagnostic equipment (DEXA) in two places: femoral neck (BMD1) and trochanter major of hip bone (BMD2). Dynamic balance was assessed using a computer posturographic system PE. During the measurement of body balance, the possibilities to perform specific tasks were analysed (deflections in the set scope and direction).

Obtain results showed positive influence of Tai Chi exercises on dynamic body balance in percentage of task performance – E ($p \leq 0.05$) and total length path – TD ($p \leq 0.05$). There were no statistically significant changes in bone mineral density.

Introduction

In people with osteoporosis, specific exercises may reduce the risk of fracture by its effect on maintenance of bone mass and, probably more important, by improving postural stability and thus decreasing rates of falling (Close and Glucksman 2000). In Li et al. (2004) researches six months Tai Chi exercises improved not only body balance (evaluated by Berg balance test, dynamic gait index and functional reach), but also is connected with reducing number of falls after exercise program.

Methods

49 men aged 60.0 to 82.1 years with identified osteopenia or osteoporosis were participated in the study. The participants were randomly assigned to either the Tai Chi group (N=25) or control group (N=24). The Tai Chi group participated in a 18-week exercise class held twice a week in the morning (45 minutes each session).

All measurements were taken one week before the intervention and again after exercise program. Femoral bone mineral density (BMD) was measured using the densytometric diagnostic equipment (DEXA) made by Norland Medical Systems. BMD was measured in two places: femoral neck (BMD1) and trochanter major of hip bone (BMD2). Dynamic balance was assessed using a computer posturographic system PE (produced by the Military Institute of Aviation Medicine in Warsaw) with software made in Pro-Med. The following parameters were taken into consideration: a) T – time of reaching the set area by point C, b) D – percentage of the reaching path to the set area, expected result – straight path is 100%, c) E – percentage of task performance (keeping point C in the set area), d) TD – total length path covered by point C.

Mann – Whittney test was used to check statistical signification of differences between two groups.

Results

The comparison of differences between Tai Chi group and control group showed (table 1) statistically significant differences in percentage of task performance – E ($p \leq 0.05$) and total length path – TD ($p \leq 0.05$). There were no statistically significant changes in bone mineral density.

Table 1. Baseline and retest scores for the Tai Chi and Control group and comparison of differences

		Baseline Mean	Final Mean	Difference	Comparison of differences (p value)
BMD1(g/cm^2)	Tai Chi	0.781	0.782	0.001	0.23
	Control	0.747	0.756	0.009	
BMD2 (g/cm^2)	Tai Chi	0.689	0.697	0.008	0.41
	Control	0.689	0.691	0.002	
T (s)	Tai Chi	1.77	1.67	0.10	0.29
	Control	2.15	2.06	0.09	
D (mm)	Tai Chi	278.6	273.8	4.8	0.36
	Control	308.3	285.9	22.4	
E (%)	Tai Chi	80.9	84.4	3.5	0.04*
	Control	78.3	79.1	0.8	
TD (mm)	Tai Chi	3314.8	3040.2	274.5	0.04*
	Control	3226.4	3154.4	71.9	

*** - p<0.05**

Discussion

Earlier researches (Carter et al., 2002) of elderly women (65-75 years old) with osteoporosis showed beneficial influence of exercises (twice a week, 20 weeks) on dynamic body balance and strength. It has been shown that the practice of Tai Chi exercise can improve dynamic body balance and probably can prevent falls in elderly individuals (Yan 1998, Wong et al. 2001).

Conclusions

Results obtained in our study confirmed significant improvement of dynamic body balance after 18 weeks of Tai Chi exercises. Comparison of obtained differences showed no influence of Tai Chi exercises on BMD.

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PREVALENCE OF SOME KINESIOLOGICALLY SENSITIVE CHRONIC DISEASES IN ACTIVE VS INACTIVE WOMEN AGED 50-65

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Abstract

Numerous studies show that many chronic diseases are more common in inactive individuals as compared with persons engaged in regular physical activity. The aim of this study was to determine if there was a statistically significant difference in prevalence of several kinesiologically sensitive diseases between regularly physically active and inactive women aged 50 to 65. A total of 214 urban women responded to questionnaire on health and physical activity. 111 women participated in aerobic classes 2-4 times a week for at least 5 years, while 103 women were never engaged in regular physical activity. Women were asked if they were diagnosed any of the following diseases / conditions: bone loss, coronary heart disease, heart arrhythmia, hypertension, diabetes mellitus, chronic low back pain, functional limitations of joints, anxiety, and depression. Statistically significant difference in prevalence of only two diseases was found. Significantly lower number of active women stated symptoms of heart arrhythmia ($\chi^2 = 4.36$, $p < 0.05$) and anxiety ($\chi^2 = 6.77$, $p < 0.01$). Observed results are not completely congruent with scientific findings of numerous previous investigations. This fact can be attributed to the limitations of the study.

Key words: *physical activity, chronic noncommunicable diseases, women.*

Introduction

Scientific findings of numerous studies (Vuori, 2004; Hernelahti, Kujala, & Kaprio, 2004; Woo, 2000; Lees & Booth, 2004; Fleischmann et al., 2004) show that many chronic diseases are more common in inactive individuals as compared with persons engaged in regular physical activity. Our bodies were made to move, and the human genome requires physical activity to lower the prevalence of many chronic diseases (Lees, & Booth, 2004).

Physical inactivity is an actual cause of many chronic diseases (Vuori, 2004; Lees & Booth, 2004). Results of a number of studies show that different confounding factors (age, sex, body fat, diet, smoking, alcohol intake, education, income) play no role in the relationship between increased prevalence of chronic diseases and physical inactivity (Vuori, 2004).

Due to the prevalent sedentary lifestyle, the incidence of kinesiologically sensitive chronic diseases in industrialised countries grows continuously (Vuori, 2004), making physical inactivity a major public health problem world-wide.

The aim of this study was to determine if there was a statistically significant difference in prevalence of several kinesiologically sensitive diseases between regularly physically active and inactive urban women aged 50 to 65. It was hypothesised that the prevalence of nine observed diseases / conditions would be higher in the inactive group.

Methods

Participants. Sample consisted of 214 women aged 50-65, resident in Zagreb. 111 women participated in regular physical activity (aerobic classes 2-4 times a week) for at least 5 years, while 103 women were never engaged in any kind of regular physical activity (all patients of one gynaecologic clinic). No significant difference between the two groups was found regarding weight (active group 68 ± 9.27 kg; inactive group 68.4 ± 10.1 kg; $t = 0.17$, $p = 0.862$) and height (active group 162.6 ± 5.6 cm; inactive group 162.7 ± 5.5 cm; $t = -0.22$, $p = 0.828$). Two groups differed significantly in age (active group 59.3 ± 4.8 years; inactive group 57.2 ± 4.6 years; $t = 3.28$, $p = 0.001$). Active women were, in average, two years older. Despite the significance of this difference, the fact that it counteracts the hypothesis made its confirmation more difficult.

Measures. Obtained answers are the part of a pool of data collected by a questionnaire composed for a larger study on health and quality of life of menopausal women. Women were asked to answer questions on regular physical activity (duration in years and volume per week). Beside that, women were asked if they were diagnosed any of the following diseases / conditions: bone loss (osteopenia and / or osteoporosis), coronary heart disease, heart arrhythmia, hypertension, diabetes mellitus. They were asked if they had experienced chronic low back pain; stiffness, pain or functional limitations of joints; as well as states of anxiety and / or depression.

Data analysis. The obtained data was analysed by the statistical package Statistica for Windows (ver 6.0). Frequencies of each disease in both groups were calculated, and Chi-square test was used to determine differences in prevalence of diseases between active and inactive group of women.

Results

The obtained results partly confirmed our hypothesis. Statistically significant difference of prevalence of two diseases was found (Table 2.). Significantly lower number of active women (Table 1.) stated symptoms of heart arrhythmia ($\chi^2 = 4.36$, $p < 0.05$) and anxiety ($\chi^2 = 6.77$, $p < 0.01$). No statistically significant difference in prevalence of other observed diseases between the two groups was found.

Table 1. Frequency and percentage of diseases in active and inactive groups of women aged 50-65 years.

Disease	Active Group (N=111)		Inactive Group (N=103)	
	No	Yes	No	Yes
Bone loss	76 (68.5%)	35 (31.5%)	76 (73.8%)	27 (26.1%)
Coronary heart disease	110 (99.1%)	1 (0.9%)	100 (97.1%)	3 (2.9%)
Heart arrhythmia	92 (82.9%)	19 (17.1%)	73 (70.9%)	30 (29.1%)
Hypertension	80 (72.1%)	31 (27.9%)	81 (79.6%)	21 (20.4%)
Diabetes mellitus	111 (100%)	0 (0%)	100 (97.1%)	3 (2.9%)
Low back pain	67 (60.4%)	44 (39.6%)	51 (49.5%)	52 (50.5%)
Joint stiffness / pain	47 (42.3%)	64 (57.7%)	39 (37.9%)	64 (62.1%)
Anxiety	99 (89.2%)	12 (10.8%)	78 (75.7%)	25 (24.3%)
Depression	95 (85.6%)	16 (14.4%)	78 (75.7%)	25 (24.3%)

Table 2. Differences in prevalence of diseases between active and inactive women aged 50-65 years.

Diseases	Chi-square (df=1)	p
Bone loss	0.73	0.3915
Coronary heart disease	1.18	0.2776
Heart arrhythmia	4.36	**0.0367***
Hypertension	1.55	0.2129
Diabetes mellitus	3.28	0.0702
Low back pain	2.54	0.1110
Joint stiffness / pain	0.45	0.5044
Anxiety	6.77	**0.0093****
Depression	3.35	0.671

* $p < 0.05$, ** $p < 0.01$

Discussion

Analysis of the data obtained from this sample did not completely confirm the initial hypothesis that the prevalence of nine kinesiologically sensitive diseases would be higher in the inactive group than in the group of regularly physically active women aged 50 to 65.

Contrary to expectations, results showed significant difference in prevalence of only two conditions between the two groups – lesser number of active women stated heart arrhythmia and anxiety symptoms. Obtained results, namely, are not completely congruent with scientific findings of numerous previous epidemiological investigations (Vuori, 2004; Woo, 2000; Lees & Booth, 2004; Fleischmann et al., 2004) in which the clear positive relationship between regular physical activity and lower prevalence of different musculoskeletal, cardio-respiratory, metabolic and other chronic conditions, including all diseases observed in this study, was found. On the other hand, results correspond to findings of a large prospective study by Hernelahti et al., in which no association between physical activity and incidence of hypertension was found in a sample of 4381 women (Hernelahti, Kujala, & Kaprio, 2004).

Expected lower prevalence of anxiety found in active group corresponds to the results of extensive series of meta-analyses that investigated the effects of acute and chronic physical activity on anxiety (Paluska, & Schwenk, 2000). The authors found that exercise was associated with reduction of anxiety symptoms, and that, clinically implemented, regular physical activity might play an important role in alleviating these symptoms. Both aerobic training and strength/flexibility training proved to be effective for treating anxiety symptoms, although aerobic exercise programmes produced stronger effect than weight training/flexibility regimens (Paluska, & Schwenk, 2000).

It is the fact that conclusions about influence of physical activity on arrhythmia cannot be thorough without detailed information on possible organic cause of this condition (e.g. conductive abnormalities). Nevertheless, significantly lower prevalence of arrhythmia observed in active group could, at least partly, be attributed to exercise-induced adaptation (i.e. parasympathetic neural activity) with a consequent more regular and stabile heart activity.

Although, based on the results, one could conclude that physical activity does not have a positive influence on prevention of observed chronic diseases, two limitations of this study should be taken into consideration. It is possible that the positive effects of regular physical activity have not resulted significant due to a small number of examinees. A larger sample could contribute to manifestation of statistically significant differences between groups in other observed variables. Moreover, Table 1. shows that both active and inactive group consisted predominantly of healthy women. It is reasonable to presume that a random sample would provide a more representative picture of chronic-disease prevalence in the female population of this age group.

In conclusion, analysis of questionnaire results obtained on a sample of 111 active and 103 inactive women aged 50–65 years shows a statistically significant difference in prevalence of heart arrhythmia and anxiety symptoms – more inactive women stated the experience of these symptoms. Observed results are not completely congruent with scientific findings of numerous previous investigations. This fact can be attributed to the limitations of the study.

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NUTRITIONAL AND PHYSICAL/SPORT HABITS OF CHILDREN

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Abstract

The following text presents the results of a research where we studied the differences between nutritional habits of 10 years old children according to frequency of their physical/sport activity in free time. This is a part of a wider research project "Physical/sport activity for health" (Završnik, Pišot, Fras, Zaletel Kragelj, Strel, Sila, 2004). We were interested in if there are significant differences among participants in the frequency of eating fruit, vegetables, snacks between meals, and the quantity of water drunk. The sample comprised 429 children, average age 10 years ± 4 months. The data processed showed that there exist significant differences according to free time physical/sport activity only in the frequency of eating fruit ($p=0.032$), but no differences in the frequency of eating vegetables and snacks between meals, and in the quantity of water drunk. A trend is noticed that more physical activity means an increased consumption of vegetables and water, and a decrease in eating snacks.

Key words: *child, lifestyle, physical activity, fruit, vegetables, water, snacks*

Introduction

In 1946 the World Health Organisation defined health as "a state of complete physical, mental and social well-being." In 2002 the same organisation in one of its reports classified the lack of physical/sport activity as one of the important factors of death, illness and development of non-contagious chronic diseases (*Agita mundo*, 2002). The researches showed that physical/sport activity protects against the majority of chronic diseases – arteriosclerosis, high blood pressure, stroke, osteoporosis and insulin independent diabetes. Epidemiological data show that physical inactivity means at least twice a bigger threat for development and progress of coronary diseases, like the other main known factors for arteriosclerosis (high cholesterol, smoking, hypertension) (Pišot, & Završnik, 2005).

Healthy nutrition also influences our health. Unhealthy food has, as well as physical/sport inactivity, a lot of negative consequences which cause several other diseases: diseases of heart and, high blood pressure, diabetes type 2, disturbance of fat metabolism, diseases of bone-muscular system, some cancerous diseases and more. Eržen states that the diseases of heart and blood vessels represent, in Slovenia as well as in the world, one of the leading causes of illness, early disability and death which are the consequences of unhealthy lifestyle (WWW.ZZV-CE.SI/DOBROJEVEDETI/PREHRANA_ZDRAVJE.PHP).

Modern lifestyle makes it almost impossible for many people to take part in a physical/sport activity, as most of the time is spent at a desk, in front of a computer or TV monitor. Sedentary style is becoming the leading style during working or free time. This lifestyle is more and more present in the life of adults, as well as in children and teenagers in Slovenia and in the world. Due to such lifestyle less attention is paid to a healthy and balanced nutrition, "superficial" attitude to nutrition is increasing instead of eating "proper" meals (Stergar, Scagnetti, & Pucelj, 2004). An increased number of adults and children, especially teenagers, skip the meals, mostly breakfast, and consume different snacks that replace the main meals. The data from various researches show that children and teenagers tend to eat unhealthily as their diet does not include fruit, vegetables and fish. Girls do not drink enough milk or eat other dairy products and meat, but very often reach for sweet and savoury snacks, fizzy drinks and drinks containing a small portion of fruit.

Methods

Subjects: The sample comprised 429 children from 10 Slovenian schools: 220 boys and 209 girls from the 4th grade (aged 10 years ± 4 months). Children's parents signed the agreement to allow their children to take part in this research.

Variables: The variables were included in the questionnaire, namely:

- frequency of physical/sport activity in free time;
- frequency of eating fruit;
- frequency of eating vegetables;
- quantity of water drunk in a day;
- frequency of eating snacks between meals.

Statistical analysis: The data were processed with the computer statistical program SPSS. We used descriptive statistics (frequencies, percentages). The differences between the groups of participants according to the frequency of physical activity in the chosen variables on eating habits were searched with contingency table and chi-squared test. As statistically significant we considered the differences with 5% alpha error.

The data of the study presented were chosen within a wider research project "Physical/sport activity for health" which is led by the Institute of Kinesiology Research at the Science and Research Centre of Koper, University of Primorska (Završnik et al., 2004).

Results

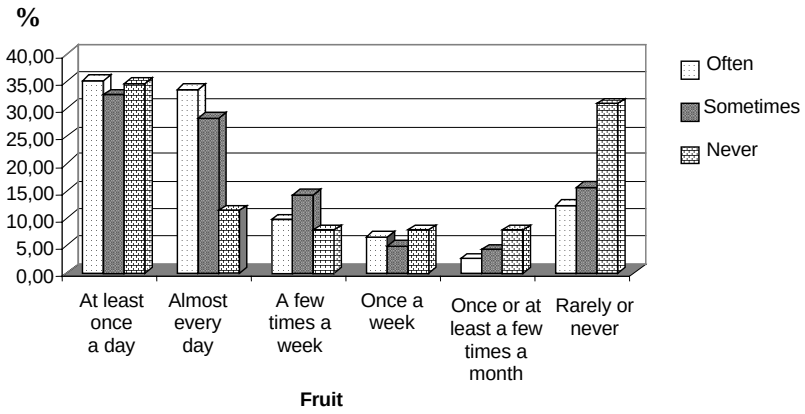

Figure 1: Differences between the participants in the frequency of eating fruit according to the frequency of physical activity in free time.

Statistically significant differences were found out with 5% alpha error (p = 0,032) between participants in the frequency of eating fruit according to physical activity in free time. Those participants who frequently take part in a physical/sport activity eat fruit at least once a day; these are 65.4%. Only 6.8% of the participants who never do sports in their free time eat fruit every day. Children who frequently do sports eat fruit every day (37.3%), the other half eats fruit almost every day (47.2%). Children who never do sports in their free time eat fruit once a week (20.0%). About 10% eat fruit almost a few times a week (12.2%), and rarely or never (11.5%).

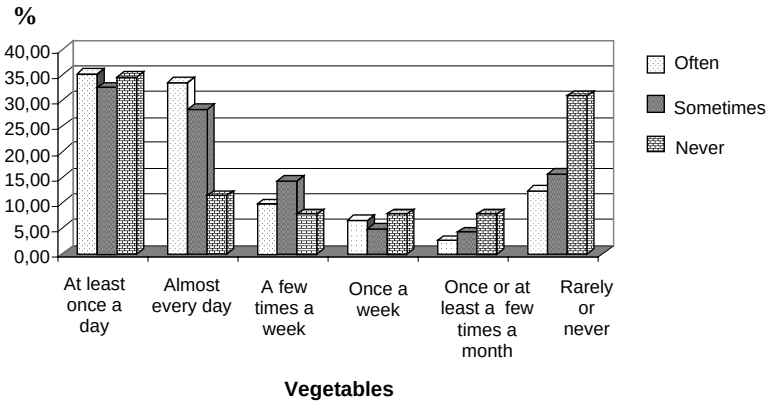

Figure 2: Differences between participants in the frequency of eating vegetables according to the frequency of physical activity in free time.

Children who frequently take part in a sport activity in their free time eat vegetables at least once a day (35.2%) or almost every day (33.5%). In the same way a third of children who sometimes (32.6%) or never (34.6%) do sports eat vegetables every day. A major decrease in eating vegetables can be noticed in children who sometimes or never do sports in their free time.

These differences between the participants in eating vegetables according to the frequency of physical activity in free time are not statistically significant.

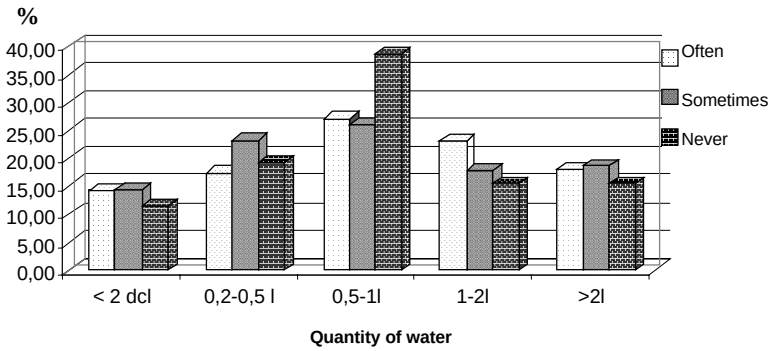

Figure 3: Differences between participants in the quantity of water drunk according to the frequency of physical activity in free time.

23.2% of children who frequently take part in a sport activity in their free time drink the recommended quantity of water a day, that is 1 – 2 litres. The children who are sometimes active in their free time are 17.8% and 15.4% among those who are never active in their free time. The differences between the groups according to the frequency of physical activity are not statistically significant. It is worrying, though, that a third of the children (33.8%) irrespective of the frequency of physical activity in free time, drink only a small quantity of water a day (up to 0.5 L).

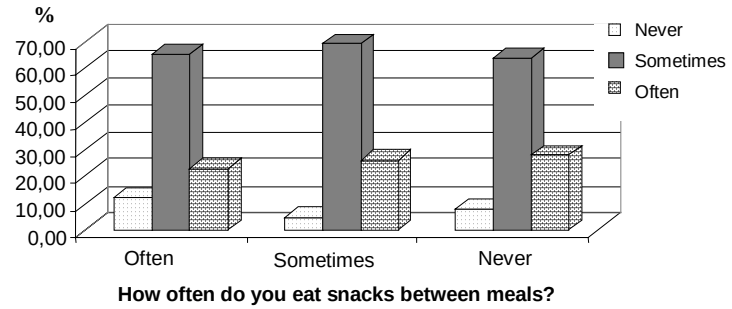

Figure 4: Differences between participants in the frequency of eating snacks according to the frequency of physical activity in free time.

65.2% of children who often do sport activities in their free time sometimes eat snacks. 22.7% of children always and only 12.0% of them never eat snacks between meals. 64.0% of children who never take part in a sport activity sometimes eat snacks and 28.0% of them always do it. It can be noticed that there is a bigger number of children who are not active in their free time and often eat snacks between meals. Even though, the differences between the participants in the frequency of eating snacks according to their physical activity are not statistically significant.

Discussion

Our research showed that between the participants there exist statistically significant differences in the frequency of eating fruit. No differences were found in the frequency of eating vegetables, snacks and quantity of water drunk. The nutrition specialists recommend eating fruit and vegetables more times a day every day. Sterger (2004) states the results of a research which confirm that the samples of eating habits of young people have a smaller input of fruit and vegetables, as only a third of them (39%) in the group of 11.5-15.5 year-olds suit the criteria of healthy eating. They are mainly the children who regularly have three meals a day: breakfast, lunch and dinner. Similar results are stated by Mlaček (2003), that is only 33% of male students and 47% of female students from Metlika eat fruit every day, while vegetables are eaten daily only by 22% of boys and 23% of girls (Mlaček, 2003). A big problem for school children is not enough drinking. The young prefer to reach for sweet and fizzy drinks rather than water (Medved, Kelšin, Miloševič, Ulčkar, & Kus, 1998: In Brcar, 2005).

It is interesting that the differences between the participants who are physically active in a different way were not found in the frequency of eating snacks. Even though it could be said that most of the children, irrespective of the frequency of physical activity in their free time, eat snacks far too often between meals or that the snacks even replace them. This was confirmed by a research *"Too few healthy meals, too many snacks"* (2003) where it was found out that children have a smaller amount of the recommended daily meals and have too many snacks instead.

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RELATIONS OF HABITUAL PHYSICAL ACTIVITY TO BMI, WHR AND BODY COMPOSITION AMONG ELDERLY MEN

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Abstract

The aim was to evaluate relations of habitual physical activity to BMI, WHR and body composition among elderly men. 137 men (72.8±5.51 years) participated in the study. Absolute weekly caloric expenditure related to habitual physical activity (PA-EE) and calculated per kg of weight (PA-EE/kg) was estimated by Caltrac accelerometer. Basic somatic features were measured to calculate BMI and WHR indices. FM and FFM were estimated by BIA method. PA-EE correlated positively with weight ($r=0.21$, $p<0.05$), BMI ($r=0.17$, $p<0.05$), FM% ($r=0.23$, $p<0.01$) and FM/kg ($r=0.25$, $p<0.01$) and negatively with FFM% ($r=-0.23$, $p<0.01$). PA-EE/kg correlated negatively with waist circumference ($r=-0.25$, $p<0.01$) and WHR ($r=-0.26$, $p<0.01$). Results showed beneficial coexistence of PA-EE/kg with waist circumference and WHR.

Key words: *accelerometer, somatic variables, partial correlation.*

Introduction

Studies connected with relations of habitual physical activity and somatic characteristic in most cases didn't show significant relationships. Reed et al. (1991) found similar level of percent of body fat both in elderly men and women with different level of PA. Westertrep and Meijer (2001) didn't notice significant differences in body fat mass and fat free mass among elderly with different level of PA, either. In study of Rudman et al. (1994) level of habitual PA determined weight and body composition only in men living in houses for the aged, but there were no similar relations in men living independently. On the other hand Voorrips et al. (1993) found lower values of weight and BMI in physically active elderly women. These findings don't allow to make unequivocal conclusions about influence of habitual PA on somatic features among elderly. It should be noticed that in researches in this area women were mainly taken into consideration and questionnaires were used to estimate PA level. The aim of the study was to evaluate relations of habitual physical activity to BMI, WHR and body composition among 65 years old and older men.

Methods

137 elderly men (mean age 72.8±5.51 years) participated in the study. Height, weight, waist and hip circumferences were measured to calculate body mass index (BMI) and waist to hip ratio (WHR) indices. The Caltrac accelerometer (Muscle Dynamics, Inc., Torrance, CA) was used to estimate absolute weekly energy expenditure related to habitual physical activity (PA-EE). Obtain results were also calculated relatively per kilogram of weight (PA-EE/kg). Body composition (fat mass - FM%, FM/kg, fat free mass - FFM%, FFM/kg) was estimated by bioimpedance analysis method (Akern, Italy). Person's correlation and partial correlation (adjusted for age) were used in statistical analysis.

Results

Positive, statistically significant correlations were found (table 1) between PA-EE and weight ($r=0.21$, $p<0.05$), BMI ($r=0.17$, $p<0.05$), FM% ($r=0.23$, $p<0.01$) and FM/kg ($r=0.25$, $p<0.01$). FFM% was negatively correlated to PA-EE ($r=-0.23$, $p<0.01$). In case of PA-EE/kg statistically significant negative correlations were observed only with waist circumference ($r=-0.25$, $p<0.01$) and WHR ($r=-0.26$, $p<0.01$).

In comparison to Pearson's correlation, partial correlation (adjusted for age) analysis showed no differences in correlation coefficients values between PA and somatic characteristics.

Table 1. Values of Pearson's correlation and partial correlation (adjusted for age) between energy expenditure related to habitual physical activity and somatic variables among elderly men

somatic variables	Pearson's correlation		partial correlation	
	PA-EE	PA-EE/kg	PA-EE	PA-EE/kg
weight	0.21*	-0.10^{ns}	0.19*	-0.12^{ns}
waist circumference	0.02^{ns}	-0.25**	0.01^{ns}	-0.27**
hip circumference	0.13^{ns}	-0.14^{ns}	0.14^{ns}	-0.14^{ns}
BMI	0.17*	-0.12^{ns}	0.21*	-0.15^{ns}
WHR	-0.12^{ns}	-0.26**	0.02^{ns}	-0.30**
FFM %	-0.23**	-0.08^{ns}	-0.23**	-0.07^{ns}
FFM kg	0.03^{ns}	-0.16^{ns}	0.01^{ns}	-0.16^{ns}
FM %	0.23**	0.08^{ns}	0.23**	0.07^{ns}
FM kg	0.25**	0.02^{ns}	0.24**	0.01^{ns}

ns – correlation statistically not significant, * $p<0.05$, ** $p<0.01$

Discussion

Statistically significant relationships between PA-EE and somatic variables are probably connected with used measurement method of PA-EE, which includes data about weight and height. When PA-EE is calculated per kg of body mass, these relationships are no longer statistically significant. In comparison to exercises used in intervention studies, the habitual physical activity of elderly has no effect on reducing weight, FM or increasing FFM.

Conclusions

Obtain results particularly showed beneficial coexistence of PA-EE/kg with waist circumference and WHR. In the other words, higher level of habitual physical activity is connected with more desirable body fat pattern.

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MENTAL TENSION EVALUATION BY HEART RATE VARIABILITY

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Abstract

The paper deals predominantly with the influence of a stress situation on the indicators of activity of autonomic nervous system. The activity of autonomic nervous system was evaluated by the method of spectral analysis of heart rate variability (HRV). It was successfully proved that HRV parameters related to tension of parasympathetic nervous system decrease with increasing mental tension. In contrary, the values of total spectral power did not show any of the expected changes.

Key words: *challenge ropes course, heart rate, mental stress, autonomic nervous system*

Introduction

Much attention is nowadays being paid to the problematic of stress. It is for example being examined in relation to general activation of mental activity; some teams study connections between various personality factors, physiological indicators and experiencing stress. The role of eustress and distress is investigated in human ontogenesis and there are interesting studies on new ways of avoiding the negative impact of stress on human health (Šiška et al., 1998).

When studying human physiological reactions we can focus on various indicators. The indicators of physiological processes that seem to be important for the matter are those that have clearly defined relation to psychological functions and processes (i.e. psycho-physiological processes). The most frequently studied psycho-physiological reactions are changes in the activity of cardio-vascular system, muscles, skin and brain (i.e. for example changes in heart rate or electro-cerebral activity). Based upon these reactions we can often quite precisely estimate the intensity of various situations a person experiences (tension, relaxation, etc.) (Malik, 1998; Šiška, 2000).

In our study we evaluated changes of mental tension by heart rate variability during an experimental stress situation – a program at a challenge ropes course based on overcoming its obstacles.

Methods

The testing, during which we obtained the evaluated records of Spectral analysis of heart rate variability was carried out in outdoor conditions, i.e. both at the grounds of the ropes courses as well as outside these facilities under relatively standard conditions ensuring appropriate value of testing results.

Course of the testing itself:

Measurement was carried out regularly between 9 –12 AM. Before the actual measurement each of the participants was introduced to the course of the testing and instructed on the use of a heart rate monitor.

For the monitoring of heart rate variability we used three situations:

M1 – sitting at rest off the ropes courses centre– 10 minutes

M2 – sitting at rest at the ropes courses centre under the obstacles – 10 minutes

M3 - sitting at the height of 8 meters – 10 minutes

Each of the stages of measurement took 10 minutes, out of which the first 5 minutes were used as a standardisation time phase and the data from the other 5 minutes was used for evaluation by the method of SPECTRAL ANALYSIS OF HEART RATE VARIABILITY.

In both low and high ropes activities participants were overcoming two obstacles. Their names were *The Pit and the Pendulum* and *The Mysterious Cross.* To mark the obstacles we used the abbreviations Pit L - *The Pit and the Pendulum* in low ropes, Pit H - *The Pit and the Pendulum* in high ropes, Cross L - *The Mysterious Cross* in low ropes and Cross H - *The Mysterious Cross* in high ropes.

The monitored group consisted of 25 participants, who met the criteria set for the testing. There were 10 men and 15 women in the group, all between 18 and 28 years old. The average age of the group was 23.12 +/- 3.13, being 22.13 +/- 2.65 for women and 24.6 +/- 3.2 for men.

For monitoring the spectral analysis of heart rate variability we used monitors Polar S-810. This type allows recording the R-R intervals and subsequent loading the records into a PC. Appropriate software Polar– Precise performance evaluation

3.0 - was used to process the collected data. After automatic filtration of the record a curve section was chosen and marked, in our case minutes 5 to 10. Band boundaries of the frequency components were set in software. For processing the record the method of frequency domain was used, which is recommended for short-term recordings. Most of the parameters were evaluated on the basis of non-parametric method of Fast Fourier of Transformation (FFT). The software "Precise Performance Evaluation 3.0" was used for adjustment of the record allows processing of R-R record and performing an analysis of basic components of the spectral analysis of heart rate variability.

The basic calculated parameter of SAHRV in the frequency band of VLF (0.02-0.05 Hz), LF (0.05-0.15 Hz), and HF (0.15-0.40 Hz) is power spectral density units (PSD) [ms^2. Hz^{-1}] of the separate HRV components. The derived parameters indicated below were used for our evaluation:

- integral size of spectral power in the separate component **P VLF**, **P LF**, and **P HF** [ms^2],
- total spectral power in all frequency ranges **Tot** [ms^2],
- ratio of spectral power of separate components **VLF/HF**,

The presented parameters like the results of examination using the method of frequency domain are complemented by time domain parameters – **R-R** (ms) representing average values of R-R intervals. Evaluated parameters were processed through statistic software STATGRAPHICS.

Results

The aim of our work was to confirm whether the values of individual indicators of spectral analysis of heart rate variability, or those connected to the vagal part of nervous system (i.e. P HF, R-R interval and Tot) will in the experimental situation of mental tension decrease in comparison to the values obtained at rest. The results of this measurement can be found in the Table 1.

Table 1. Synoptic comparison table of monitored parameters of the spectral analysis of heart rate variability between the rest measurement M1 (outside the ropes courses centre), rest measurement M2 (at the ropes courses under the obstacles) and 'in stress' measurement M3 (at the ropes courses at the height of 8 meters)

Var.	M1		M2		M3		M1 x M2	M1 x M3	M2 x M3
	x	sd	x	sd	x	sd	p	p	p
Tot	4045.1	3033.85	3729.57	3051.30	3355.22	3016.34	NS	NS	NS
P VLF	811.23	1064.96	786.44	587.56	741.32	781.04	NS	NS	NS
P LF	2337.5	1594.9	2143.75	166.44	2144.34	1841.07	NS	NS	NS
P HF	895.77	945.13	798.29	994.05	469.56	685.47	NS	***	**
VLF/HF	1.66	1.18	2.07	1.33	4.25	3.47	NS	***	**
R-R	810	120	808.2	130.2	686.52	108.73	NS	***	***

Average (x); standard deviation (sd); relevancies (p); NS $p > 0.05$; **$0.001 < p < 0.01$; *** $p < 0.001$

Comparing the measurement M1 and M3, the components of P VLF and P LF decreased, however they do not show a statistically important difference. PHF and R-R parameters show a statistically highly significant difference. Both components are lowered with increasing stress. From the values in the Table 1 it is obvious that the overall spectral power decreased. The difference in the values did not achieve the level of statistical importance, but its value was the borderline. This decline shows, together with decrease of PHF, R-R, that vagal activity was lowered during the stress situation caused by the height of 8 meters.

When comparing the measurement of M2 (sitting down under the obstacles) and M3 (8 meters above the ground) it can be observed that total spectral power decreased. However, this was not statistically significant. P VLF and P LF components do not change significantly. At the other two components, i.e. PHF and average R-R interval the value fell remarkably with the increasing tension.

Discussion

The cornerstone of the work was the generally accepted assumption that human stress and existence in general must be approached as a complex bio-psycho-social phenomenon and that consequences of stress can be found practically in all areas of human life. For this reason we chose monitoring of the influence of experimental stress on autonomic modulation of heart activity, for there is a general agreement about the fact that autonomic nervous system presents one of the most important factors during securing homeostasis.

During the comparison of the rest measurement M1 and measurement M2 under the obstacles at the ropes course there was a descent in PHF, but the difference was not significant. The surrounding of the ropes centre itself without any

straining activities is not probably a sufficient stress factor and therefore there were not found any distinct changes in autonomic nervous system.

However, different results were obtained from another measurement. A statistically significant difference was found in $p < 0.001$ in the value of PHF in the phase before and during the exposure to stressing situation. That is in the situation of complete rest when measuring outside the ropes course centre (M1) and in situation of the highest stress during measuring in the height of 8 meters (M3) (Table 1).

For the same parameter there was traced a statistically significant difference when compared to measurement M2 (sitting down under the obstacles) and M3 (sitting down at the height of 8 meters), where there also occurred the significant decrease in the parameter (Table 1), which shows lesser vagal activity. This corresponds with the results of the research of Šiška (1999). Assuming that mental tension has the same or similar effects as physical one, the outcome of our testing, respectively the decrease in power of HF component (P HF) can be also grounded on surveys done by Vrána et al. (1993), Brychta et al. (1997), Cowan (1995), Cingálek et al. (1999), Stejskal and Salinger (1996).

The change in the values of the total spectral power (Tot) between the measurement at rest and sitting under the obstacles was not significant, but when we compared the testing at rest to the testing at the height we found new conclusions. The dynamics of the total spectral power (Tot) corresponds to the dynamics of the other components, which decrease with increasing stress. From the Table 1 can be observed the quite tangible difference in the values of the total spectral power. The obtained difference of values, however, was not statistically remarkable. Total decrease in spectral power proves and confirms the total decrease in vagal activity.

The fact that total spectral power did not decrease repeatedly could be explained by the thesis offered by Brychta and Stejskal (1996). They found out that reduction in indicators of time domain is more significant than the decrease of total spectral power during the load for the reason that high sympathetic activity is realised through oscillations with the slowest frequencies, the number of which is limited in a short-term record.

Power of the LF component (P LF) does not change significantly throughout the whole testing. Between the measurement M1 and M2 the value of P LF was lowered a little and between M2 and M3 there cannot be found practically any difference.

The dynamics of the VLF/HF ratio, which tends to be considered as an indicator of sympatho-vagal activity follows our assumptions, i.e. it increases from M1 to M3 significantly, which supports the theoretical assumption that sympatho-vagal activity shifts towards the sympathetic area with increasing stress.

It was successfully proved that values of SA HRV parameters connected to tension of parasympathetic nervous system decrease with increasing mental tension. The results show that there really occurred a statistically significant diminution in values of values P HF and R-R interval. Per contra, the values of total spectral power (Tot) did not show any of the expected changes. However, the decrease in their values can be considered significant for the matter.

The results of monitoring using the method of SA HRV prove that staying at high places itself influences activity of autonomic nervous system.

SA HRV method is frequently used to evaluate changes in autonomic nervous system during physical strain and to monitor the pace of recovery. A number of surveys have monitored the dependence of individual components upon the age etc., but in the field of mental strain there do not many similar studies exist.

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THE POTENTIAL OF RECREATION AND LEISURE FOR PERSONAL LEARNING: HOW OLDER ADULTS USE FREE TIME FOR PERSONAL LEARNING

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Adjustments in work, family, and health are a normal part of each person's life and especially for the older adult. Self-directed learning is one way of negotiating these changes. Self-directed learning often occurs during leisure time and is a reflection of meaningful and personal choices. The purpose of this study was to understand how older, rural adults utilize self-directed learning in the adjustments of late-life. This study employed a general qualitative design that used in-depth, semi-structured interviews for data collection. The sample of ten purposively selected older adults from a rural area also reflected diversity in gender, race, education, and employment. The age of the participants ranged from 75 to 87. Three research questions guided this study: (1) What is the nature of the self-directed learning of these older adults? (2) What are the late-life adjustments of these older adults? (3) What is the role of leisure in their personal learning? Data analysis guided by the constant comparative method revealed various findings. The primary findings of this study are that self-directed learning is a highly engaging process, the adjustments of older adults include time, family, and loss; and that leisure has an integral role in one's self-directed learning activities. Older adults are involved in multiple projects of learning; this leisurely style of learning enables the individual to adjust to change.

Key words: *Leisure, Self-directed learning, Late Life Adjustments, Rural, Qualitative Research*

Introduction

The increasing influence of older Americans as well as the imminent aging of 78 million "Baby Boomers" is causing many segments of our society to re-evaluate the concept of "old age." This is due in part to numerous medical advances and changes in personal lifestyles that have resulted in people living longer and healthier lives (Haskell, 1994). One of these changes has been in education, and especially self-directed learning. Self-directed learning has an integral role in aging, as each change often becomes the impetus for learning (Lamdin, 1997). In addition, education and especially self-directed learning have been positively related to higher life satisfaction in older adults (Brockett & Hiemstra, 1991), and self-directed learning is the primary way that adults learn (Knowles, 1984). The late-life adjustments of older adults provide specific opportunities for self-directed learning projects. The purpose of this study was to understand how older, rural adults utilize self-directed learning in late-life adjustments.

What is especially interesting is the potential of self-directed learning to enable the older adult to adjust to change. For example, the older adult can take the initiative to learn what is necessary to age successfully. Rowe and Kahn (1998) emphasize the learning process of older adults, especially how it relates to longevity and successful aging. Also Baltes and Baltes (1990) discuss how personal learning is a key to their concept of selection, optimization, and compensation. This research matters because of the universal experience of aging, the increasing numbers of older adults, and the potential of self-directed learning to address concerns of older adults.

Method

Self-directed learning often takes place during free time when the individual initiates personal learning on specific topics. In order to learn more about self-directed learning, this study incorporated what Merriam (1998) describes as a general qualitative design: "To discover and understand a phenomenon, a process, or the perspectives and world views of the people involved" (Merriam, 1998, p.11). Data were collected primarily through interviews, and included some observations and documents. The results of this research were a combination of information from the interviews and an analysis based on the research questions. The detailed probing (Hollway & Jefferson, 2000) during the interviews exposed more about the older adult's learning projects, the nature of the learning, process of how it was carried out, and the relationship between leisure and learning.

Each member of the sample participated in two interviews. This allows the researcher as well as the participants to make sure the information is correct and to double check any missing information. This also presented an opportunity to delve deeply into issues raised in the first interview. Each interview lasted approximately two to three hours for a total of four to six hours with each participant. All interviews took place in their homes. During the interviews the participants were encouraged to show evidence of their personal learning. For example, when Dora and Thelma talked about learning how to make Christmas decorations, I would ask to see me an example. The interviews were spread over two consecutive

days and reflected a semi-structured format with open-ended and flexible questions. A brief life history of each participant was video recorded - all but two of the participants agreed to be videotaped. The life history helped me to understand more about the historical context of the individual and provided an additional way to validate information. In addition, I took field notes and recorded other pertinent information concerning the time with the participants. Field notes were helpful while writing about the interviews and for verification of information.

The sample was chosen purposively to represent the diversity of older adults in rural Georgia. For example, four main criteria were used in selecting the participants in this study. These included age, rural dwelling, diversity (race/gender), and evidence of self-directed learning. The sample contained five males and five females, a mixture of widowed and non-widowed participants, and a range of education from fifth grade to Master's Degree. The minimum age of the sample was set at 70, and the actual age range of the final sample was 75 to 87 years. In order to guarantee the sample had experienced late-life adjustments, I asked each participant in a phone call prior to the interview what changes they had experienced as an older adult.

Findings

This paper focuses on three findings: Leisure plays an integral role in the learning of older adults by providing a context for meaningful activity. Self-directed learning is a highly engaging activity of these older adults. The late-life adjustments of these older adults are time, family, and loss; these adjustments become the basis for self-directed learning activities.

The Role of Leisure in Self-Directed Learning

There is a connection between leisure and the participants' personal learning. One of the primary areas of adjustment for the older adult concerns time. There is so much more discretionary time than when one was working full-time; therefore, leisure time is an important consideration for older adults. The quality and quantity of time is an important component of leisure activity. In addition the findings from the sample indicated how meaningful their leisure learning activities were to them. From grandchildren to personal health, these activities were more than trivial matters - they were meaningful concerns. Older adults now have time to pursue meaningful activities, and many older adults choose to fill this leisure time with personal educational pursuits. It is often in one's leisure time that important issues of aging are attended to.

Time to pursue meaningful activities. The participants in this study enjoy retirement although two of them chose to continue to work for pay. One of the adjustments in retirement involves learning how to utilize this extra time. In essence, retirement has given them the time and society's permission to pursue the activities that interest them. However, some activities such as gardening or yard work have become more than activities to fill new segments of time. Participants have become knowledgeable as a result of these personally crafted learning projects, and several have developed expertise in these areas.

Leisure provides adequate time to adjust to change. Leisure is essential for the older adult because during this new allotment of time important tasks are attended to. Similarly, other participants chose a special pursuit that required concentration and a focus of energy. Norman was an early retiree at age 62, and he has been retired for almost 22 years. This lengthy retirement can take on its own career. Although Norman has always been a busy man, his adjustment in retirement was to replace his normal job with freely chosen activities that center on intentional learning. One of his main learning activities concerns the computer, and he spends around four hours a day on the computer. Norman was free to choose any activity to learn. He chose the computer because it could help to replace the emptiness at home after becoming widowed. He discussed how this new learning helped with this change:

Freedom to be involved with personal choices. The participants in this study had the resources to be involved with these activities. Also, there was a confidence in each of these participants that they could and would learn what they need to learn. Interestingly, Bill and Wilbur were both sharecroppers as young boys, having dropped out of school in the 5th grade to help with their family. Despite the lack of formal education, these two men compensated by learning during free time throughout their life. These two men have lived through the racial tensions of life in a small town in south Georgia. However, the confidence and freedom to be involved with a variety of leisure pursuits helped to give their life meaning and purpose.

Self-Directed Learning is Highly Engaging

One of the most pervasive topics in the interview data is that self-directed learning is highly engaging. The participants discussed activities of enjoyment as well as excitement or passion as qualities of highly engaging activities.

Enjoyment. Each person in the sample discussed how much he or she enjoyed this personal learning. This self-directed learning was in itself the source of enjoyment. Norman enjoyed various activities on the computer and going to the library everyday that it was open. He stated, "I can only go five days a week! [Laughter]. You see they are closed on Saturday and Sunday…Yeah. I haven't been there yet [today]! I am going!" The library is a place where Norman can

leisurely pursue self-directed learning activities. Norman would spend time learning the topics he enjoyed, especially that of following current events and interests in nature.

Excitement and passion. Similar to enjoyment but more intense is the excitement involved in the self-directed learning of older adults. Concerning the reading of the paper, Robert discussed how he reads the details and attempts to understand the concepts within the paper, especially in the editorials. Similar to other participants, the daily paper is also a vehicle for learning: "Well, we take the Valdosta Times, and I don't scan it, I read it, I get criticized for that sometimes." For many people reading the paper is a random pursuit, but it is also an opportunity for learning for Robert and for Charlie. Similarly, Charlie usually had the editorial page of the regional paper open on the table the entire day. In between various activities he would sit down and read or re-read an editorial and contemplate its meaning. He said, "Listen, I have been doing that for over 35 years."

Discussion and Conclusion

Personal learning is more than a mental exercise; there is also a significant role of leisure to self-directed learning. This study acknowledges the influence of enjoyment, personal choice, and inward motivation on personal learning. This leisure learning results in significant information or powerful knowledge; for the older adult, this powerful knowledge may help in adjusting to change. Three qualities of leisure time, meaningful activity, and freedom of choice (Goodale & Godbey, 1988) were represented in these activities of personal learning.

Self-directed learning activities often occur within one's leisure time. Self-directed learning was described as a highly engaging activity, and these older adults now have the time to pursue various enjoyable learning activities. The participants were absorbed in these activities, and their lives were focused around this learning. One of the main topics from the interview data is that self-directed learning is highly engaging. The participants discussed activities of enjoyment as well as excitement or passion as qualities of highly engaging activities. Their daily lives were aligned around these activities of interest.

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ENVIRONMENT ANALYSIS OF COMMUNITY SPORT ACTIVITIES

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Abstract

It is possible to state that the organisation and way of functioning of the State administration is going through a development process, which has responded and will be responding to changes and needs of society.

"The basic philosophy of local authorities, which are willing to build up new and well functioning organisation models, is their orientation towards "public services". It means that services offered by local authorities should be designed not only for people but in cooperation with them (Welsh, 1994).

It is thus necessary for the municipality to stay in contact with its inhabitants and to evaluate their needs and attitudes. According to Welsh (1998), the task of local authorities is to analyse the impact of services offered to particular segments of community, which should be served by the authorities. This analysis, which can be considered as an audit made for certain clients, is a starting point for the elaboration of an overall municipality strategy. This analysis can be realised by the means of primary or secondary research.

Present state of our society and developmental tendencies taken in consideration, it is clear that the existence of leisure activities system will be a significant element in the decision-making processes of State employees on all levels of State (public) administration.

The relationship between those who can influence the outer forces, and those who occupy positions in the leisure-time organisations defines the dynamics of future development.

The role of municipalities in the domain of public services cannot be replaced. That's why it is necessary to study the opinions and attitudes of employees responsible on the local scale. It is also important for the information transfer and communication to be realized rapidly.

Key words: *municipality, citizen, leisure activities, organisations, conditions.*

Introduction

The European Urban Charter (1992) defines the present and future conditions of urban development. It states, besides others, that the enforcement of individual rights should be based on solidarity and responsible citizenship. The citizens of European towns have, according to this Charter, following rights:

Health – the right to live in an environment, which promotes physical and psychical health of a man;

Sport and leisure – the right to use a large variety of sport and leisure facilities, irrespective of age, abilities or income;

Culture - the right to use the facilities and take part in a variety of creative activities;

Participation – the right to participate in pluralistic democratic structures and in the municipal management, this participation being characterized by cooperation among different partners, by the principle of subsidiarity, by a right to information and by protection against excessive regulation;

Personal development – the right to live in urban conditions that help to acquire personal richness and to insure to individuals social, cultural, moral and spiritual development;

Financial mechanisms and structures – should enable local authorities to find financial backing necessary for putting in practice the rights defined in the Declaration.

In the creation of a new "Conception of Sport and Physical Culture Development in the Liberec Region", the Liberec regional council has asked the Faculty of Physical Culture to work out a study describing and evaluating the opinions and attitudes of local authorities' employees toward communal recreation. The stress was put on educational activities of sport character.

The study comprised of three parts:

1. Representatives' attitudes toward leisure activities of sport character, seen in the frame of local politics.
2. Present day situation in financing of communal recreation from local budgets.
3. Present day situation in the domain of ownership (in the sphere of sport and physical education).

The size of the region and the diversity of studied subjects made the realisation of the study very difficult. Due to the volume of information gathered, we will restrict this article to the first part of the problem: representatives' attitudes toward leisure activities in the frame of local politics.

Methodology and characteristic of the sample

The client has agreed to the survey, which would include 23 questions and 8 demographic indicators.

228 questionnaires were distributed in two rounds. 97 communities were sent the questionnaires by mail and after a logic control, all 97 of them were used for statistical processing. This means that the return rate was 100%. The results of the survey are described in this article. In the second round, the researchers spoke with 131 local authorities representatives in the remaining communities of the Liberecký region. After a logic control, all 131 questionnaires were used for statistical processing. The results are being treated.

Note: the authors of the survey use the terminology as defined by the client and they are aware of the fact that objections of technical character could be raised.

Representatives' attitudes toward leisure activities of sport character on the level of communal politics

Having taken in consideration the needs of the article, we will state several findings of the research realized in 1999 by the Institute of Children and Youth of the Ministry of Education, Youth and Sport, in cooperation with the Department of Recreology of the Palacký university in Olomouc and departments N°73 and K3 of the Ministry of Education, Youth and Sport.

The research analyzed opinions and attitudes of those regional and local authorities' employees who have already been working in the field of youth and physical education:

Respondents submitted that their work does not comply with the initial objectives. It is evident that the classification of particular work positions is not clear: one third of the employees said that they use only 10% of their time working on original objectives of the particular position.

There are significant contrasts among the respondents when it comes to the nature of their work (what they think it should be) and the reality:

The respondents consider as **important** the following items:

A/ Protection of society against negative influences;
B/ Realization and use of State subventions;
C/ Support of NGO's, counseling activities;
D/ Information;
E/ Coordination of the activities of all participating subjects;
F/ Participation in creation of the plans and budgets;
G/ Participation in material, economic and personal backing of the activities;
H/ Working out proposals of local conceptions;

On the other hand, they consider as **less important**:

I/ Creating the conditions for good functioning of the corporations;
J/ Working out communications for higher administration units.

The **level of education** and professional training is unsatisfactory. The respondents' opinion concerning their own readiness for the function corresponds with their opinion concerning the methodical leadership of higher structures. Employees want to express that they are not "to blame" themselves.

The **central** system of financing leisure activities in regions is inconvenient. Decentralized financing of individual bodies (the finance distribution by a particular local administration) is more clear and more "fair".

In respect of the need of creation of a clear concept in this domain, we consider as **very important** the following opinions:

A/ the issue of leisure time is very important for the public;
B/ it is needed for the decision making concerning certain conceptional issues to be transferred to the competence of lower administration units;
C/ there is an urgent need to resolve the issue as a system solution;
D/ it is beneficial and necessary to solve the issue of leisure activities as a whole ("from one point"), given that it is possible to coordinate the process with other departments – social dep., dep. of construction, etc.

It is interesting to compare the conclusions of the analysis of opinions and attitudes of the employees already "active" in this sphere (made in the entire Czech republic) with the results of the survey in the Liberecký region: see Table 1.

We state that the methodology of the two surveys was identical, the only difference being the partition of the communities. We made a more detailed partition in the case of Liberec, according to the number of inhabitants.

Table 1. Summary of opinions of executive representatives of the municipalities of the Liberecký kraj

Total number of communities in the region who participted	97							
	1-500 inhabit.	**501-1000**	**1001-1500**	**1501-2000**	**2001-5000**	**5001-10000**	**10001-50000**	**50001-100000**
Number of employees who are, in your office, in charge of organization and management of communal physical education and recreation:								
	3	2	0	0	1	2	1	3
Their education level (in numbers)								
University of sport character	0	0	0	0	1	0	1	0
University	1	0	0	0	0	1	0	2
Secondary school	2	1	0	1	0	1	0	1
Elementary school	0	1	0	0	0	0	0	0
Do you have a department in charge of this sphere?								
Yes	0	0	0	0	0	0	1	0
No, but we consider its creation	3	0	0	0	1	1	0	0
No, and we do not consider its creation	36	28	9	7	3	4	1	1
Do you have a special commission who deals with this issue?								
Yes	7	7	0	1	1	3	2	1
No, but we consider its creation	4	2	2	2	2	1	0	0
No, and we do not consider its creation	28	18	7	4	1	1	0	0
You consider the sport and communal recreation								
Important for inhabitants of all age and social groups	19	17	6	5	2	5	2	0
Important mainly for children and young people	21	12	2	4	2	0	0	1
Less important for the life of the municipality (town) and its inhabitants	2	1	0	0	0	0	0	0
It is not at all important for the town's (municipality's) life and life of its inhabitants	1	0	0	0	0	0	0	0
The problems of communal sport and recreation and the problems of regional tourism								
Are closely related and should be considered as a whole	23	20	7	6	4	5	2	1
Are not related too closely and i tis not necessary to consider them as a whole	12	8	2	1	0	0	0	0
Are not related at all	3	0	0	0	0	0	0	0
The economic support for the NGO's is in your community realized								
As financial support of the activities (the contents and personál side), as grant politicy	6	9	3	3	1	4	1	1
By the means of financial supporting of investments and reconstruction of facilities i…	9	8	3	3	1	1	2	1
By advantageous lease of the sport facilities that belong to the municipality	3	5	2	1	1	2	1	1
By lending the municipal sport facilities for free or for a symboli charge	14	14	4	3	3	3	0	0
By other means	8	4	3	1	1	0	0	0

Conclusion

On the basis of the data gathered in the survey, we can state that:

Present state of affaires is very similar to the one described in the research made in 1999. We can therefore say that the development rate does not correspond with the needs and developmental trends of today's society.

In general, it is not true that the communities have created specific work positions that would insure functioning of this domain.

Education of responsible employees is higher in the communities with higher population.

Number of employees with proper education is rising according to the population growth but still does not correspond with trends.

Only one community has an independent department which is fully focused on the issue.

4/5 of the communities do not even consider creating of such departments.

Bigger the community, more likely it is to have sport **committees**. However, 1/2 of the communities do not even consider creating such committees.

It is positive that only one community considers the issue of communal recreation as unimportant, and only two as less important.

94 communities consider this issue as important for all age and social groups**.**

67 communities consider combining communal recreation with tourism as important and beneficial, only 3 communities smaller than 500 inhabitants think that these issues are not connected.

41 communities support the NGOs by lending them the communal sport facilities for free or for a symbolic price.

Majority of communities support the NGO's by combining several approaches,

Grant policies are also often used to stir up the material and personal development.

The results have shown that the issue of communal recreation – and not only in the domain of sport and physical culture – is becoming a subject of interest of State employees on all levels of State administration. It is necessary to add that in most of the cases, these employees do not have the capacity to leave the traditional point of view and that they do not conceive the domain as the space for influencing and forming the modern life style.

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Physical Conditioning

4th INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

"SCIENCE AND PROFESSION – CHALLENGE FOR THE FUTURE"

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METHODOLOGICAL AND APPLICABLE ASPECTS OF THE CONDITIONAL TRAINING OF ELITE SPORTSMEN – FOOTBALL

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Introduction

The moving activity of the human body is a function of complex adaptational mechanisms, formed in the process of the human phylogenetic and ontogenetic evolution.

This fixed adaptive condition also known as "Physical condition" represents the global adaptational potential of the man for supporting different kinds of motive power.

In the areas of elite sport the "physical condition" is differentiated by its basic and precisely defined elements. Gathered together, these elements form a factor, which limits the level of the competitive effectiveness as an integral characteristic of the sporting achievement.

Main thesis

The highly qualified sportsmen have a solid basic training, which needs to be supported on a high level. The main part of the effort should be directed towards the forming of the so called specific (competitive) condition! This is being achieved through the usage of specific training (muscular overload), through which the moving quantities – strength, speed, stamina etc., are being developed alongside with the biodynamical and the kinetic structure of the movements specific for the specified sport or discipline. This would furthermore lead to an eligible activity of the genetic "engine" (DNA) and to specific changes in the main elements of the competitive activity. Having control over these elements and their optimal condition appears to be one of the main problems of the theory and methodology of sports.

Current development of the problem

The scientific research and the practical results have lead us to believe, that in the field of the methodology of several sports a few mistakes are quite often made:

- The stress falls on the development of different fragments of the sportsmen training, as the physical condition training is rare and most often separated from the development of the tactical and the technical abilities of the sportsmen. Most often in order to cover the Physical Fitness issues are used training programs based on the so called "mezocycles".
- The assessment and the control of the level of the specific conditioning are measured through traditional methods in laboratories, which determine basic factors like V02 max, Wmax etc. Yet those factors do not provide enough information on the specific condition of the athletes in a normal competitive situation.

The represented weakness of the methodology of the physical conditioning training could be found mostly in games in which the moving activity is intermittent and a complex coordination structure. (T. Reilly et al., 1988; R. Verhaijen, 1997; J. Weineck, 2000; P. Mikulic, 2003; D. Milanovic, I. Jukic, 2003; R. Velebit, 2003; Tz. Zhelyazkov, 2004)

Methods

The main goal of the research is to determine the level of the competitive conditioning of elite athletes through the deployment of a specific test (CC-256) on the field. (Tz. Zhelyazkov, L. Krustev, M. Galov, 2003).

The test was held on a grass football field. The athletes are in typical football clothing. After the preliminary warm up they cross the traced path for the smallest possible amount of time, as described in figure 1. At the end of the second minute after the finish the concentration of La in the bloodstream was measured. The pulse frequency was being measured telemetrically up to the fifth minute.

The proposed test is characterized by the following elements:

- According to the dynamic and the kinetic characteristics the test reveals adequately the specifics of the football game – short sprints, slalom, "shuttle run" with change of directions, etc.
- The specific speed-power overload of the muscles for 50-60 seconds is a serious test for the glycolytic fraction of the energy supplements and the compensating abilities of the cardio-respiratory system in restoring the glycogen and the myoglobin in the muscles.

- The technology of the measurement (telemetric measurement of the pulse, La, as well as the software base of the test) allows us to register several specific factors of the functional overload, as well as to develop corresponding indexes for the assessment of specific conditioning of the athletes.

The described characteristics of the test were experimentally developed by four different tests of 54 football players of the elite A division of the Bulgarian Football League as follows: 17.06.2003;26/29.05.2004; 19.07.2004; 10.12.2004 year in Sofia.

Results

The average values and the variations of the researched factors are represented in table 1. Combined they reveal a lot of precious information, which, used in a comparative manner, could be used for every following test. Special attention must be drawn to the low variation coefficient – V%. This confirms the thesis that the tested elite football players, according to the test factors, measuring the specific efficiency are a homogeneous mass – so there would be comparatively low variations of the individual characteristics around the middle value - $\underline{x}$. An additional information concerning those factors is also the As and Ex indexes, which prove that these variations are close to the so called normal distribution.

From the analysis of the middle values – $\underline{x}$ of the indexes becomes obvious that the overload is of the anaerobic glycolytic type, which is specific for the football game. For example, starting from pulse = 124 Y0/min. for about 60 seconds a HR of 184Xd/min was reached. The levels of La, measured at the second minute after the test are $\underline{x}$=13,4 mmol/l (in specific cases these could vary from 6.9 to 21.1 mmol/l

Concerning its functionality this test is close to the classic interval method of H.Reindell, H.Roskamm, W.Gerschler (1962), where from starting pulse of 120 Yd/min followed by resting periods of 45-90 seconds HR returns to the starting levels of 120-125 Yd/min. This training was proven to be an excellent tool for development of the cardio-respiratory system of the body in order to improve the aerobic abilities through interval anaerobic stimulation.

Discussion and conclusion

The measured factors (from 1 to 8) and the additionally measured indexes for power and efficiency (table 1) lead us to the conclusion that the adaptation of the tested elite sportsmen to the highly intensive glycolythic type of work, typical for the competitive conditions in the professional football is not satisfactory. The most convincing proof is the dynamics of the restoration processes. The restoration of the pulse frequency from 184 Yd/min to 138 Yd/min in an interval of 2 minutes reveals weak compensatory abilities of the athletes after an intensive speed-power overload. A level of HR of 138 Yd/min and La of 13,4 mmol after a resting period of 2 minutes excludes the possibility for highly effective work with the characteristics of the football game.

For further reference in figures 2 and 3 are shown the HR levels of two of the elite athletes – G.P. and B.N. They clearly reveal that the firs athlete G.P. is far behind the second one –B.N. considering the specific condition at the time of the test.

- A slower speed compared to the second athlete – 69,84 against 66,19
- Higher cost of the overload – La = 11,8 mmol/l against 9.6 mmol/l
- Lower compensatory abilities – HR was held above 180 Yd/min for about 57 s. compared to the 48 seconds of B.N.; from 160 to 180 fro about 55 seconds against 46 seconds and 130-160 for about 217 seconds against 120 seconds.

We can so conclude that the athlete G.P. after the completion of the test will not be able to “repay” his lactate oxygen “debt” and reach the level of the aerobic threshold (AT) around 130 Yd/min for about 5 minutes, while the athlete B.N. will do that in about 3 minutes. We should also state that the well-trained football players restore their HR from 185 Yd/min to 120-125 Yd/min for about 45-90 seconds. This allows them to work longer over the anaerobic threshold (AT) and to form adaptive mechanism for faster and more effective muscle work and restoration.

The insufficient adaptation of the tested elite athletes to the highly-intensive muscle work is a result of the extremely small volume of exercises of speed-power (explosive) characteristics, which should develop both of the fast muscle fibres (fast-twitch).

Most of the coaches stress on the endurance developing exercises, which develop mostly the slow muscle fibres (slow-twitch). This leads to lasting morph-functional changes, which do not correspond to the requirements of the contemporary “total” football.

Application in practice

The experimental deployment of the specific (CC-256) test allows the development of a comparative base for measuring the competitive condition of elite football players. This precise method will surely replace the intuitive methods for establishing control over the training process.

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PHYSICAL CONDITIONING AND MOVEMENT TECHNIQUE

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Abstract

Physical conditioning is strongly related to movement technique although this may not be regularly recognized in sports praxis. Neuro-muscular characteristics that are subjected to conditioning are the keystone of movement technique. Therefore, it seems quite obvious that change of movement technique should first be reflected in proper change of neuro-muscular system. Two examples are presented to support the effect of conditioning on precision in three-point throw in basketball and on sprinting technique.

Introduction

There are many believes about role of physical conditioning in sports. A lot of trainers still wonder what conditioning may bring to his athlete, especially in ball sports. One common opinion is that conditioning has negative effect on technical performance. For instance, in basketball, using exercises as bench-press or similar employing weights will reduce precision of throwing ball. For that reason many sportsmen are prevented from specific forms of conditioning.

Conditioning is often assumed to quantitatively influence technique. Stronger muscle will better accelerate mass. Changed muscle fibre type distribution will make muscle faster or more endure. Nevertheless, no qualitative changes in movement technique are expected. However, Paavolainen et al. (1999) showed that explosive-strength training increase utilization of elastic energy in 5-km run and thus improve running economy. Stronger muscles and especially higher pre-activation level in stretch shortening cycle exercise provide basis for better elastic behavior of muscle-tendon unit. This may not only improve economy of movement as in mentioned above but may also provide basis for greater velocity of movement since tendon may achieve greater velocity of shortening than muscles (Zatsiorsky, 1995).

Changing a movement technique of sportsmen is considered as an extremely difficult task. Many trainers are afraid to change an existing technique because of a fear for worse results. From control theory, technique represents an interaction among given elements. In simplified human model, these elements include muscle-tendon-skeletal system with given mechanical characteristics. With a great number of repetitions, humans are able to optimize solution by finding corresponding (optimal) interactions among the elements of the system. If the sportsman would like to change his technique, he is looking for new interactions among the elements of the system. The question arises if he is able to find a better solution than before. To change a technique, it seems more fruitful way to change properties of one or more elements and then look for a new optimal solution.

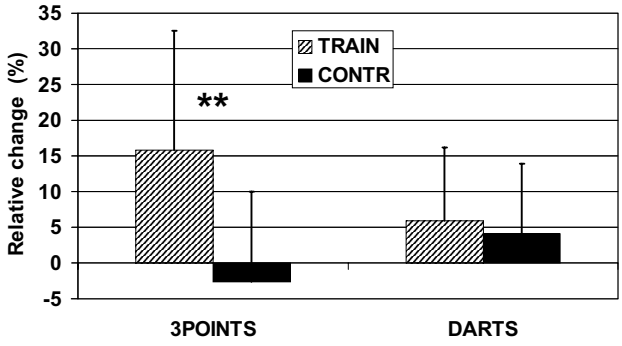

*Figure 1. Results in throws for 3 points and darts. TRAIN – training group, CONTR – control group, INIT – initial measurements, FIN – final measurements, ** - P < 0.01*

Conditioning to improve precision

In many events, substantial amount of muscle force must be employed in precision task. It is clear that variability of performance increases with increasing load. However, the greatest variability is observed at the loads that engage approximately 65 % of the maximal muscle force (Schmidt, 1982). Afterwards variability decreases. In basketball, throws for three points demand substantial amount of power which is estimated to be 30-50% of the maximum. According to the variability

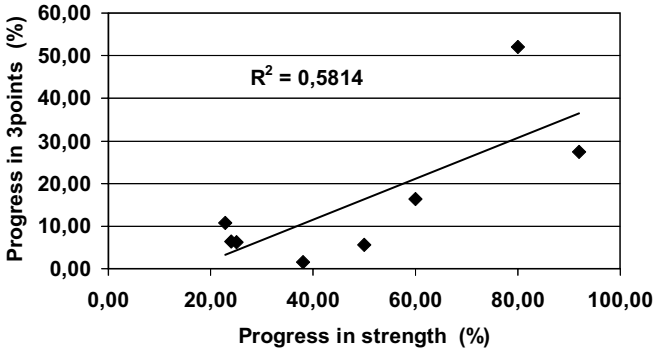

Figure 2. Correlation between progress in three-points throw and progress in strength. R^2 – determination coefficient.

– force curve, strengthening of the muscles should have the greatest effect on precision in the tasks performed bellow 65% of maximal effort when still substantial effort is needed to perform the task. Tasks with low involvement of muscle force are not expected to benefit from muscle strengthening. To test this hypothesis, we compared effect of muscle strengthening on throwing for three points (high effort task) and dart throwing (low effort task).

Two groups of healthy young men were formed (each group 8 subjects), from which one underwent strength training and the other served as a control. Training group performed bench-press and French-curl for 6 weeks, the first 3 weeks with slow pace and the second 3 weeks in explosive way. Loads were 80-90 % of 1 RM. The training aimed to increase muscle activation.

Training was effective and increased maximal bench-press load (49 $\pm$ 25.6 %, $P<0.001$), while in the control group the changes were minimal. In precision tasks, the only significant change was observed in the three-point throw in training group (Figure 1). Even more important, the greatest progress in three-point throw was obtained by the subjects that had improved their strength to a greater extent ($P = 0.028$, Figure 2). On the other hand, there was no relation between strength progress and changes in results obtained in darts.

Precision is more affected by strength training when more force is needed to accomplish task. Since there was no additional training in throwing for three point or darts, the effects can be solely contributed to strength improvement. There are claims that changed mechanical properties of effectors without adapted motor program will lead to disintegration of movement (Pandy et al., 1990). These effects can't be ignored; however, it seems they were overcome with a stronger mechanism that supports better precision. One possible explanation would be decreased antagonist co-activation which is reduced with a strength training (Carolan and Cafarelli, 1992). In this way agonist muscles worked at even lower activation level and therefore at more effective part of movement variability – force curve. Further explanation may be reduced presentation area of motor cortex. Neural activity in motor cortex increases with growing force (Dettmers et al., 1996) and may be projected to neighbour areas. It is expected that strength training reduces cortex excitability for the same load and thus reduce co-activation of neighbouring muscles. Whatever the reason, this research showed that strength training is effective for basketball players but not for the dart throwers.

Conditioning to change sprinting technique

Wiemann (1986) predicted two kinetic chains responsible for sprinting technique (Figure 3). One kinetic chain is responsible for stride frequency and the other one is responsible for stride length. Therefore, domination of one kinetic chain over the other would lead either to more pronounced stride frequency or to prolonged stride.

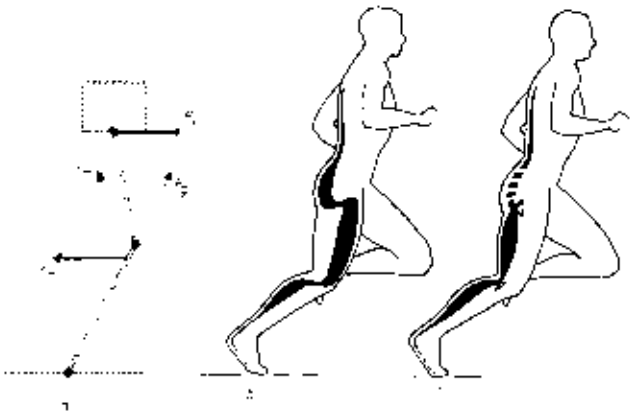

Figure 3. Two kinetic chains related to (b) pushing (long stride) and (c) grabbing (stride frequency). Wiemann (1986)

It has been shown that the different squat jump techniques correlate to the different sprinting techniques (frequency – stride length) (Juhart, 2003). Additionally, these two muscle groups have also distinctive roles in squat jump related to proximal-distal muscle activation pattern (Bobbert and van Ingen Schenau, 1988). In accordance to this the maximal isometric strength ratio between the knee flexion and extension correlate to the different squat jump techniques (Sarabon and Strojnik, 2002). Therefore is seems that sprinting technique indeed depends on strength ratio of mentioned kinetic chains. The sprinter just simply uses the advantages of the elements of the muscle-tendon-skeleton system he has. Training muscles of the single kinetic chain should produce corresponding changes in sprinting technique without any technical training. The aim of the experiment to be present here was to find

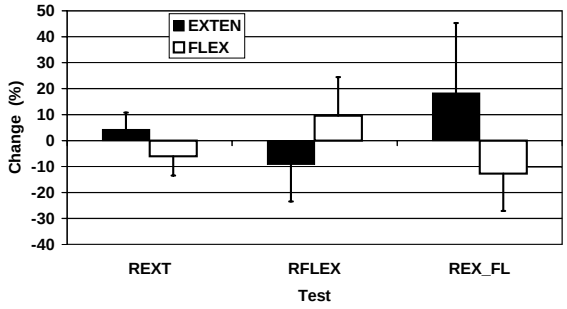

Figure 4. Relativ changes in knee torque. EXT – extension; FLEX – flexion.

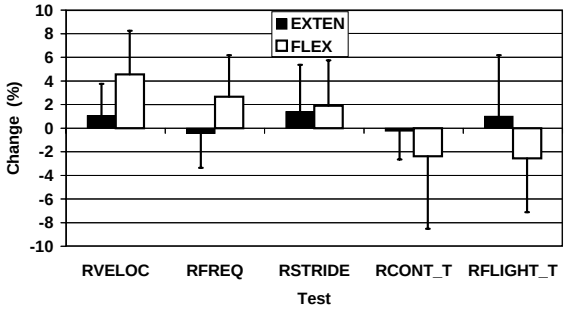

Figure 5. Relative changes in sprinting parameters. VELOC – velocity; CON_T – contact time

out the relationship between strengthening the muscles of different kinetic chains and corresponding changes in sprinting technique.

Physical education students without expertise in sprinting were randomly divided in to two groups (n=9 and n=10 students). One group performed strength training for the knee extensors (group A) while the other group performed strength training for the knee flexors (group B). The strength trainings were performing three times per week for six weeks. Before and after the training period maximal isometric torque of knee extensors and knee flexors, as well as 60 m dash sprinting over a contact mat were measured.

After six weeks of strength training, the group A increased maximal torque of knee extensors while the group B increased maximal torque of knee flexors (Fig. 4). The group A showed weak tendency of increasing running velocity, stride length in flight time (Fig. 5). The group B showed tendency of increasing running velocity, stride frequency and stride length and tendency of decreasing contact and flight times (Fig. 5).

Six weeks of strength training resulted in increased strength in the trained muscles. There were no statistically significant changes in sprinting parameters, however, the nature of the changes were very well in accordance of the model proposed by Wiemann (1986). Strengthening the knee flexors increased the running velocity through higher stride frequency. The stride frequency was connected to shorter contact and flight times respectively. Weak tendencies of changes in the group that was strengthening the knee extensors might be explained that knee extensors are much more involved in daily life activities than knee flexors and consecutively less responsive to the training stimulus. According to the results, it was possible to conclude that the appropriate technique depends from the physical fitness level. In sprinting it means that the sprinting technique is related to the ratio between the muscle groups and that the effective technical training must be based on proper conditioning.

Conclusion

Conditioning should be considered as an integral part of technical training. For its successful integration one needs to understand the role of neuro-muscular system in specific movement and the methods to achieve specific adaptation. This knowledge should be included in a studying schedule of those dealing with development of skills.

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TERMS, MEANINGS AND RESEARCH OF PHYSICAL CONDITIONING OF ATHLETES

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Abstract

Physical conditioning is the most common term used for one significant aspect of sport preparation focused on development and maintenance of physical characteristics of athletes.

Many other terms denoting the same aspect of sport preparation are used in sport science and practice. A few such terms mostly depending on language differences and authors' preferences can be found in the following paper. Complete structure of physical conditioning and all its components are presented and explained in detail. Furthermore, to successfully realize the process of physical conditioning, crucial factor which cannot be avoided is scientific research. Authors pointed out several basic directions of research in that aspect of sport preparation and the importance of the transfer of scientific information into training practice.

Finally, knowledge and research were divided in two inseparable continuums that show logic and necessary order of research that would result with practically usable information.

Terms and meanings of physical conditioning of athletes

Division of sport preparation goals determined formation of special aspect of preparation, focused on development and maintenance of physical characteristics of athletes. Most common term for this aspect of sport preparation is **physical conditioning**.

Word condition comes from the Latin word *conditio* = *settlement, prerequisite.* Foreign words dictionary (Klaić, 1974) explains conditioning as ability to induce work, and conditioning training at low intensity training with purpose of maintenance of flexibility and enhancement of body preparedness for upcoming competition.

Terms physical preparation, body preparation and functional-motoric preparation are also used for this type of preparation in the Croatian language. Most frequently mentioned terms in the international literature are strength and conditioning (Beachle i Earle, 2000), strength training (Zaciorskij, 1995), conditioning (Brzycki i Brown, 1993, Brittenham, 1996, Epley, 2004), sports conditioning (Foran, 2001), physical training (Bompa, 1999), physical fitness training (Bangsboo, 1994), physical performance training (Clark, 2001), physical preparation (Pyke, 2001), physical conditioning, body conditioning, physical training, motor development, physical development (English) (Kent, 1994), konditionstraining (German) (Jonath i Krempel, 1987), dvigatelna trenirovkata (Bulgarian) (Željaskov, 2002), fizičeskaja podgotovka (Russian) (Matveev, 1999), preparation physique (French), preparacione fisica (Italian) (Sassi, 2001), preparacion fisica (Spanish) (Maldonado i sur., 2001).

Physical conditioning of athletes made big entrance in sport preparation system in the second half of 20. century (Čustonja i Jajčević, 2003). That is mostly applied to the most popular sports like sport games, combat sports, tennis, but also other sports where result mostly depends on physical abilities of athletes. After period in which technical-tactical training was used to great extent, improvement of physical (conditioning) abilities became more important than before. Stress due to competition in physical, emotional, intelectual and sensory way seriously endangers athletes personal integrity. Busy competition calendar, large number of continental and intercontinental trips, shorten recovery period, tougher and more balanced competition and other factors cause the survival of only the fittest athletes in top level sport today. For these reasons coaching staffs want to develop system of sport preparation to the highest level. That level is hard to reach without optimal physical conditioning (Jukić et al., 2003.).

Physical conditioning (figure 1) can be defined as a process of improvement of motoric and functional (energetic) abilities, morphological characteristics, athlete's health status and also improving skills responsible for those aspects (Jukić et al., 2003). Physical conditioning has its versatile, basic, specific and situational directivity (Jukić, 2001). Domination of each aspect of physical conditioning depends on long term sport development phase, short term training periodization, sport discipline characteristics and individual characteristics of an athlete. It is because of individualization of physical conditioning process that diagnostics becomes very important. Probability for improvement of conditioning status of an athlete is enhanced by determination and control of fitness level in different training cycles (Milanović, 2004). Recent times bring need for use of variety of additional aspects of conditioning preparation. Reason for that is the increase of effects gained through usage of standard motoric means of conditioning development (Matveev, 1999).

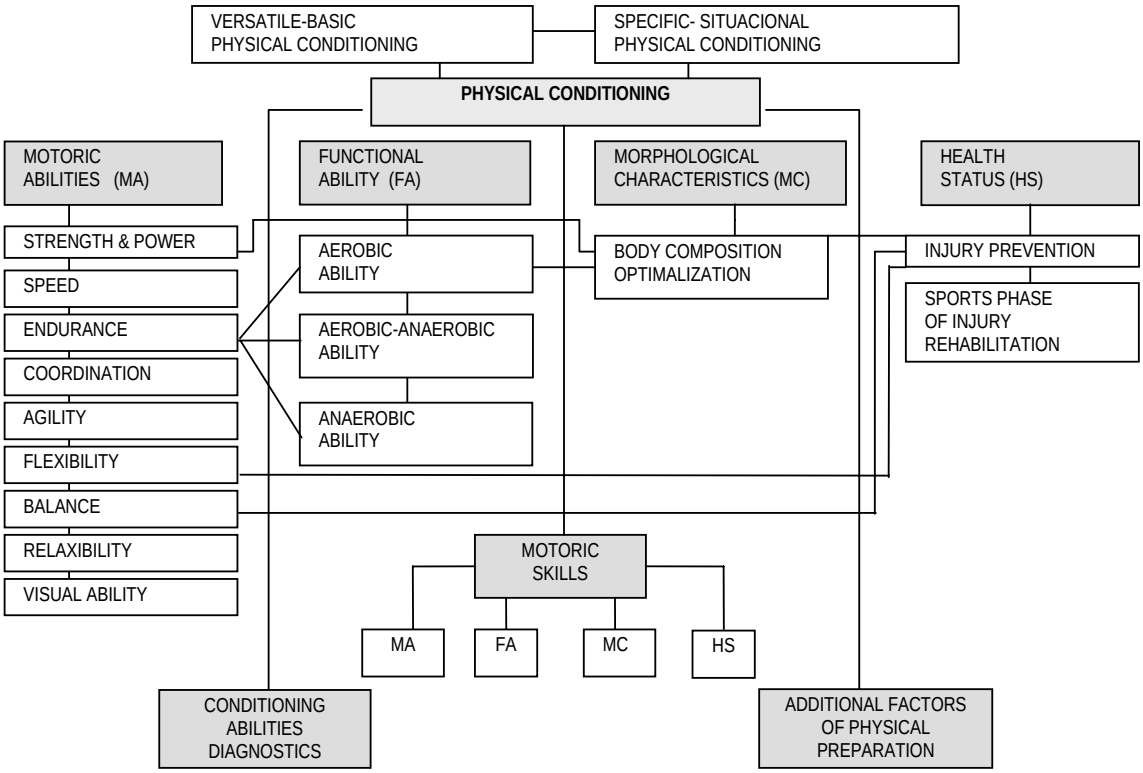

Figure 1: Structure of physical conditioning (by Jukić et al., 2003)

Therefore, purpose of physical conditioning is improvement and development of human body characteristics. Goal of this system of improvement is to reach higher level of physical efficacy, which is according to the physical education theory (Željaskov, 2003) known as physical (conditioning) preparedness. Physical preparedness contains three elements: physical health, physical development and physical efficacy (Fleischman, 1965., Zatciorskij, 1966., Matveev, 1977., Thomas, 1982., Željaskov and Dasheva, 2002., by Željaskov, 2003.). Combined, these elements determine morphological-functional potential of a person for performing many, by quantity and intensity, diverse motoric activities. Systematic action on these elements through specific methods and training programs is also known as improvement of physical abilities (Željaskov, 2003.). In that context, Željaskov (2003) views conditioning training as a acomplex process of adjusting, adaptation through process of development and improvement of physical characteristics with strict regard to biodynamic and kinematic structures of certain sport. However, there are also different opinions about conditioning preparation. Weineck (1999) defers conditioning training in a extended and limited sense. Term condition in a extended sense considers all psychological, physical, technical, tactical, cognitive and social factors of achievement, while condition in a limited sense is based only on phyisical factors (endurance, strength, speed and flexibility). Jonath and Krempel (1987), talk about three groups of characteristics that define condition. They are physical (strength, speed and endurance), coordinational (flexibility and coordination) and psychological (active and passive interpersonal characteristics). Bompa (1999) defines conditioning training as process with goal for enhancement of physiological potentials of an athlete and improvement of biomotorical abilities to highest level. The same author puts conditioning training on the bottom of training factors pyramid, and makes clear that this type of training represents prerequisite for development of technical, tactical and phsycho-mental qualities. Beachle and Earle (2000) see meaning of physical conditioning in procedures that help athlete to reach highest level of physical accomplishment, and stay injury free.

Of course, there are many other, different definitions of conditioning training. Connection between definitions is a object of physical conditioning, which is always athlete with his physical abilities. However, this aspect of preparation has its secondary effects: fatigue delay, recovery acceleration and decrease of number and severity of injuries (Keul, 1984., by Milanović, 1997). Besides everything, physical conditioning should be observed as a part of integral sport preparation. Its primary goal should be securing prerequisites for performing of technical-tactical and psychological qualities of athlete through competition (Milanović et al., 2003).

Researches in physical conditioning of athletes

Realization of physical conditioning as important aspect of athlete's preparation caused large interest of scientists (Rhea, 2004, Kraemer, 2005). That interest is mostly addressed to conditioning qualities of athletes (diagnostics, modelling, relations, differences), but also to procedures for their improvement (means, methods and programs).

There are several basic directions of research of physical conditioning of athletes:

- **Diagnostics and modelling of conditioning qualities** – creation and valorization of measuring instruments for conditioning qualities, creation of model values of conditioning qualities for different sports, age, gender and quality level and also structure of conditioning qualities.
- **Relations between conditioning qualities** – determination of connection between certain major characteristics (for example, relations between motoric abilities and morphological characteristics), but also relations between lower rank qualities (for example, relations between explosive strength and lean body mass)
- **Relations between conditioning qualities and success in certain sport** – determination of connection between level of certain motoric abilities and situational efficacy of athlete
- **Differencies in conditioning qualities of athletes of different age, gender, rank and kind of sport** – determination of differencies between level of motoric, functional and morphological characteristics, and motoric conditioning knowledge between athletes of different age, gender, training and competition rank and sport
- **Analysis of exercises of physical conditioning of athletes** – structural, anatomical, biomechanical, energetic analysis of exercises used for improvement of conditioning qualities of athlete
- **Modelling and valorization of methodical procedures in a physical conditioning** – creation of procedures for improvement of conditioning characteristics in isolated conditions (procedures include motoric and ergogenic means, loads, methods and metodic forms, equipment, locations) and effect analysis of the same procedures on changes in conditioning qualities
- **Modelling and valorization of physical conditioning programs** – creation of physical conditioning programs in real training/competition cycles, and effect analysis of those programs on changes in conditioning qualities

Scientific approach to physical conditioning research comes from biomedical, natural, social and humanity and methodological scientific disciplines (Milanović, 1999, Muller et al., 2001). Currently, largest scientific production on physical conditioning exists within physiology, biomechanics, biochemistry, sports medicine and kinesiology of sport (Željaskov, 2004., Hopkins, 2004.). Fundamental and applied research approach also exist in this area of research (Kamen, 2001.). Fundamental research within physical conditioning is a part of large area of sport sciences research, which are oriented on proving existant and gaining new information about human body reactions on physical exercise. On the other hand, applied research on physical conditioning tend to create and valorize most efficient procedures for changing of conditioning characteristics. Something like that would be unimaginable without referring to the fundamental research. It is also important to properly present research to sport experts who apply new informations in daily training (Kraemer, 2004., Kraemer, 2005.). This procedure is called transfer on scientific informations into training practice, and is done by people scientifically educated and with practical experience in sport training. They are highly qualified experts who are able to "decode science language into practical language" and, actually give meaning to scientific research performing.

It seems that "reading" of scientific information for being applied in training process became the largest problem of sport preparation. The same is applied to unjustified parting of scientists and practitioners. Simple, but not easy double solution can be found by respecting both sport research continuum and sport knowledge continuum (figure 2). Both continuums show logic and necessity of research order that will result with practically usable information for direct realization of training process.

	PHYSIOLOGY	BIOMECHANICS	EXERCISES ANALYSIS OF CP	METHODICAL RESEARCH OF CP	PROGRAM EFFECTS RESEARCH IN CP
RESEARCH	Contractile mechanisms research within SSC	Kinetic and kinematic movement parameters research suitable for SSC	SSC manifestation research in different motoric exercises	Research on different methodical procedures for development of SSC	Research on training effects of different programs for development of SSC
KNOWLEDGE	Knowledge of physiologic mechanisms dominating in SSC	Knowledge of movement characteristics that activate SSC	Knowledge of efficacy of different motoric exercises on SSC	Knowledge of suitable methodical procedures for development of SSC	Knowledge of proper training programs for development of SSC

Figure 2: Continuum examples for research in sport and sport knowledge (goal: stretch-shortening cycle)

Conclusion

Undoubtable need for development and maintenance of physical abilities of an athlete justifies existence of conditioning aspect of sport preparation. Terminology differences when concidering physical conditioning don't disregard need for clear positioning of physical conditioning in theoretical sport systems and real sport practice. Improvement of conditioning practice is only possible with strong support of scientific research. Of course, it is important to ensure the flow of

scientific information to sport experts – practitioners. Reason for that lies in a following fact: physical conditioning is more dependable on scientific information than the other aspects of sport preparation. Besides, the effects of physical conditioning are easy to measure in both laboratory and field, even in competition conditions.

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EXERCISE PERFORMANCE IN HUMANS: ROLE OF BODY SIZE

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Abstract

The effects of body size on various exercise performance has been studied for decades. However, recent review of literature (Jaric, 2002) has shown that there are inconsistencies in normalizing exercise performance for differences in body size. As a consequence, a number of previously reported data on exercise performance have been body size depended, while relationships among different exercise performance tests have been confounded by the effect of body size. Another consequence is that the comparisons of the data obtained in different studies have been often invalid which prevented researchers from establishing normative values for various exercise performance tests applied on particular populations. In this paper, we discuss how different maximum exercise performance depend on selected indices of body size and what could be the optimal methods for normalizing performance in order to compare different groups of subjects and establish standards for the maximum performance.

Key words: *scaling, allometric, muscle strength, exercise performance*

Introduction

Maximum exercise performance capacity in humans is usually assessed using various exercise performance tests. Numerous factors may confound exercise performance tests. In addition to age, gender, body composition, skill, and physical activity level, the body size has proved to be an important attribute that has profound consequences on the outcome of a number of exercise performance tests (Jaric, 2002). Although the role of body size has been studied for decades (Astrand and Rodahl, 1986), the normalization for body size had been often inconsistently applied when presenting the data of routine exercise performance tests (Jaric, 2002). Therefore, most of the data presented through the scientific literature has been body size dependent, while relationships among different tests have been confounded by the body size effect. Finally, comparisons of the data obtained in different studies have been often invalid which prevented researchers and professionals from establishing normative values for various tests applied on particular populations.

We believe that these problems mainly originate from two different sources. The first is a lack of standardized methodology for assessment of the role of body size in the tested exercise performance. In particular, exercise scientists usually 1) do not normalize exercise performance tests for body size, or 2) use so-called *ratio standards* by normalizing recorded exercise performance per kg of body mass or fat-free mass (Jaric, 2002). However, for this ratio to be an accurate representation of a body size independent index the true relationship between two variables should be linear and the regression should pass through the origin. Unfortunately, regarding the most of human physiological functions neither of these two conditions has been satisfied and, consequently, this scaling method has been often criticized (Nevill et al. 1992). Alternatively, a number of authors (Astrand and Rodahl, 1986; Jaric, 2002; Nevill et al. 1992) have demonstrated theoretically and experimentally that an allometric scaling is more appropriate scaling statistic when normalizing human exercise performance variables for body size. Allometric relationship between the exercise performance variable P and a body size variable S is expressed as:

$$P = a \cdot S^b, \qquad \text{(eq. 1)}$$

where a, and b are constant multiplayer and scaling exponent, respectively.

The second source body size dependent data reported in literature is a negligence to consider the test specific effects of body size. Namely, different groups of exercise performance tests could have different relationships with body size (Jaric, 2003). In order to address these problems, we will review both the common methods employed in normalizing exercise performance, as well as the experimental findings related to the effect of body size on various exercise performance measures. Based on both the literature review and our recent experimental findings, we present the evidence for recommending allometric scaling method and theory of geometric similarity as a starting point for providing a standardized set of methods for normalizing outcomes of routine exercise performance tests for the effect of body size.

Normalizing exercise performance for body size: theoretical approach

The most often applied theoretical model when describing structure-function relationships in living beings is geometric scaling model. In particular, geometric scaling model assumes that all human bodies have the same shape and, therefore,

they only differ in size (i.e., they are geometrically similar). As a consequence, all lengths L are proportional to a characteristic length measured on a subject (e.g., body height), all areas (e.g., muscle cross-sectional area) are proportional to L^2 (body height or any other length L squared), while all volumes and volume-related indices (such as body mass or weight) are proportional to L^3. Conversely, if body mass (m, or fat-free mass or any other related index) is measured, any area is proportional to $m^{2/3}$ (or $m^{0.67}$), while any length is proportional to $m^{1/3}$ (or $m^{0.33}$).

A number of important relationships between body size and various exercise performance could be deduced from the effects of scale based on the presumption of geometric similarity (Jaric et al. 2005). These theoretical relationships are presented in Table 1.

It is important to note that this approach often leads to the normalization with respect to the body size indices on power different from 1 (except for muscle torque), as suggested by ratio standard (see Table 1). This scaling approach is often referred to in the literature as *allometric scaling* while the assessed exponential exponent (b; see eq. 1) is referred to as *allometric scaling exponent.* An important practical implication of these theoretical findings is a method for normalizing the tested exercise performance. For example, if a certain performance P is proportional to m^b, then the equation:

$$a = P / m^b , \qquad \text{(eq. 2)}$$

is expected to provide a body size independent (or normalized) index of performance a.

Normalization of exercise performance for body size: comparison of theoretical and experimental findings

The most often used method for experimentally deriving the relationship between body size and various exercise performance tests is allometric scaling (see eq. 1). The parameters a and b from eq. 1 is constant multiplayer and allometric scaling exponent, respectively, and can be derived by performing linear regression on logarithmically transformed eq.1:

$$\log(P) = \log(a) + b \cdot \log(m) , \qquad \text{(eq. 3)}$$

When scaling exponent b is determined, a body size independent (or normalized) index of the tested performance a can be calculated by using eq.2. By using above presented allometric approach, many authors examined experimentally the relationship between body size and various exercise performance tests.

We compared the results of previous experimental studies with the theoretical predictions regarding exercise performance-body size relationship (see Table 1) and found a very close similarity between theoretically predicted and experimentally derived body-mass scaling exponents b for various exercise performance tests.

Moreover, our theoretical analysis and the observed experimental findings suggests that a number of different exercise performance tests could require the same allometric exponent b (see eq. 1, and Table 1), and therefore, the tests can be grouped according to the particular exponents b.

Table 1. A comparison of theoretically and experimentally derived relationships between body size and various exercise performance tests.

Exercise performance tests	**Theoretically derived body-mass scaling exponents *b* based on theory of geometrical similarity (m^b)**	**Experimentally derived body-mass scaling exponent *b***
Exertion of maximum muscle force	Muscle force ~ cross-sectional area of muscle ~ $\boldsymbol{m^{0.67}}$	0.67 (Jaric et al. 2002) 0.51 (Vanderburgh et al. 1995)
Exertion of maximum muscle torque	Muscle torque ~ muscle force × moment arm ~ $m^{0.67} \times m^{0.33} \sim \boldsymbol{m^1}$	1.07-1.2 (Davies and Dalsky, 1997) 1.02 (Jaric et al. 2002) 0.94-1.31 (Weir et al. 1999)
Exertion of maximum muscle force when overcoming external loads	Weight lifted ~ muscle force ~ $\boldsymbol{m^{0.67}}$	0.62 (Atkins, 2004) 0.67 (Challis, 1999) 0.67 (Lietzke, 1956) 0.56-0.74 (Wisloff et al. 1998)
Exertion of maximum muscle power	Muscle power ~ muscle force × movement velocity ~ $m^{0.67} \times m^0 \sim \boldsymbol{m^{0.67}}$	0.68 (Nevill et al. 1992) 0.63 (Nevill et al. 1991) 0.64-0.89 (Hetzler and Omo, 2002)
Explosive force exertion	Rate of force development ~ muscle force ~ $\boldsymbol{m^{0.67}}$	0.32-0.52 (Mirkov et al. 2004)
Rapid movements tests – jumps, sprints, kicking and throwing light objects	Rapid movements ~ movement velocity ~ $\boldsymbol{m^0}$	0.07 (Markovic and Jaric, 2004) 0.02-0.04 (Markovic and Jaric, *in press*)
Supporting body weight tests	Supporting body weight ~ muscle force / m ~ $m^{0.67} / m \sim \boldsymbol{m^{-0.33}}$	-0.22-(-0.38) (Crowder and Yunker 1996) -0.54 (Markovic and Jaric, 2004)
Maximum oxygen uptake (VO_2max)	VO_2max ~ body surface area ~ $\boldsymbol{m^{0.67}}$	0.71 (Bergh et al. 1991) 0.69 (Hoff et al. 2004) 0.67 (Nevill et al. 1992) 0.67 (Nevill et al. 2004) 0.66 (Wisloff et al. 1998)
Distance running tests (running time)*	Distance running performance ~ -(VO_2max / m) ~ - ($m^{0.67}$ / m) ~ $\boldsymbol{m^{0.33}}$	0.30 (Vanderburgh and Mahar, 1995)

* Inversely scaled variable (i.e., smaller results is better).

Table 2 illustrates classification of selected exercise performance tests from the perspective of the effect of body size. The current classification is based on a restructured table of our recent proposal (Jaric et al. 2005), with addition of the tests of maximum oxygen uptake and distance running time. The classification of all selected tests is based on only five recommended values of the allometric exponent $b = \{1; 0.67; 0.33; 0; -0.33\}$.

Table 2. Classification of selected exercise performance tests based on the recommended allometric exponent.

Recommended allometric exponent *b*	Groups of tests	Examples of tests	Recorded variable
b = 1	Muscle torque	Strength of a muscle group recorded with an isokinetic device	Torque
b = 2/3 = 0.67	Maximum oxygen uptake	O_2 uptake during progressive treadmill or cycling test to exhaustion	Liters of O_2 per time unit
	Muscle force	Strength of a muscle group recorded with a dynamometer	Force
	Rate of force/ torque development	Maximum slope of the force-time or torque-time curve	Force or torque per time unit
	Muscle power	Wingate tests, vertical jumping tests, power measured by an isokinetic device	Power
	Exertion of external force	Weight lifting, manual material handling	Weight lifted
b = 0	Performance of rapid movements	Sprinting, jumping, throwing, kicking, punching	Velocity, movement time
b = -1/3 = -0.33	Supporting body weight	Maintaining difficult postures, chin-ups, push-ups, one-leg raises	Time or number of repetitions
b = 1/3 = 0.33	Distance running performance	1500m run, 3200m run	Time

Despite some inconsistencies and limitations (see Jaric, 2002 Jaric et al. 2005), the main finding based on the experimental results reviewed within this section is that the relationship between the exercise performance and body size is generally in line with the theoretical predictions discussed in previous sections. Thus, instead of experimental assessment *we propose using allometric scaling exponents based on the theoretical predictions of the effect of scale and geometric similarity.* This method of normalization for body size should be applied when reporting results of routine tests of exercise performance in various human movement related areas.

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THE EFFECT OF PROPRIOCEPTIVE TRAINING ON JUMPING PERFORMANCE*

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Abstract

The purpose of this study was to examine the effect of proprioceptive training on explosive leg performance. Sixty five physically active men were randomly allocated into experimental (EG; n = 33) and control group (CG; n = 32). Jumping performance was assessed at the beginning and at the end of the 10-week training program using three vertical jump tests (countermovement jump (CMJ), one-leg countermovement jump on left (CMJL) and right (CMJR) leg, respectively), and three horizontal jump tests: (standing long-jump (SL), one-leg standing long-jump on left (SLL) and right (SLR) leg, respectively). Experimental group carried out a specifically designed proprioceptive training program. Control group was instructed to avoid any strenuous physical activity during the experiment. After experiment, EG significantly ($P < 0.05$) improved all six measures of jumping performance. Significant improvement ($P < 0.05$) in CMJR was also found in CG. At the end of 10wk program, two groups differ significantly ($P < 0.05$). F-test showed significant difference between groups in only one test CMJ.

Key words: *explosive power, muscle function, proprioception, training*

Introduction

There is an increasing interest in studying the effectiveness of proprioceptive training in injury prevention and sport rehabilitation in general. However, impact of proprioceptive training programmers on human exercise performances is not well understood. Few studies showed improvement in balance (Eils i Rosenbaum, 2001; Heitkamp i sur., 2001), leg strength (Blackburn i sur., 2002) as well as unilateral leg power (Liu-Ambrose i sur., 2003; Ziegler, 2002) as a result of proprioceptive training. The purpose of this study was to examine the effect of proprioceptive training on explosive leg performance, vertical and horizontal jump performance in particular.

Methods

Sixty five physically active men (age: 20 ± 2 yr; mass 77.1 ± 7.6 kg; height 180.1 ± 5.6 cm) participated in this study. They were randomly allocated into experimental (EG; n = 33) and control group (CG; n = 32). Jumping performance was assessed at the beginning and at the end of the 10-week training program using three vertical jump tests (countermovement jump (CMJ), one-leg countermovement jump on left (CMJL) and right (CMJR) leg, respectively), and three horizontal jump tests: (standing long-jump (SL), one-leg standing long-jump on left (SLL) and right (SLR) leg, respectively). Jumping height in each vertical jumping test was measured on a force platform (Quattro Jump, Kistler, Switzerland) and the average value of two trials was used in further analysis. Standing long-jumps were performed on rubberised surface with measurement tape (Elan, Slovenia). Jump distance was measured to the nearest centimeter by observation from zero mark to rear-most heal on landing. Subjects performed three maximal efforts, and the average value was used for further statistical analysis. To exclude the contribution of arms swing in all tests, hands were placed on the hips. Subjects were previously familiarised with the technique of performed jumps. Experimental group carried out a specifically designed proprioceptive training program over a period of 10 weeks, with a total of 30 training session (i.e., three times a week). Each training session lasted for 60 min and started with a 15 min warm-up program consisting of low-intensity running and stretching. The proprioceptive tasks consisted of exercises on wobbling boards and on two-dimensional free-moving platforms. Control group was instructed to avoid any strenuous physical activity during the experiment.

Data were analysed with Statistica for Windows 5.0. Changes in jumping performance within groups were analysed using t-test for dependent samples. For determining differences between experimental and control group discriminant analysis was used. *P* value of 0.05 was used as the level of statistical significance.

* *Young researcher award*

Results

Main results of the study are presented in Table 1. EG significantly ($P < 0.05$) improved all six measures of jumping performances. Significant improvement ($P < 0.05$) in CMJR was also found in CG. Table 2 presents the results of discriminant analysis. At the end of the experiment, the two groups differ significantly ($P < 0.05$). F-test showed significant difference between groups in only one test CMJ.

Table 1. Jumping performance at the beginning (pre-test) and at the end (post-test) of the experiment.

		Pre-test			Post-test			
		Mean	±	Std. Dv.	Mean	±	Std. Dv.	*P* - level
Experimental group	SL	190.31	±	10.86	195.79	±	12.39	0.002
	SLR	170.37	±	10.53	177.19	±	12.18	0.001
	SLL	174.85	±	11.56	179.97	±	14.13	0.001
	CMJ	43.56	±	4.10	44.97	±	4.04	0.013
	CMJR	28.81	±	3.65	30.25	±	3.18	0.006
	CMJL	29.61	±	3.63	31.17	±	3.34	0.012
Control group	SL	187.65	±	13.47	189.60	±	13.77	0.212
	SLR	173.00	±	14.06	170.79	±	14.11	0.163
	SLL	174.03	±	14.63	174.40	±	15.47	0.841
	CMJ	41.63	±	3.95	41.20	±	3.46	0.460
	CMJR	27.75	±	3.43	28.80	±	3.59	0.024
	CMJL	28.82	±	3.19	29.17	±	2.92	0.537

Table 2. Results of discriminant analysis between experimental and control group at the end of experiment

Wilks' Lambda: 0.77; F (6,58)=2.88 p< 0.016				
	Wilks' Lambda	Partial Lambda	F-remove (1,58)	p-level
SL	0.770	1.000	0.000	0.986
SLR	0.778	0.990	0.598	0.442
SLL	0.781	0.986	0.834	0.365
CMJ	0.879	0.876	8.218	0.006
CMJR	0.787	0.978	1.301	0.259
CMJL	0.775	0.994	0.348	0.557

Discussion

The major finding of the present study is related to proprioceptive training-induced changes in vertical jump performance. Although EG significantly improved jumping performance value in all six tests, the magnitude of changes was rather small (2.9-5.3%), and from the practical point of view, irrelevant. Several research groups have stated that quadriceps and hamstrings strength and power are critical in performance of variety of jumps (Baker, 1996; Brown et al., 1994; Davies and Jones, 1993). Previous reports have shown that proprioceptive training increase the strength of ankle extensors and flexors (Tropp and Asking, 1988), as well as the strength of quadriceps and hamstrings muscles (Headlamp et al., 2001). Therefore, the changes in strength of leg extensor muscles, in addition to an inhibition of muscle stretch-reflex (Lloyd, 2001), could be responsible for the improvements in vertical jump height. Although research of Ziegler (2002) has shown great changes (12%) in CMJ height, this study examined untrained females. Sample of subjects in our study were physically highly active men with similar jumping performance at pretest as trained athletes (e.g., Matavulj et al. 2001).

To our knowledge, this is one of a few studies that examined changes in horizontal jump performance induced by proprioceptive training. Although in this, as well as some other studies (Ziegler, 2002) significant improvements in vertical jump performance as a result of proprioceptive training was found, we found no proprioceptive training-induced changes in horizontal jumping performance. Several possible explanations exist. First, standing long jump tests used in this study have higher coefficients of variation (SDM = 3.44%; SDMD = 4.9%; SDML = 2%) than vertical jump tests performed on a force platform (on average 2%). Moreover, possible exhalation is related to involvement of different muscles during performance of vertical and horizontal jump tests. In particular, in horizontal jumps without the arm swing the relative contribution of hip extensors is greater compared to its contribution in vertical jumps (Robertson and Fleming, 1987). Since the training program applied primarily activated knee and ankle muscles, this could be the reason for the lack of training-induced changes in horizontal jump performance. Finally, no changes in horizontal jump distance could also be the result of low intensity exercises, short duration of the experiment (10 weeks), or the small number of training sessions per week (i.e., 3 × week).

Conclusion

In conclusion, proprioceptive training may be effective in improvements of vertical jump performance in physically active individuals. Therefore, this training method should be incorporated into the overall training program of athletes

aiming at improvements of explosive leg power. Further studies with more training sessions per week and/or longer duration of the experiment are needed.

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PHYSIOLOGICAL PROFILES OF JUDO ATHLETES AND CLIMBERS: A COMPARISON*

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Abstract

The aim of this study was to describe and to compare maximum arm and leg performance attributes of male adult judo athletes (n = 6) and climbers (n = 7) of different rank, derived from laboratory tests, which are similar in duration to a competition (5 minutes). Beside body composition (BIA), power and spirometric data were measured during an incremental load test at the arm crank ergometer and during a 5-minute test on the cycle ergometer with a constant maximum sustainable work load. Climbers had nearly the same arm and leg relative power values as judokas, but their VO_2 values for reaching those performances were significantly higher. In contrast, performance of judo athletes may depend more on anaerobic capacity. The correlations between upper and lower body's physiological parameters of both groups reflected the general state of training of the whole body.

Key words: *endurance tests, ergometry, aerobic, anaerobic, power, VO_2max*

Introduction

Although physical fitness is indispensable for a successful sport performance, only few studies (1-5) have examined physiological profiles of judokas and climbers. Moreover, there is no comparison in literature between performance parameters of athletes of these two sports. Respective data can be obtained by two or more separate tests: Wingate *anaerobic* test for the assessment of *anaerobic power* and capacity, and an incremental *ergometry* test for the determination of *aerobic* performance. No research until now has focused its attention on the development of a laboratory test lasting the duration of judo / climbing competition (about 5 minutes), regarding maximum arm and leg performance.

Purpose. The aim of this study was first to describe maximum arm and leg performance attributes of judo athletes and climbers, derived from laboratory tests, which are similar in duration of a competition, and second to compare the results of the two groups.

Material and Methods

Subjects. The test groups investigated consisted of 6 male senior judo athletes from the Judozentrum Innsbruck sports club of different age (from 20 to 33 years) and rank, amateurs as well as competitive judokas from regional up to international level, and of 7 male adult climbers of Innsbruck, also of different age (17 - 35 years) and rank (from regional to national). Before testing, athletes were asked about their medical history and a clinical routine examination was performed. Moreover, informed consent was obtained from all subjects prior to their voluntary participation in the performance assessment program.

Testing Procedures. The measurements for every athlete were all performed on the same day and in the same order, with about one-hour break between the two *endurance tests.* The tests were preceded by a standardised warm-up.

Anthropometric measurements included stature, body weight, Body Mass Index (BMI), body water, lean (LBW) and fat body weight (Bioelectrical Impedance Analyses).

Test for upper body. Heart rate (Polar, Finland), oxygen uptake (VO_2), ventilation and respiratory exchange ratio (Oxycon Alpha Jaeger Spirometric Analyses, Germany) were measured during the 4th minute of a continuous incremental test with an arm crank ergometer (Ergoline, Germany). While the starting *power* was set at 25W, the increment of *power* was body weight-dependant: half the value of the body mass pro minute, with gradual increment-units of 5W, intending to reach about 5 minutes. The test ended when physical or psychological exhaustion prevented athletes from holding a frequency above 40 revolutions/minute. Maximum *power* (Pmax) and total crank time to exhaustion were also recorded.

Test for lower body. The protocol consisted of a continuous 5-minute maximum test on the cycle ergometer (Lode, Netherlands), using a torque factor of 0.5. Subjects controlled *power* output by themselves via the pedaling rate. Heart rate (Polar, Finland), *VO_2max*, ventilation and respiratory exchange ratio were measured during the 4th minute, and mean *power* (P mean) was also recorded.

** Young researcher award*

Work efficiency was calculated for both tests and groups of athletes.

Statistical Analysis. Values are presented as means ± SD. Two-tailed paired Student's t-test was used to evaluate differences between means. Simple Correlation Coefficients by Spearman and by Pearson were determined respectively for qualitative and for quantitative variables. P values < 0.05 indicate statistical significance. Programs used for statistical analyses were Excel and SPSS.

Results

The most important physical and physiological characteristics of the judo athletes and climbers analysed in the present study are summarised in Table 1. Parameters of upper body indicate submaximal values (during the 4th minute of the test), those of the lower body maximum values.

In Table 2 the most interesting results of the Pearson Correlation Test between the measured parameters are reported.

*Table 1. Judokas' and climbers' physical characteristics and physiological measurements. Values are means ± SD. Significant differences: * p<0.05 ** p<0.01 *** p<0.001. These parameters were measured during the 4th minute of the tests*

	Judokas (n=6)	*Climbers (n=7)*	t-test
Age (yrs)	25.2 ± 4.9	26.9 ± 5.5	
Height (cm)	176.5 ± 6.5	182.6 ± 5.5	
Body weight (kg)	77.5 ± 11.2	72.2 ± 9.0	
BMI (kg/m^2)	24.8 ± 2.7	21.6 ± 1.7	*
LBW (%)	87.1 ± 5.8	85.9 ± 4.9	
Body fat (%)	12.9 ± 5.8	14.1 ± 4.9	
Body water (%)	63.8 ± 4.3	62.9 ± 3.6	
UPPER BODY			
P max (W/kg)	2.75 ± 0.33	2.73 ± 0.28	
VO_2 (ml/min/kg)#	30.0 ± 3.5	39.4 ± 2.7	***
Work efficiency (%) #	15.8 ± 1.7	15.3 ± 1.3	
LOWER BODY			
P mean (W/kg)	3.95 ± 0.46	4.41 ± 0.29	
VO_2max (ml/min/kg)#	50.2 ± 6.4	58.0 ± 3.6	*
Work efficiency (%) #	22.5 ± 2.1	21.6 ± 1.4	
RATIOS			
P arms/legs (%)	69.6 ± 3.5	62.4 ± 9.5	
VO_2 arms/legs (%) #	60.0 ± 5.1	67.9 ± 1.9	**

*Table 2. Results of the Pearson Correlation Test: performance parameters of upper and lower body were correlated. Statistical significances: * p<0.05 ** p<0.01 *** p<0.001*

	UPPER BODY	
	P max (W/kg)	VO_2 (ml/min/kg)
LOWER BODY		
Judokas		
P mean (W/kg)	0.812 *** p<0.000	0.101 p<0.689
VO_2max (ml/min/kg)	0.637 ** p<0.004	0.574 * p<0.013
Climbers		
P mean (W/kg)	0.759 * p<0.048	0.658 p<0.108
VO_2max (ml/min/kg)	0.433 p<0.331	0.918 ** p<0.004

Discussion

Among the anthropometric parameters, the only one that differed markedly between the two groups of athletes was the BMI, being significantly lower among climbers. This trend may reflect different constitutional types.

The comparison between judokas and climbers showed that the latter group had nearly the same relative arm Pmax values as the judokas, but their oxygen uptake for reaching that performance was significantly higher. Also concerning the lower body there were significant differences between the two groups of athletes for relative *VO_2max*, without significant differences concerning mean *power*. In contrast to climbers, performance of judo athletes may depend more on *anaerobic* capacity. The better *aerobic* performance of climbers could probably be explained by their high volume of endurance training. Because of the higher VO_2 values during arm cranking among climbers, their VO_2 ratio between upper and lower body was significantly higher than that of the judo athletes.

In Figure 1 *VO_2max* values of judokas and climbers of the present study are compared with those of male adult athletes of different sports taken from literature. *VO_2max* values of judokas are placed in the lower third of *VO_2max* values of the presented sports, values of climbers in the middle third.

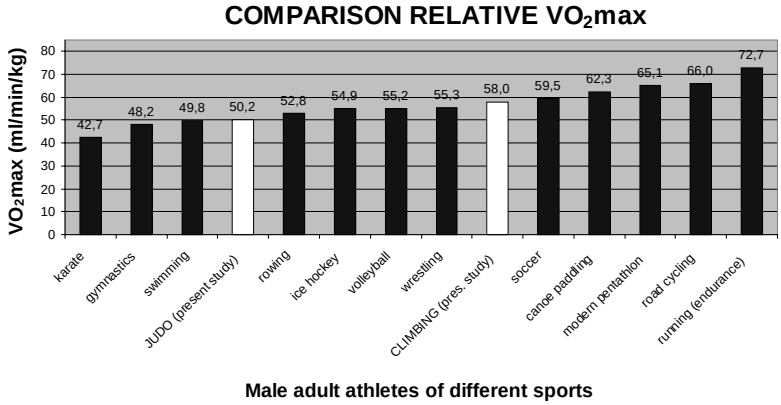

Figure 1. Comparison between VO_2max values of judokas and climbers of the present study and those of male adult athletes of different sports from literature.

The correlations between upper and lower body's physiological parameters of both groups of athletes reflected the general state of training of the whole body, since in judo as well as in climbing both upper and lower body are involved in determining the performance. A similar result was that of the athletes of the 1987 Canadian National Judo Team, among whom the physical work capacity with the arms (PWC_{170}) was significantly correlated with maximal *aerobic power* as determined from the treadmill *aerobic* test (Thomas *et al*., 1989).

Conclusion

The present study indicates that climbers may need a higher *aerobic* capacity than judo athletes. In contrast, we can assume that performance of judokas depends more on *anaerobic* capacity.

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CORRELATION BETWEEN VARIOUS TYPES OF SPEED IN 17 YEARS OLD BASKETBALL PLAYERS

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Abstract

The study was based on a sample of 56 Slovenian quality basketball players, aged 17, who were measured with eight tests by means of which the level of development and correlation between various types of speed were established.

The results of the research showed a high and statistically significant correlation between various types of speed in young basketball players. Of great interest is the finding that this is also true for movements which are not that similar in terms of co-ordination.

Key words: *Young basketball players, motor tests, speed, correlation*

Introduction

Basketball is a fast and dynamic ball game characterised by movements such as short sprints, abrupt changes of direction and rhythm (speed), stops, accelerations and quick responses (reactions) to the playing situation. Successful and efficient execution of all these movements is enabled by a psychomotor ability – speed.

As in other team ball games, speed in basketball is a complex ability as well. Generally, one could say that speed is an ability enabling a basketball player to move as fast as possible at a given degree of resistance. This movement may be acyclic or cyclic.

Speed is an ability that represents an important efficiency factor in basketball. A player who is not fast enough cannot succeed in modern top basketball. Players with well developed speed are capable of executing more efficiently the elements of the modern basketball technique and tactics. It is owing to the above and to hereditary determination that speed has become an important factor in selection of basketball players. It is taken into account already in the phase young boys and girls are directed to basketball and, certainly, in all subsequent selection phases.

In basketball, as well as otherwise, there are generally three basic types of speed: speed of reaction, acyclic speed and cyclic speed (Komi, 2003, Dežman, Erčulj, 2000; Čoh, Hofman, 2003). In the continuation, attention will be focused on cyclic speed.

The speed of repetitive movements i.e. cyclic speed depends on the ability of nerve centres which control the antagonist muscle groups (Dežman, Erčulj, 2000). These enable rapid passage from the state of stimulation to the state of slowdown and vice versa. Cyclic speed manifests itself most clearly in alternate movements of arms or legs, particularly when resistance is low. In basketball, such movements often occur in defence, when a defence player waves their arms so as to obstruct the passing of the ball.

Rapid repetitive movements with strong external resistance may be simple (e.g. fast running) or complex (e.g. fast ball dribbling). It also corresponds to speed of acceleration (and stopping). This ability enables us to give our entire body or part of it the highest acceleration or decline possible. In basketball it manifests itself in a rapid start from various positions, abrupt change of direction and immediate stopping.

Basketball movements are executed with and without the ball; therefore, in basketball, speed of movement is divided into that with ball and that without it. Of major importance is the speed of running with and without the ball (sprinting speed) which is also cyclic. It depends on the frequency of leg movement (movement of arms in ball dribbling), nerve–muscle co-ordination (quality technique) as well as rapid, explosive and maximum power (Dežman, Erčulj, 2000).

Fast transfers of ball from the defensive to offensive half (mostly in fast-breaks), starts of dribbling, dribbling against the defensive man, penetrations and some other (actually all kind of dribbling the ball) are movements requiring highly developed speed and agility with ball. Getting open, cutting, fast running to defence or offence, covering offensive player are those movements in which speed and agility without the ball come to the foreground.

In terms of co-ordination and technique, movement with the ball is more demanding than movement without it. Fast movement with the ball requires a very good technique of ball dribbling i.e. “controlling” the ball at a high speed. It may happen that a player who moves fast without the ball is much slower when in possession of the ball. This is particularly true for complex movements as well as for players with poor technique of movement with the ball (dribbling) at a high speed.

Some scientific findings show that the correlation between various types of speed is not strong, except in the case of those movements that are similar in terms of co-ordination (Dežman, Erčulj, 2000; Čoh, Hofman, 2003; Erčulj, 2004.) In basketball, various types of speed interweave and combine with endurance (speed endurance), explosive strength and co-ordination (ability to rapidly execute composite movements). It was owing to the fact that the latter is characterised by specific movement structure and speed structure that we wanted to establish correlation between various types of speed in basketball in this study. Contextually, we were particularly interested in the correlation between speeds of those movements that are similar in terms of co-ordination and those that are not.

Methods

The test sample included 56 basketball players (18 guards, 18 forwards and 14 centres). In 2003, 2004 and 2005, when the measurements were carried out, all players reached 17 years of age. They were all included in the comprehensive list of Slovenian national teams and were therefore the top basketball players of their age group in Slovenia. All players had at least four years' status of basketball players.

Eight measuring instruments were used in this study to assess various types of speed. Each test focusing on muscular activity and co-ordination of agonists and antagonists represented one of the predominant types of speed in real situations in basketball. The tests and norms for individual playing positions and different age categories are described in greater detail in the book Conditioning for Basketball (Dežman, Erčulj, 2000).

		test	ability
1.	S20	20-metre sprint [0.01 s]	speed of acceleration without the ball
2.	V20	20-metre dribbling [0.01 s]	speed of acceleration with the ball
3.	TSS	Running with changes of direction – 6 x 5 metres [0.1 s]	agility i.e. speed of changing direction 180^0 in simple movement without the ball
4.	VSS	Dribbling with changes of direction – 6 x 5 metres [0.1 s]	agility i.e. speed of changing direction 180^0 in simple movement with the ball
5.	TTP	Running, stance [0.1 s]	agility i.e. speed of changing direction 90^0 in composite movement without the ball
6.	HSM	Fast stepping on spot [no. of steps/10 s]	speed of simple leg movement
7.	PSE	Alternate passes of ball by throwing it against the wall [no. of passes/15 s]	speed of passing
8.	VRV	Various dribbling [0.1 s]	speed of composite movement with the ball

The results of individual tests were measured with manual stopwatch (TSS, VSS, TTP, HSNN, VRV) or electronically by means of photocells (S20, V20). In the HSM test, foot touch-downs (steps) were recorded with the ERGO TESTER device (Globus Italy), which is otherwise designed for measuring take-off contact time. In the PSE test, we recorded the number of passes by throwing the ball against a wall in 15 seconds.

The collected data were processed by means of a statistical computer software SPSS for WINDOWS. For all variables the following was calculated: basic statistics, Kolmogorov–Smirnov test for normality of distribution and Pearson's correlation coefficient.

Results

The basic parameters of descriptive statistics were first calculated for all variables and the Kolmogorov–Smirnov test was carried out to establish normality of distribution.

Table 1. Descriptive Statistics and One-Sample Kolmogorov–Smirnov test

	Minimum	Maximum	Mean	Std. Deviation	K-S Z	Sig.
S20	294	360	325.24	15.125	.848	.468
TSS	77	101	84.96	5.333	.822	.509
TTP	86	113	97.58	6.344	.743	.639
HSM	42	72	59.93	5.805	.524	.946
V20	296	395	341.02	19.237	.645	.799
VSS	78	104	87.73	6.305	1.045	.224
VRV	102	133	115.29	6.671	1.102	.176
PSE	72	98	84.56	6.837	.746	.634

As the sample mainly consists of variables from special tests of speed (these are practically nonexistent in foreign literature), the achieved results may be evaluated and compared only to the results of domestic research (Erčulj, 1998). In

view of the above and the norms that were established on the basis of testing of quality Slovene male basketball players over many years (Dežman, Erčulj, 2000), the level of development of various types of speed is considered to be quite high.

The results in Table 2 show that the values of all variables are distributed normally, which facilitates further processing of data.

In the continuation Pearson's correlation coefficient was used to establish correlation between individual tests i.e. types of speed for the selected sample of tested players.

*Table 2. Pearson correlation between variables and 2-tailed significance**

	S20	TSS	V20	VSS	VRV	PSE	HSM	TTP
S20	1	.662	.878	.693	.661	.477	-.592	.563
		.000	.000	.000	.000	.000	.000	.000
TSS	.662	1	.680	.881	.813	.449	-.557	.653
	.000		.000	.000	.000	.001	.000	.000
V20	.878	.680	1	.753	.686	.449	-.588	.472
	.000	.000		.000	.000	.001	.000	.000
VSS	.693	.881	.753	1	.815	.452	-.639	.581
	.000	.000	.000		.000	.001	.000	.000
VRV	.661	.813	.686	.815	1	.590	-.626	.734
	.000	.000	.000	.000		.000	.000	.000
PSE	.477	.449	.449	.452	.590	1	-.511	.591
	.000	.001	.001	.001	.000		.000	.000
HSM	-.592	-.557	-.588	-.639	-.626	-.511	1	-.541
	.000	.000	.000	.000	.000	.000		.000
TTP	.563	.653	.472	.581	.734	.591	-.541	1
	.000	.000	.000	.000	.000	.000	.000	

* All correlations are significant at the 0.01 level (2-tailed).

Table 2 shows that all correlations between individual variables (types of speed) were statistically significant at 0.01. Correlation coefficients ranged from 0.449 (TSS – PSE, V20 - PSE) to 0.881 (VSS – TSS). The lowest average correlation with all other variables may be seen in the PSE variable (0.502) and the highest in the VRV variable (0.703).

Discussion

As regards correlation between the test for measuring the speed of arm movement i.e. ball passing (PSE) and the rest of the tests for measuring the speed of leg movement, the following may be established. The correlation between the PSE test (speed of passing) and other tests is high and statistically significant, despite the fact that the former is quite different from the latter in terms of movement and co-ordination structure. But is also true that the lowest average correlation with all other variables may be seen in the PSE variable (0.502). The degree of correlation with other tests does not differ much, ranging from 0.45 to 0.59.

Correlation between the tests measuring the speed of acceleration with the ball and without it (V20 and S20) is expectedly very high, in spite of the fact that in the test involving ball dribbling (S20) co-ordination is more demanding. Similar was observed in correlation between the VSS and TSS tests, namely, agility with the ball and without it. In both cases correlation is higher than 0.87. It may hence be concluded that those players who are moving fast without the ball are most often moving fast with the ball, too. In our opinion this is probably true for players playing on outside positions (guards and forwards) and less for extremely high players and/or centres.

Correlation between the tests measuring speed of movement (running) with ball (V20, VSS and VRV) is high and statistically significant in all cases. Regardless of the differences in co-ordination level and complexity of movement (in this respect the VRV test is particularly distinctive) the correlation coefficients between the above mentioned tests are very equalized, ranging between 0.69 and 0.81.

Correlation between the tests measuring speed of movement (running) without the ball (S20, TSS, TTP, HSM) is quite high in all cases. In spite of the fact that the remaining tests measure primarily other types of speed and some other abilities, correlation between the aforementioned four tests is statistically significant and ranges between 0.54 and 0.66.

The results of the research showed a high and statistically significant correlation between various types of speed in young basketball players. Of great interest is the finding that this is also true for movements which are not that similar in terms of co-ordination, seeing that some other authors (Dežman, Erčulj, 2000; Čoh, Hofman, 2003, Erčulj, 2004) came to different conclusions. Nevertheless, it has to be pointed out that these researches were carried out on the samples of female basketball players (Erčulj, 2004), athletes of other sports (Čoh, Hofman, 2003) or general population (Dežman, Erčulj, 2000).

To some extent this specific structure of correlation between various types of speed in young basketball players may probably be attributed to specific morphological and motor status of basketball players. Here we have in mind primarily the extremely high players (centres) whose speed as well as other motor abilities are usually less developed (Erčulj, 1998) and who are selected mostly on account of their height and less their motor abilities and/or speed.

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DIFFERENCES IN VOLUME AND INTENSITY OF LARGE-SCALE CYCLIC MOVEMENTS BETWEEN CADET MEN, JUNIOR MEN AND SENIOR MEN IN TEAM HANDBALL

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Abstract

The aim of this study was to identify differences in the volume and intensity of large-scale cyclic movement activities performed by handball players. The sample consisted of 84 players (average age 20.26 ± 4.28 yrs; average height 182.51 ± 6.59 cm; average body mass 80.61 ± 10.37 kg) and was divided into three sub-samples by age (cadet men, junior men and senior men). For this purpose six experimental model matches (2x20 min), were analyzed. The collection of large-scale cyclic movement's data was based on the computer-aided automatic tracking method SAGIT (Ljubljana, Slovenia). There were statistically significant differences between different age categories in terms of volume of the total distances walked and run during the matches as well as in intensity of large-scale cyclic movement. In view of different age categories of handball players, we expected some differences in analyzed variables, as the athletes belonging to older categories are biologically more mature and are subjected to functional training for a longer time. That reason enables them to perform more large-scale cyclic activities during a match and spend a higher percentage of time in higher speed classes.

Key words: *team handball, time and motion analysis, age categorie*

Introduction

The intensity and volume of work-rate or loading in handball are very heterogeneous. In a handball match acyclic (intermittent) activities (passing the ball, various kinds of shots, jumps, etc.) occur along with the player's cyclic movements (running, walking, moving sideways, etc.). In handball loading of players is a combination of both, cyclic movements and acyclic activities. Therefore, during the course of play, work-rate of loading, which may vary in intensity and volume, alternates continuously with periods of relative rest, i.e. standing or slow walking. The large-scale cyclic movements are fundamental because they allow the player to move across the court area in two dimensions. They include walking and running without a ball as well as dribbling the ball when walking or running (Bon, 2001, Šibila 2004). The type, volume and intensity of movements can be observed by time-motion analysis. Numerous studies have used time-motion analysis to access the demands of soccer players and referees (Ali & Farraly, 1991; Krunstrup & Bangsbo, 2001), rugby players (Coutts, Reaburn & Abt, 2003) and other sports. Also in team handball in recent years the researchers have tried to analyze the volume and intensity of large-scale cyclic movements of handball players by using different methods and samples (Al – Lail, 1996; Cuesta, 1988, in Cardinale, 2000; Bon, 2001). The aim of our study was to identify differences in the volume and intensity of large-scale cyclic movements performed by the players of three age categories – cadet men (aged between 15 and 17 years), junior men (aged between 17 and 20 years) and senior men (aged 20 years or over).

Materials and methods

The sample of subject consisted of 84 male handball players of twelve teams (average age 20.26 ± 4.28 yrs; average height 182.51 ± 6.59 cm; average body mass 80.61 ± 10.37 kg) and was divided into three sub-samples by age – cadet men (average age 16.14 ± 0.76 yrs; average height 178.82 ± 6.74 cm; average body weight 73.86 ± 12.99 kg), junior men (average age 19.29 ± .98 yrs; average height 181.93 ± 5.90 cm; average weight 81.07 ± 7.11 kg) and senior men (average age 25.36 ± 3.03 yrs; average height 186.79 ± 4.45 cm; average weight 86.9 ± 86.89 ± 4.78 kg). The data on work-rate of loading of male handball players during a match were collected from six model matches in the categories of cadet men, junior men and senior men. In each category two matches were played and analyzed, i.e. four teams were observed. In all the matches certain environment conditions were standardized: the playing time for all the games was 2 times 20 minutes, all the teams played 5-1 zone defense, the selected players had to play the entire game, and a one-minute team time-out was not allowed.

The sample of variables included the ones pertaining to the large-scale cyclic movements by definition. We established the volume (duration) of all cyclic movements and percentages of time spent in particular speed classes. The intensity of large-scale cyclic movements was divided into four speed classes according to the speed of performance (Table 1).

Table 1. The variables used for the evaluation of volume and intensity of the cyclic movements in a handball match.

VARIABLE	DESCRIPTION OF VARIABLE	UNIT
S (distance)	Total of all distances run/or walked in a match	m
First speed class (1stSC)	Percentage of time spent in the 1stSC (distances run/or walked at speed up to 1.4 m/s	%
Second speed class (2ndSC)	Percentage of time spent in the 2ndSC (running at speed of 1.4 to 3.4 m/s)	%
Third speed class (3rdSC)	Percentage of time spent in the 3rdSC (running at speed of 3.4 to 5.2 m/s)	%
Fourth speed class (4thSC)	Percantege of time spent in the 4thSC (running at speed above 5.2 m/s)	%

The collection of data on the large-scale cyclic movements of players in handball match was based on computer-aided automatic tracking method with the SAGIT (Ljubljana, Slovenia) system (Perš, Bon, Kovačič, Šibila, & Dežman, 2002). The output data on large-scale cyclic movements obtained from the SAGIT program were processed by the selected descriptive statistics methods. The differences in the volume and intensity of large-scale cyclic movements were established by a multi-factor analysis of variance.

Results

Table 2 shows the absolute values of all the distances walked and run during the matches played and the percentages of time the players of different age categories spent in individual speed classes. The senior men achieved the greatest volume of movements, as well as the highest intensity of movements in the 3rd and the 4th speed classes. According to the volume of movements, then follow the groups of junior men and cadet men. Cadet men achieved the highest average percentage of movement in the 1st speed class.

Table 2. Volume and intensity of large-scale cyclic loading of players regarded to different age categories.

	CADET MEN	JOUNIOR MEN	SENIOR MEN
TRD	3055 ± 465 m	3300 ±275 m	3505 ±285 m
1stSC	67%	62%	60%
2ndSC	23%	23%	21%
3rdSC	8%	12%	15%
4thSC	2%	3%	4%

TRD – total run distance; 1stSC - first speed class; 2ndSC - second speed class; 3rdSC - third speed class; 4thSC - fourth speed class.

The results of analysis of variance in the Table 3 showed, that there were statistically significant differences between the cadet men, junior men and senior men in terms of volume of the total distances run (p = .000) and the percentage of time in the first, third and fourth speed class (p = .000). It was only in percentage of time in the second speed class, that there were no statistically significant differences (p = .673).

Table 3. Analysis of variance of total run distance, the percentage of run distances in individual speed classes (HRs) and average speed of movement by category

	F	p
TRD	20.268	.000
1stSC	11.669	.000
2ndSC	.399	.673
3rdSC	23.832	.000
4thSC	41.495	.000

TRD – total run distance; 1stSC - first speed class; 2ndSC - second speed class; 3rdSC - third speed class; 4thSC - fourth speed class, F – coefficient F, p – statistical significant of coefficient F.

Discussion

After analyzing volume and intensity of large-scale cyclic movements, we can establish that there exist differences between three age groups of players during handball matches. The senior men achieved the greatest volume of movements, as well as the highest intensity of movements in the 3rd and the 4th speed classes. According to the volume of movements, then follow the groups of junior men and cadet men.

In view of the fact that the defense model was standardized (5-1 zone defense) and that the players in the phase of attack or defense were on specified playing positions, the possibility that these differences resulted from tactical characteristics of both teams playing was excluded. We presume than the principal reason for these differences lies in the player's capability of preserving a certain level of intensity. This is also proven by the fact that the difference between the distances run and walked by the senior-men teams in both halves was only 55 meters, while the relevant difference in the cadet category was 170 m.

Comparing our result with the Bon (2001), we can find similar share of total work-rate as well as intensity speed classes during games, especially if we take in to consideration that we used in our study the same methodology (SAGIT system) for collection and analyzing as Bon.

In view of different age categories of handball players, we expected some differences in analyzed variables, as the athletes belonging to older categories are biologically more mature and are subjected to functional training for a longer time. That reason enables them to perform more large-scale cyclic activities during a match and spend a higher percentage of time in higher speed classes. Cadet men, being the youngest, differed from junior men and senior men in all of the discussed variables, except in the second HR. We can foresee, that on of the reasons for this is probably also influence of maturity-associated variation in growth and physical activity of our sample (Malina & Bouchard, 2004).

Of course it stands to reason that cyclic activities constitute only a part of comprehensive game loading of handball players. Besides running at various intensities and of different duration (walking, jogging, cruising, sprinting, moving side-ways), handball players have also to perform many acyclic activities such as: shots at goal, jumps, passing the ball, dribbling, falls and standing ups. As a rule, these activities are carried out with high intensity and represent a substantial share of the player's work-rate in the match. Therefore, highly intensive running in the 3rd speed class (SC), and particularly the 4th SC) is just one segment of the highly intensive loading in a handball match (Šibila, Vuleta & Pori, 2004). In view of the modern model of handball, which has been substantially conditioned by a change of rules, it may be concluded that the time during which the players are subject to low- intensity loading has to be reduced. Already with cadets the training methods have to include a large number of highly intensive activities of both large-scale cyclic and acyclic types. The volume of less intensive cyclic movements has to be reduced and these should only be used as relative break.

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DIFFERENCES IN MOTOR ABILITIES BETWEEN YOUNG-SENIOR AND CADET FEMALE BASKETBALL PLAYERS

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Abstract

Training-status diagnostics are one of the fundamental activities used in order to improve basketball efficiency. At the beginning of preparation period for the 2004 European Championships cadet (N=13) and young-senior (N=12) female basketball teams were tested with eight tests to determine their motor abilities. The results of this research show us that the cadet basketball players were better in 4 of the 8 tests of motor abilities (explosive leg power, flexibility, acceleration and cyclic speed, and agility). Young seniors showed better results in tests of explosive arm power, repetitional trunk strength, repetitional arm strength, and short-term anaerobic power. A cadet training program must focus towards improvement of the relative upper body strength and core stability in order to ensure proper efficiency in order to successfully enter the young-senior age category.

Key words: *Age category, national team, team game, success, condition.*

Introduction

In order to plan and control an effective training program for elite female basketball players, insight into their actual motor functioning knowledge and conditioning abilities is needed. Training-status diagnostics are the fundamental activities used in order to improve basketball efficiency (Milanović, 1997), for the purpose of our study, the tests focused on motor abilities. This research was conducted in July 2004 in order to determine the differences between the initial motor abilities of 12 members of the Croatian young-senior team (year of birth: 1984/85) compared to 13 members of Croatian cadet team (year of birth: 1988/89) at the beginning of preparation for the 2004 European Championships. The 14 to 16 year old cadet basketball players are an especially interesting group because they are in between the puberty and post-puberty phase of their development. While the young-seniors (21 and under), represent the age for optimal sports achievement (Bompa, 2000). Training programs for different age groups must take into consideration growth dynamics, i.e. not only chronological age but also biological age. Both groups of players were evaluated with 8 tests in order to determine their motor abilities (table 2-tests and abilities).

Methods

The sample consisted of 12 members of the Croatian young-senior team compared to 13 members of Croatian cadet team at the beginning of preparation for the 2004 European Championships. Variable sample consists of tests used to determine their motor abilities: SAR-Explosive leg power, BLG-Explosive arm power, S&R-Flexibility, M 20-Acceleration and cyclic speed, Y 20-Agility, TRB 30-Repetitive trunk strength, SKL-Repetitive arm strength and SMB-Short -term Anaerobic power.

The results of motor ability tests of the investigated female groups were processed using descriptive statistics parameters (mean and standard deviation) and canonical discriminant analysis which determined if there is statistically significant difference in motor abilities between 12 members of the Croatian young-senior team and 13 members of Croatian cadet team.

Results

The results of Bartlett Chi-Square Test (Table 1) show that analyzed discriminant function significantly differs cadet and young-senior teams at the 0,01 level of statistical significance with the canonical correlation of 0,65, so it can be concluded that 10 test used to asses the motor abilities show the differences between cadet and young – senior teams.

Table 1. Chi-Square Tests/successive roots

Chi-Square Tests with Successive Roots Removed						
	Eigen-value	Canonical R	Wilks' Lambda	Chi-Sqr.	df	p-level
0	0,74	0,65	0,57	90,68	13,00	0,00

Eigenvalue – the discriminant function value, Canonical R – canonical correlation coefficient (discriminant), Wilks' Lambda – Wilks' Lambda value for each discriminant function, Chi-Sqr – value of Chi – Sqr test for the testing of discriminant function significance, Df – degrees of freedom on basis which the testing was performed, P – level – proportion of error made by accepting the hypothesis that the difference is statistically significant

Table 2. Results of motor tests and the abilities they measure: descriptive statistics, Discriminant Factor Structure Matrix, F-test and centroids of groups

Tests	YS MEAN	YS SD	K MEAN	K SD	Abilities	Root 1	p-level (F-test)
SAR	37,67	5,49	38,77*	3,56	Explosive leg power	-0,08	0,61
BLG	9,41*	0,73	9,2	0,56	Explosive arm power	0,10	0,75
S_R	12,46	4,49	13*	8,39	Flexibility	-0,03	0,12
M20	3,56	0,21	3,54*	0,12	Acceleration and cyclic speed	0,04	0,66
Y20	5,14	0,36	5,01*	0,15	Agility	0,16	0,36
TRB30	29,75*	3,14	28,23	3,3	Repetitive trunk strength	0,15	0,27
SKL	19,17*	7,86	7,31	5,01	Repetitive arm strength	0,57	0,00
SMB	30,88*	1,26	32,14	2,11	Short -term Anaerobic power	-0,23	0,34
					Centroids of group	DF1	
					Cadet	-1,52	
					Young seniors	1,65	

The results of this research show us that the cadet basketball players were better in 4 of the 8 tests of motor abilities (explosive leg power, flexibility, acceleration* and cyclic speed*[1], and agility). Young seniors showed better results in tests of explosive arm power, repetitive trunk strength, repetitive arm strength, and short-term anaerobic power.

Discussion

In order to appropriately interpret these results, we must take into consideration other factors, specifically the timing of test-taking as it relates to the athletes' competition schedule. While it was expected that the young seniors would excel in all 8 tests, the reason that the cadets were better in 4 tests could be due to the fact that the tests were taken during the Cadets' peak performance training stage. The Cadets had just finished the Croatian Cadet Championships (or Junior Championships), while the Young seniors, on the other hand, ended their competition almost 2 months prior to testing. Determined differences could be the result of young-seniors experiencing a post-competition training recovery process which results in a decrease, first, in speed and agility, next in strength, and finally in endurance (Bompa, 2000).

Regardless, results of F-test (table 1, p-level of F-test) show statistical significance only in the SKL test, which measures repetitive arm strength. There were no significant differences between groups in other tests. The results of canonical discriminant analysis (Root 1) similarly show that the greatest differences between young seniors and cadet female basketball players was also in the in SKL test.

Results of this research show the importance of differentiating the planning and programming of the conditioning training of elite female basketball players according to their growth dynamics. A cadet training program must focus towards improvement of the relative upper body strength and core stability in order to ensure proper efficiency in order for them to successfully enter the young-senior age category.

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[1] *M20 and Y 20 are the negligible tests.*

ONE YEAR MARTIAL ARTS TRAINING EFFECTS ON SOME ANTHROPOLOGICAL CHARACTERISTICS OF 12-YEAR-OLD BOYS[1]

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Abstract

This paper defines the differences after a one-year training process in children who train Martial arts at the ages of 11 and 12. The sample of participants consisted of 49 boys in Martial Arts (17 judokas and 32 wrestlers) from different clubs in Croatia who were tested at the beginning and at the end of a one-year training process. The anthropological status was measured by an array of 16 tests. After one year's training period participants achieved statistically significant improvements in almost all variables for evaluating anthropological status.

Key words: *differences, martial arts, motor abilities, functional abilities, training process*

Introduction

Martial arts belong to the group of poly-structural sporting activities, in which dynamic and complex structures of a-cyclic characteristics are dominant. The goal of a bout is the symbolic destruction of an opponent, and the result is a binary variable, win and a loss. To win one must use different technical and tactical structures most appropriate for the momentary situation.

Bouts in martial arts are characterised by great variability, which comes from the characteristics of an opponent, situations, posture (on the ground or in standing position), category and many other factors. Because of this, a large number of technical and tactical variants have been developed to solve these situations. The training process must engage all abilities and characteristics necessary and responsible for positive result in martial arts. Long-term and complex training will enable the development of an athlete with the goal of achieving best results.

This paper interprets the differences after one year of training period in Martial arts of children between the ages of 11-12. Under the terms "Wrestling sports" and "Martial arts" judo and wrestling are considered, whose athletes were tested in this research.

According to Bompa (2000), the best time to start practicing martial arts is between the ages of nine to twelve, and the average age of these athletes at the Olympic Games is twenty four. Bompa classifies the age of our participants in the age best for starting to form our athletes and puts the emphasis on the necessity of developing flexibility, coordination, balance and general strength. Also, it would be good to introduce athletes with moderate anaerobic training.

According to Milanović (2004) children athletes must be incorporated into the methodical training process as part of elementary school sport when they reach the age of 10 and 11. This period means the beginning of directed sport-motor development and sport specialization. Training characteristics in that period should include learning the basics of techniques and tactics, all-round training, starting with competitions, further developing of functional and motor abilities with a special accent on coordination, balance, speed and space orientation.

As well as respecting scientific acknowledgements about sensitive phases in developing athletes, coaches should acknowledge the hypothetical equations of specification for particular sports. By these equations, for success in judo, the following factors have a big influence: strength (22%), coordination (15%), functional abilities (15%), speed (12%), flexibility (8%), balance (8%) and cognitive characteristics (20%) (Sertić, 2004; according to Sertić and Lindi, 2003). In wrestling the order of significance is: endurance (25%), strength (30%), coordination (15%), speed (15%), balance (10%) and flexibility (5%) (Sertić, 2004; according to Marić, Baić and Aračić, 2003).

Methods

The sample of participants consisted of 49 boys active in Martial Arts (17 judokas and 32 wrestlers) from different clubs in Croatia who were tested at the beginning and at the end of one year's training period. Boys in judo had trained 41.71 months in average and had an average of 3.09 training sessions per week. Wrestlers had trained 16.02 months in average and had an average of 3.13 training sessions per week. Training goals were development of basic motor and functional abilities and basics of techniques and tactics. In the first part of the training session main exercises were basic

[1] *This paper is part of science-research project "Observations of changes in anthropological status of children in wrestling sports" (code: 0034214), approved by Ministry of Science and Technology Republic of Croatia.*

exercises for development of speed, coordination, power, flexibility, core stability and relative strength. Second part of the training consisted of specific exercises and learning the basics of technique and tactic. Every training session lasted for 60 minutes. Beside training sessions, boys also attended physical education classes in school, which took place twice a week for 45 minutes.

For this research a battery of 16 tests was used. Anthropometrical characteristics were assessed with: body height (ATV), body weight (ATT), latitude of forearm (AOP), triceps skinfold (ANN).

Motor abilities were evaluated with variables for assessment:

1. coordination; agility on the ground (ONT), side steps (KUS), polygon backwards (MPN)
2. strength and power: long jump from standing position (MSD), push ups in 60 seconds (SKL 60), sit-ups in 60 seconds (MPT60), squats in 60 seconds (CUC60), hang time (MIV)
3. flexibility: sit and reach with legs apart (MPR)
4. speed of movement: tapping with hand (MTR)
5. specific endurance: throw and two push ups in 90 seconds (BAC2SKL90).

For assessing functional abilities 6 minutes running (F6) test was used.

The results are analysed with the Statistica 6,1 program for Windows. For testing differences between the same group of participants who were tested two times, at the beginning and at the end of the training process, the t-test for dependent samples was used.

Results

Table 1. Mean values of participants on tests and their differences between 1. and 2. measurement

VAR	Means	Std. Dv.	N	Diff.	Std. Dv. Diff.	t	df	p-level
ATV	150,852	7,2263						
ATV2	158,231	7,1917	42	-7,38	3,7928	-12,608	41	0,000000
ATT	42,021	8,4529						
ATT2	48,755	10,6633	42	-6,73	4,2148	-10,353	41	0,000000
AOP	21,418	1,9087						
AOP2	22,337	1,8907	49	-0,92	1,0317	-6,231	48	0,000000
ANN	13,048	6,5807						
ANN2	12,422	6,5806	49	0,63	3,3261	1,317	48	0,194047
ONT	21,220	3,8589						
ONT2	19,853	4,4831	35	1,37	2,3541	3,437	34	0,001570
KUS	11,548	0,9543						
KUS2	10,563	0,8847	36	0,99	0,9868	5,991	35	0,000001
MPN	14,352	2,9932						
MPN2	12,699	2,7234	48	1,65	2,0754	5,520	47	0,000001
MPR	52,302	10,6795						
MPR2	53,588	10,2179	49	-1,29	8,4599	-1,064	48	0,292597
MSD	169,612	16,8662						
MSD2	182,054	19,7009	49	-12,44	11,6069	-7,504	48	0,000000
MTR	26,893	2,4749						
MTR2	28,926	2,5054	45	-2,03	2,6859	-5,078	44	0,000007
MIV	30,200	19,0911						
MIV2	41,816	26,8721	49	-11,62	17,8557	-4,554	48	0,000036
MPT60	38,913	6,6327						
MPT602	43,587	8,1147	46	-4,67	8,5324	-3,715	45	0,000559
BAC2SKL90	12,206	2,6943						
BAC2SKL902	11,941	2,6736	34	0,26	3,1267	0,494	33	0,624826
SKL60	19,529	9,9977						
SKL602	28,382	12,4997	34	-8,85	13,2896	-3,884	33	0,000467
CUC60	45,971	8,3248						
CUC602	49,176	7,2047	34	-3,21	10,2773	-1,819	33	0,078012
F6	1092,028	110,7459						
F62	1216,361	122,3760	36	-124,33	139,3030	-5,355	35	0,000005

Legend: Means-arithmetic means; Std.Dv.-standard deviation of first and second measurement; N-number of entities; Diff.-difference of arithmetic means; Std. Dv. Diff.-standard deviation of difference of results from first and second measurement; t-value of t-test; df-degrees of liberty df=n-1; p-level of significance; VAR-variable

The results in table 1 show that differences occurred in all tests, and statistically significant difference was found in 13 of 16 tests. If the area of anthropometrical characteristics is analysed it can be seen that a statistically significant difference occurred in the variables body height (ATV), body weight (ATT), latitude of forearm (AOP), and in the variable triceps skinfold (ANN) a difference was also recorded but wasn't statistically significant.

The motor abilities also recorded significant changes. Statistically significant changes were noticed in all variables except in the variables sit and reach with legs apart (MPR), throw and two push-ups in 90 seconds (BAC2SKL90) and squats in 60 seconds (CUC60).

The participants achieved statistically significant changes in test 6 minutes running (F6) which evaluates functional abilities.

Discussion

It can be concluded that training has positive effects on the anthropometrical status of participants. Training doesn't influence body height. It is influenced by normal growth and development, however by increasing the weight and latitude of the forearm positive changes in muscle mass are noticed, which is, in a great amount, consequence of the organised training. Statistically insignificant differences in the results of triceps skinfold indicate slower changes in anthropometrical status of participants in dimensions of body fat.

If the anthropometrical characteristics are evaluated one must always have in mind that they describe actual morphological status of the athlete - they are the result of heritage and adaptation on different influences, mainly training and nutrition (Mišigoj-Duraković, 1997.).

It is logical to expect greater changes in the anthropological status of participants later in sport career, when the volume of training will be higher because of increased intensity, frequency and duration of training session. That type of work should contribute faster changes in anthropometrical status of the athletes.

Test sit and reach with legs apart (MPR) evaluates flexibility and it is noticed that it doesn't increase at such a level like it would at a younger age. The process of ossification had an influence in slowing down improvements of flexibility, and as flexibility isn't the most important ability for success in these martial arts, it doesn't play a very important role in training process. The results on the test throw and two push-ups in 90 seconds (BAC2SKL90) are also advancing on positive scale. This test requires well-developed specific endurance and as it isn't main goal of training at this age, changes can't be so obvious.

The fact that laboratory research indicates that specific training improves adaptation and learning specific techniques, doesn't mean that it must be the main objective from the early age. Basic and multilateral training that comprises development of all abilities will lead to enhanced performance in later stages. Specific training should start after the athletes develop good basic abilities (Bompa, 2000.).

The same explanation, as in test throw and two push-ups in 90 seconds (BAC2SKL90), applies for test squats in 60 seconds (CUC60) for evaluating leg strength. The development of strength and endurance will be the main goal of training later in sport career.

Variables in which statistically significant changes are noticed all represent variables of coordination, variables for evaluating power, static force, relative repetitive strength of trunk and hands and speed of movement variables. With tests: agility on the ground (ONT), side steps (KUS), backwards polygon (MPN) these types of coordination are estimated: specific coordination, agility, body coordination. Significant changes point towards a training process done according to the rules for this age where coordination must be the primary goal.

Sertić and others (1999) carried out research on a sample of 100 children of the age of 11, on the influence of coordination on success in judo bouts. Statistically significant correlation was recorded between the mentioned variables with the help of regressive analysis.

Although strength isn't the first ability to be trained at this age, some types of strength show significant changes. Results of tests MSD-long jump from standing position, for evaluating power, push ups in 60 seconds (SKL 60), for evaluating strength of arms, (MPT) sit ups, for evaluating trunk strength and hang time (MIV) for evaluating static force, record statistically significant changes. Important changes in the strength of arms (static and dynamic), versus lower improvement of leg strength, reflect the way of fighting at younger ages. Children of that age base their bouts, except on coordination, on strength of arms, which are extremely active in movements of pushes, pulls, and squeezes.

Strength measuring tests have the largest contribution, especially those regarding the strength of arms and shoulders, together with the coordination test. (Banović, 2001.)

They rarely use legs because of low level of technical and tactical skills, which occur in later stages of sporting development. Trunk muscles also play an important role as synergists and stabilization factors in all movements in martial arts.

Improvement of power in the long jump test from a standing position is explained by the improvement of coordination, and the right use and direction of forces.

Speed of movement is evaluated by the MTR - hand tapping test. In that test statistically significant difference in results occurs. One can conclude that this is the consequence of intra and inter muscular coordination, in part because of training and in part as the result of growth and development. Researches show that by comparing the population of non-athletes, the martial arts population doesn't have better results.

Variable F6 shows changes in functional abilities, which occurred under an organised one-year training process. With the 6 minutes running test the aerobic abilities of an athlete are estimated. This type of functional training must be dominant at this level. That approach will provide the creation of wide basis on which, in later phases of development, one can build other types of functional abilities (anaerobic glycolitic and phosphate endurance). If one fails to develop aerobic capacities at this age that can have negative influence on later development and limit our athletes. Beside, athletes at this age aren't capable of handling stresses of the anaerobic type because of insufficiently developed mechanisms for the removal of lactic acid and a low level of enzymes that mediate in the anaerobic breaking down of glucose, which leads to a reduction in the creation of pyruvic acid.

With the help of the training process, defined as a long-term organised process of exercise, it has been proven that one can develop all abilities and characteristics. Boys from martial arts at the age of 11, exposed to a one-year training process, achieved statistically significant improvement in almost all tests. Anthropometrical characteristics are also changed under the influence of growth and development, but training enables right path and speed of these changes. Values of results in motor abilities of participants show statistically significant changes in almost all tests apart from tests: strength of legs, specific test - throw with two push ups and in flexibility test. With correctly planned and programmed training process the abilities of young fighters that must be obtained at this age (coordination, speed and flexibility) are developed. With training process that is focused on aerobic functional abilities wide base is developed for later improvement of anaerobic abilities (glycolytic and phosphate). Seeing as this research didn't include a reference group, we cannot be 100% certain that the attained results are exclusively the product of training. However, numerous researches that obtained similar results, certainly point to such a conclusion.

Baić and others (2001) followed the results of tests done to assess motor abilities and aerobic and anaerobic capacity and anthropometrical characteristics of 12 and 13 year-old wrestlers in a six-month cycle. It was established that statistically significant changes occurred in results for one variable used to gauge anthropometric characteristics, size of forearm, and three variables used to assess motor abilities, static strength, coordination and flexibility.

Vračan and others (2004) used an array of 11 tests to estimate the anthropological status of 86 boys aged 11. Out of that sample, 41 boys trained judo and 45 of them didn't take part in organised sport. The analysis of the different arithmetic means by using the t-test was used to establish a statistically significant advantage in favour of the judokas in the variables used to assess repetitive strength, flexibility and aerobic and anaerobic capacity.

So it can be presumed that a one-year training process in children who practice martial arts enables the development of all needed functional and motor abilities and creates a good base to continue the work that would ensure quality results at a later age.

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CHANGES IN CERTAIN ANTHROPOLOGICAL CHARACTERISTICS OF BOY WRESTLERS AFTER A ONE-YEAR TRAINING PERIOD

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Abstract

In this paper, the differences that occurred in boy wrestlers between the ages of 11 and 12 due to a one-year training cycle were interpreted. The sample of examinees comprised of 32 boy wrestlers from 9 different Croatian clubs, all of who were tested initially, before the one-year training cycle, and transitively, after its completion. The anthropological status of the afore-mentioned boys was assessed with an array of 16 tests and, after a one-year training period, the examinees achieved a significant improvement in almost all of the variables (10) used to determine one's anthropological status. Changes were registered in variables representing coordination, power, motion frequency and static force, while there was no improvement in variables representing body flexibility and repetitive strength.

Key words: *differences, wrestling, anthropological characteristics, training cycle*

Introduction

Wrestling is a contact sport that, by definition, falls under the category of poly-structural sporting activities. High variability and complexity makes it a unique and dynamic sport. Wrestlers undergo a lengthy and complex training process, which aims to develop a wide spectre of anthropological characteristics that enable the attainment of great sporting feats. This paper has been written as part of a project named "Following changes in the anthropological status of children in wrestling sports"[1] and interprets the differences recorded in boy wrestlers between the ages of 11 and 12 after a one-year training period. Already, as part of the project[1], papers have been published that interpret the differences between boy wrestlers, boys who practice judo and untrained boys, where it was shown that wrestlers and judoka's have a significant advantage over untrained boys in regard to the tested anthropological characteristics.

Cvetković and others (2004) conducted tests on a sample comprised of 97 schoolboys in 5th grade; all of them were 11 years old (+/- 6 months). Out of the sample, 52 boys were wrestlers while 42 didn't take part in organized sporting activities. The results showed that boy wrestlers achieved better results in almost all of the variables estimating their anthropological status.

Sertić, Đapić and Baić (2004) conducted tests on a sample of 100 schoolboys in 5th grade; all of them were 11 years old (+/- 6 months). Out of the sample, 59 boys were wrestlers while 41 of them were judokas. An array of 11 tests was done to gauge their anthropological characteristics, motor and functional capabilities. The tests showed that wrestlers differ from judokas in 5 variables: size of forearm, triceps skinfold, hand tapping, the backwards polygon and the sit and reach with legs apart.

Methods

The sample of examinees comprised of 32 boy wrestlers, from 9 different Croatian clubs, who were tested prior to the start of their training cycle, and afterwards. The average sporting tenure of the boys was 16.02 months (S.D. 9.47), while the average number of weekly training sessions conducted during that time was 3.13 (S.D. 0.95). The training goals were as follows: the development of basic motor and functional abilities, and learning the basis of wrestling techniques and tactics. Every training session consisted of a basic part, and a specific part. In the basic part, boy wrestlers developed all motor and functional abilities with basic exercises and in the specific part of training session these abilities were incorporated in specific wrestler's exercises. Beside training sessions which lasted for 60 minutes, the boy wrestlers also attended physical education classes in school, which took place twice a week for 45 minutes.

In this research, an array of 16 tests was used for the purpose of assessing: anthropometrical characteristics (ATV – body height, ATT – body weight, AOP- size of forearm, ANN- triceps skinfold); motor abilities; coordination (ONT

[1] *This paper is part of a scientific research project: "Following changes in the anthropological status of children in wrestling sports" (code: 0034214) approved by The Croatian Ministry of Science and Technology*

– floor dexterity, KUS - lateral steps, MPN- backwards polygon); flexibility (MPR- the forward arm stretch with legs apart); power (MSD- long jump from still position); repetitive strength (SKL 60 - push ups in 60 seconds, MPT60 – sit ups in 60 seconds, ČUĆ - squats in 60 seconds, B+2skl90 – throw with two push-ups in 90 seconds), static strength (MIV - hang time) and functional abilities (F6 – six minutes running).

A description of the standard tests used in Croatia's school-system to assess anthropological characteristics can be found in the book "Norme" (Findak and others, 1996), the specific tests used for wrestling and judo are described in the previously mentioned project.

The results are analysed with Statistica 6.1 program for Windows. To analyse the differences in two time points – at the beginning and the end of the training period, t-test for dependent samples was used.

Results

Table 1. The arithmetic means attained by the examinees at their tests, and the difference recorded between the first and second measurements.

VAR	Means	Std. Dv.	N	Diff.	Std. Dv.Diff	t	df	P-level
ATV	150,094	7,4595						
ATV2	157,463	7,3046	32	-7,37	3,9144	-10,649	31	**0,000000**
ATT	40,610	7,3783						
ATT2	46,829	8,6857	31	-6,22	3,4609	-10,006	30	**0,000000**
AOP	21,413	1,6094						
AOP2	22,203	1,7775	32	-0,79	1,0387	-4,306	31	**0,000155**
ANN	12,865	6,8197						
ANN2	12,135	6,9853	32	0,73	3,9707	1,039	31	0,306931
ONT	18,605	2,8971						
ONT2	17,133	4,1126	19	1,47	2,2548	2,845	31	**0,010744**
KUS	11,680	1,1298						
KUS2	10,505	0,9515	19	1,18	1,0771	4,756	18	**0,000158**
MPN	23,321	2,6357						
MPN2	11,853	2,5531	31	1,47	2,1648	3,776	18	**0,000704**
MPR	49,859	10,3325						
MPR2	50,453	10,2267	32	-0,59	8,0009	-0,420	30	0,677262
MSD	173,281	17,9060						
MSD2	186,083	19,9957	32	-12,80	9,6542	-7,501	31	**0,000000**
MTR	27,470	2,3329						
MTR2	29,321	2,5394	28	-1,85	3,0339	-3,229	27	**0,003256**
MIV	35,938	19,9272						
MIV2	46,688	27,9336	32	-10,75	18,5159	-3,284	31	**0,002540**
MPT60	39,724	7,5635						
MPT602	41,345	7,1378	29	-1,62	6,7210	-1,299	28	0,204688
BAC2SKL90	12,176	3,3955						
BAC2SKL902	11,706	3,4235	17	0,47	4,2000	0,462	16	0,650318
SKL60	25,647	7,7374						
SKL602	29,529	11,9275	17	-3,88	9,8735	-1,621	16	0,124502
CUC60	48,706	6,0287						
CUC602	48,882	5,6000	17	-0,18	6,4540	-0,113	16	0,911641
F6	1095,947	119,9511						
F62	1188,368	107,4286	19	-92,42	129,6844	-3,106	18	**0,006093**

Legend: Means-arithmetic means; Std. Dv. - standard deviation of first and second measurement; N-number of entities; Diff.-difference of arithmetic means; Std. Dv. Diff.-standard deviation of difference of results from first and second measurement; t-value of t-test; df-degrees of liberty df =n-1; p-level of importance, or mistakes, with which we ascertain that a statistically significant change has occurred; VAR-variable

The results presented in Table 1. show the differences in results attained by boy wrestlers after a one-year training period. Statistically significant differences occurred in 10 of 16 variables. As far as anthropometrical characteristics, statistically significant changes occurred in the following variables: ATV- body height, ATT- body weight, AOP – size of forearm. Tests conducted with the purpose of measuring motor abilities pointed to a statistically significant difference in the variables used to assess coordination (ONT – floor dexterity, KUS - lateral steps, MPN- backwards polygon), flexibility (MPR- sit and reach with legs apart); power (MSD- long jump from standing position); motion frequency (MTR - hand tapping) and static strength (MIV - hang time).

A statistically significant difference wasn't recorded in variables: the trunk flexibility test (MPR- the forward arm stretch with legs apart); the relative repetitive strength tests (SKL 60 - push ups in 60 seconds, MPT60 – sit ups in 60 seconds, ČUĆ - squats in 60 seconds, BAC+2skl90 – throw with two push-ups in 90 seconds).

Results in test 6 minutes running, for assessing aerobic abilities, showed statistically significant positive changes.

Discussion

The changes that took place in body height, as this is a normal and expected occurrence in the growth and development of children, cannot be controlled and influenced on. With the other two mentioned variables (body weight and size of forearm), one can say that positive changes occurred in the muscular mass of the examinees, which was, in large part, a direct outcome of one year's training. Small changes in the triceps skinfold (ANN), an indicator of subcutaneous fatty tissue, point to the fact that such body fat with training at this age cannot be reduced. To do that, one would have to increase the volume of training, which is not recommendable at this age.

Statistically significant differences in the motor area (ONT, KUS, MPN, MPR, MSD, MTR, MIV) are a result of developed and adopted motor skills, but they also show that the correct path was taken in the training process for this age group, where developing coordination should play a prominent role. A greater number of gymnastic elements are used for this age group, and the wrestling take down techniques themselves influenced the development of coordination.

Wrestling has a strong effect on abilities associated with coordination. (Baić, 2001).

The increase in power (MSD) in boy wrestlers is explained by improved coordination, and overall growth and development. Good results attained by the young wrestlers in the hang time flex can be attributed to a development of static force, due to a characteristic static grip, which is required to successfully carry out a good deal of wrestling techniques. Sustaining the grip is made more difficult by moist skin, so the grip has to be increased above the level that would normally suffice if the skin or mat were dry. An improvement in the tests used to assess motion frequency can be attributed to the specific nature of wrestling (a bout is actively conducted only with the use of one's arms or body, as the rules do not allow the use of lower extremities for the purpose of executing techniques). An important part of training in wrestling is a specific exercise called "arm protraction" which encourages the development of this ability. The skill is used on a daily basis during a wrestler's training, the faster a wrestler protracts his arm, the better his grip, which makes it easier to take down an opponent.

In the following tests used to assess motor abilities, a statistically significant difference wasn't noted: the trunk flexibility test (MPR- sit and reach with legs apart); the relative repetitive strength tests (SKL 60 - push ups in 60 seconds, MPT60 – sit ups in 60 seconds, ČUĆ - squats in 60 seconds, B+2skl90 – throw with two push-ups in 90 seconds). This can be explained by the fact that such abilities are not essential in wrestling, and, therefore, aren't emphasised during training. Seeing as the cognitive component was significant at this age, a substantial development in specific stamina, and repetitive strength in the arms, trunk and legs wasn't to be expected, so the results in these categories (specific stamina, repetitive strength in the arms, repetitive trunk strength and repetitive leg strength) were not surprising, but some researches indicate that an inadequate amount of attention devoted to trunk strength and flexibility between the ages of 10 and 14 will lead to boys lagging behind when trying to master advanced lifting techniques during floor exercises. (Baić, 2004)

The results of the functional ability test (6 minutes running) show that one year of the organized training process has had a statistically significant effect on the functional abilities of the aerobic kind. Out of all the functional abilities, the aerobic ability is mostly developed during this period. Children of this age shouldn't be exposed to anaerobic exercises, so this statistically significant improvement was to be expected. It is also an indicator of proper training methods.

After one year of organized training, the boy wrestlers have achieved a marked improvement in almost all of the conducted tests. A statistically significant improvement was recorded in variables used to assess coordination, power, motion frequency and static force, although the same cannot be said for trunk flexibility and repetitive strength. There can be little doubt that the change in anthropometrical characteristics was also influenced by growth and development, but training certainly played an important role in properly directing and expediting the process. It is obvious that the goals and training programmes used were appropriate and well carried out, seeing as statistically significant improvements took place in the areas that should be emphasised at that age and are important for successful wrestling, coordination, speed and flexibility. Because of the great importance of flexibility for young wrestlers, and athletes in general, exercises that develop trunk flexibility should be more often engaged during training sessions (at the beginning and end of the session). It can be predicted that repetitive strength will increase during later stages of physical training, when the boys become anthropologically and psychologically ready to endure such efforts. Aerobic training has increased the boys' functional abilities, which will be very useful in later training, and necessary in developing other functional abilities. This research didn't include a reference group so one we cannot be 100% certain that the attained results are exclusively the product of training. Nevertheless the results show that, in boy wrestlers, a one-year training period has enabled the development of all the necessary capabilities that will pave the way for better training in the future and better results in competitions.

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CHANGES IN SOME ANTHROPOLOGICAL CHARACTERISTICS OF NON-ATHLETIC MALE CHILDREN DURING THE SCHOOL YEAR

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Abstract

The sample of participants was consisted of 52 boys who were not involved in any kind of organised sport activity aged 12 yrs ± 5 months. The anthropological characteristics were measured twice (in 5th and in 6th grade) using the battery of 11-item tests which were regularly used in the Croatian elementary schools. The aim of the study is to compare the anthropological status in first and in second measurement. The t-test for dependent samples was used to analyse differences of arithmetic means. The boys achieved better results in almost all variables regarding anthropological status in second measurement but within the boundaries of physical education (PE) class (two times a week per 45 minutes) the lessons are insufficient for achieving significant anthropological improvement.

Key words: *nonathlete boys, anthropological characteristics, differences*

Introduction

Educational system in the Republic of Croatia prescribed one class of physical exercise, two times a week for 45 minutes, what in our research (Sertić, (1997. a), Sertić, (1997. b), Cvetković and associates (2004), Jurendić, Dimitrijević, (2004)) proved to be an insufficient amount of exercises with which students could not achieve significant changes in anthropological characteristics. Up till now, a vast number of research has been done, where the success of young sportsmen from a variety of sport disciplines was compared with the success of non-sportsmen who are physically exercising only in the boundaries of educational system. The results have very often proved that the amount of physical exercise in the primary and secondary schools is not sufficient to achieve some significant positive changes in the anthropological status of children. On the other hand, the children that are systematically into sports, are achieving significantly better results in that same tests.

The most interesting research regarding this matter was published in 1997 by Sertić and associates. The sample consisted of 80 children, seventh and eighth grade students, that were divided in two groups. First control group were the students who didn't take part in any organized physical exercise, with exception of regular physical education (PE) lessons, and the second group were the students who were practising organized sports such as tennis, volleyball, football, athletics, handball, basketball, table tennis and rowing.

The analysis of the data showed that the children practising sports also outside of the regular PE class, achieve better results in the given variables for the evaluation of motor skills and functional abilities than the children that are exercising only in the given limits of regular and necessary PE (physical education) lessons. The author suggested some changes in the educational system, such as an additional "third" class of physical exercise within a week, so that the non-athletic children would severely improve their motor skills and functional abilities.

In 2004,on a sample of 97 boys from the fifth grade of primary school, Cvetković and associates compared some anthropological characteristics of male children wrestlers with the characteristics of non-athletic children, and got numerically and statistically better results in favour of young wrestlers, in almost all variables that are today in standard use in all primary schools in Republic of Croatia.

Vračan and associates in 2004 compared the differences in anthropological characteristics between young judo wrestlers non-athletic juveniles. The sample consisted of 86 boys from the fifth grade, of whom 41 were judo wrestlers, and 45 were non-athletes. In that research, it can be clearly seen, that the boys who were practising judo on an organized basis, achieved much better results in almost all the variables.

Jurendić and Dimitrijević in 2004 periodically monitored students from the fifth to eighth grade of primary school. The sample consisted of 74 examinees divided in two groups (G1-children who had regular PE classes plus additional two hours of organized exercises, and G2- children that only had two hours of organized exercises in a week). Given results confirm the fact that exercising of only two hours per week is insufficient to significantly change children's health and anthropological status.

With purpose of improving children's anthropological and health conditions, they suggested an increasement in the number of exercising hours in a week, from two to four hours.

The aim of this research is to analyse the anthropological status of the children who are not involved in organized physical exercising except within the plan and programme of PE class in primary school, from the initial to final stage. The observed children are at the age of eleven and twelve.

Working methods

Sample of the examinees:

Sample of the examinees consists of 52 boys from the sixth grade of primary school. The examinees are not participating in any organized sport (except that they attend physical education class two times a week, each lesson lasting 45 min).

Sample of the variables

This research combined a group of eleven tests to evaluate the anthropological status in Croatian primary schools. Metrical characteristics of these tests are satisfying, and in that area, they are the most extensive ones at the present time (Findak 1996). A detailed description of these tests and procedures of measurements can be found in the book "Norms" by Findak and associates (1996). Testing is conducted in accordance with the demands of measurements prescribed in the above book.

ANTHROPOMETRICAL CHARACTERISTICS (4): Body height - ATV, Body weight - ATT, Upper arm volume - AOP, Forearm wrinkle - ANN

MOTOR SKILL ABILITIES (6): Coordination: polygon backwards - (MPN),Static strength: endurance in hanging in a pull up - (MIV), Movement frequency: hand tapping (MTR), Flexibility: spread legs bent over (MPR), Explosive strength: spot jump - (MSD), Repetitive strength : torso lifting (MPT)

FUNCTIONAL ABILITIES (1): 6 minutes running – F6

Methods of data processing:

Central and dispersed parameters have been calculated by means of descriptive statistics. The differences in above mentioned anthropological variables, which are used for evaluating the anthropological status of boys who are not involved in any organized sport except for PE class (two times a week for 45 minutes), in two time lines, were ascertained by the analysis of arithmetic mediums using the t-test for dependant groups of examinees.

Results

Results in table 1 reveal that the boys in the second period of time have achieved, numerically and statistically better results in almost all the variables, which was expected with children at that age. Still, changes in anthropological status measurement are not considered satisfying because most of the variables compared with necessary physical achievements in that age, are below standard.

A significant statistic differences between the first and the second measurement have been noticed in the anthropometrical characteristics for example characteristics of body height ATV and body weight ATT, which can be expected, considering the age of the examinees (11 –12 year). The height and weight gain have been noticed at the age of eleven and twelve. It can be expected that the upper arm volume (AOP) has also changed, but in comparison with the Croatian prescribed norms it can be seen that the results from the first measurements are above standard, and the ones from the second measurements are within the limits of standard results. The anthropological size of forearm wrinkle (ANN) which has, according to the Croatian norm rank , a poor result, if added, one comes to the conclusion that the upper arm volume enlargement is caused by the enlargement of body fat (PMT), which is not, in any case satisfying.

By analyzing motor abilities it is noticed that statistically significant result improvements have been accomplished, in almost all the variables. Interesting improvement is noticed in the results of the variable for the evaluation of explosive strength (spot jump-MSD) and in the variable for the evaluation of repetitive strength (torso lifting-MPT), whose results, between these two measurements, have improved from the ones below standard to the ones above standard. Positive but lesser improvement is noticed in the variable for the evaluation of the frequency movement (MTR), in which the boys had better results from first to second measurement, progressing from standard to above standard results (table2).

Further analysis of table 2 shows a change in the result of the test for evaluation of flexibility (MPR). Although a change in the result is not statistically significant, looking closer at the Croatian norms, it is noticed that the results which were in the first period time above standard, have now, in the second measurement, dropped to a rank of standard results. To prevent the tendency of decreasement of results in that motor skill, it is necessary to involve additional kinesiology operators in the physical education programme, who are primary going to influence on the development of flexibility.

In further realization of PE class it is also necessary to pay attention to the involvement of additional operators for the development of static arm strength, which is measured by a hanging pull up test (MIV), because in both measurements, its result was below standard. With statistically significant change, the tendency of continuous result improvements was not accomplished in relation to the Croatian norms, so the future physical education programme should primary focus on the development of abilities.

The differences between the two measurements of functional abilities (6 minitsrunningF6) are showing statistically significant changes, but the results in the first measurement were in the rank of poor results, as well as during the second

measurement, so the changes cannot be considered satisfying and, in the next school year, it will be necessary to involve a greater number of kinesiology operators who will influence and improve the development of functional abilities (F6).

Not only the kinesiology operators who can influence on the improvement of anthropometrical characteristics of motor and functional abilities, but also it is recommended that the children involve themselves in some system of organized sport in order to improve the level of certain characteristics and abilities.

To achieve that, Cvetković and associates (2004), as well as Vračan, Sertić and Baić (2004), recommend wrestling sports, because in a free style and greek-roman wrestling and judo, significant differences were noticed between young wrestlers and non wrestlers, already after 12 months of training.

Table 1. Differences in some anthropological characteristic of boys non-athlets, after one year

52 boys, non-athletes, from five different schools, were longitudinally monitored.
A t-test for the sample of dependant group of examinees has been used.

Variables	Mean	Std.dev.	N	Diff	Std.Dv.Diff	t	df	p-level
ATV 1	150,850	7,2105						
ATV 2	159,919	8,7254	48	-9,07	3,8598	-16,278	47	0,000000
ATT 1	41,120	9,1637						
ATT 2	47,367	10,7926	49	-6,25	3,3217	-13,165	48	0,000000
AOP 1	20,891	1,9823						
AOP 2	21,633	2,1318	46	-0,74	0,9373	-5,364	45	0,000003
ANN 1	12,764	8,5181						
ANN 2	13,639	8,1420	48	-0,88	4,8508	-1,250	47	0,217585
MPN 1	17,757	6,6432						
MPN 2	16,228	7,3875	49	1,53	4,8129	2,224	48	0,030880
MPR 1	49,220	9,6562						
MPR 2	46,644	10,0470	44	2,58	11,1740	1,529	43	0,133575
MSD 1	161,447	22,4551						
MSD 2	178,213	23,0151	47	-16,77	16,1229	-7,129	46	0,000000
MTR 1	25,121	3,7553						
MTR 2	28,096	4,0975	47	-2,98	3,3755	-6,043	46	0,000000
MIV 1	26,336	17,4486						
MIV 2	36,694	23,2065	44	-10,36	21,1085	-3,255	43	0,002215
MPT 60 1	28,381	8,5510						
MPT 60 2	35,833	6,3742	42	-7,45	7,8312	-6,167	41	0,000000
F6 1	994,953	157,4081						
F6 2	1094,651	164,4082	43	-99,70	154,8762	-4,221	42	0,000127

Table 2. Orientational values of standard tests for the sixth grade of primary school

	POOR	BELOW STANDARD	AVERAGE	ABOVE STANDARD	EXCELLENT	POOR
AOP	18,4 and lower	19,4-18,5	21,4-19,5	23,5-21,5	23,6 and more	
ANN	14 and higher	12-13	10-11	8-9	6-7	5 and less
MPN	More than 22	22,0-18,5	18,4-16,5	16,4-14,5	14,4 and less	
MIV	less than 25	26-36	37-48	49-60	61 and more	
MTR	less than 21	22-25	26-27	28-29	30 and less	
MPR	less than 39	40-44	45-49	50-54	55 and more	
MSD	less than 159	160-174	175-189	190-204	205 and more	
MPT	less than 26	27-30	31-35	36-40	41 and more	
F6	less than 1049	1050-1149	1150-1249	1250-1299	1300 and more	

Discussion

In this work some anthropological characteristics of non-athletic boys have been compared in a two time periods. The boys achieved better results in almost all final testing variables. The first two variables that describe anthropometrical characteristic (ATV I ATT) can be explained by the normal development of height and weight. By further examination of the results, the progress in most of the variables can be noticed and explained as a consecuence of growth and development. Bearing in mind that in some variables the progress was insufficient, it is necessary in future physical education programme to pay special attention to the development of these abilities.

To ensure constant and harmonious development of all motor skills and functional abilities of children, a greater number of regular PE lessons has to be ensured, and also carefully planned and programmed additional lessons within

universal sport schools. From the former researches it is evident that wrestling sports have a strong influence on a wide spectre of abilities (motor skills and functional abilities) already at the early ages of development, and that they positively affect children's health and their entire anthropological status so they are highly recommended as an additional part of regular PE programme and also of universal sports school programme.

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DIFFERENCES BETWEEN JUDO TRAINED BOYS AGED 11 AND 12 IN SOME ANTHROPOLOGICAL CHARACTERISTICS[1]

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Abstract

Research was conducted on a sample of 108 subjects, out of which 41 were 11 year-old judokas, while 67 of them were 12-year-old judokas. The subjects were put through an array of 16 tests with the purpose of determining their motor and aerobic and anaerobic capacity, as well as their anthropological characteristics. The goal of this research was to compare certain anthropological characteristics of 11 and 12 year-old boys who take part in judo training. To process the data, an analysis of the different arithmetic means with the help of the t-test for independent groups of subjects was used. The 12 year-old judokas attained significantly better results in the variables for body height, body weight, size of forearm, polygon backwards, long jump from a standing position, sit ups, floor dexterity, lateral steps, push-ups in 60 seconds and squats in 60 seconds. The differences can be attributed to a correctly planned and programmed training process, in line with the hierarchal structure of the equation of specification in judo for this age group, as well as an 18 month longer tenure in judo training for the 12 year-old boys.

Key words: *judo, boys, anthropological characteristics, differences*

Introduction

With regard to its structural complexity, judo can be placed in the category of composite polystructural acyclic sports. Success in judo depends on the development of a high level of motor abilities and aerobic and anaerobic capacity and on possessing specific anthropometric characteristics. Between the ages of 11 and 12, the first selections of boys for taking part in judo are carried out (Lucić 1987, Sertić 1994, 1999). The selections are based on analysing the similarities of the selected boys' anthropometric characteristics with the hierarchal structure of importance concerning certain abilities and traits in the equation of specification for success in judo for younger age groups, of which the highest ranked, are coordination, strength and speed (Sertić 1994).

The aim of this research is to compare the anthropological status of 11 year-old boys, who are in the early stages of judo training, with that of the 12 year olds, who have been in the training process for some time. Out of the existing research on samples with subjects of the same or approximate age group, it should be pointed out that:

Baić and others (2001) followed the results of tests done to assess motor abilities and aerobic and anaerobic capacity and anthropometric characteristics of 12 and 13 year-old wrestlers in a six-month cycle. It was established that statistically significant changes occurred in one variable used to estimate anthropometric characteristics, size of forearm, and three variables used to assess motor abilities, static strength, coordination and flexibility.

Jagiello and others (2001) did a research on the effect judo training had on children aged 11 to 17. The children trained 2-3 times per week for 90-120 minutes, depending on their age. Tests were conducted before and after the training cycle. The experimental group consisted of 224 judokas, while 200 000 school children who didn't take part in sporting activities served as a reference group. In the 50-metre sprint, the biggest changes came about in judokas aged 12 and 13, while the 16 and 17 year-old judokas didn't show as many differences. In the 1000-metre race, the judokas also bested the reference group, with the biggest margins being produced by the 14 and 15 year-olds.

Sertić and others (2004) used an array of 11 tests to analyse certain anthropometric characteristics in 59 wrestlers and 41 judokas aged 11. Differences were established by using t-test for independent samples. The results showed that boy wrestlers achieved better results in the variable size of forearm, used to assess anthropometrical characteristics, and in two variables used to assess motor abilities, the hand tap and the polygon backwards. The judokas had better results in the variable "triceps skinfold", used to assess anthropometrical characteristics, and the "forward arm stretch with legs apart" variable, used to assess motor abilities.

[1] *This paper is part of a scientific research project: "Following changes in the anthropological status of children in wrestling sports" (code: 0034214) approved by The Croatian Ministry of Science and Technology*

Methods

The research was conducted on a sample of 108 subjects, 41 of who were 11 year-old judokas, while 67 of them were 12 year-olds. The average sporting tenure of the 11 year-old boys was 23.37 months (S.D. 20.27), with an average of 2.95 training sessions per week (S.D. 0.45). The average sporting tenure of the 12 year-old judokas was 41.71 months (S.D. 22.37), while the average number of weekly training sessions conducted during that time was 3.09 (S.D. 0.42). Every training session lasted for 60 minutes and consisted from the basic part, and the specific part. In basic part judokas were developing basic motor abilities (coordination, power, relative strength) and functional abilities (aerobic capacity) with basic exercises and in the specific part of training session these abilities were incorporated in specific judo exercises.

The sample of variables comprises a set of 16 tests used to assess motor abilities and aerobic and anaerobic capacity, and anthropometric characteristics. The testing was done according to the standards set in the book "Norme" (Findak and others, 1996), as well as the project: "Following changes in the anthropological status of children in wrestling sports" (code: 0034214) approved by The Croatian Ministry of Science and Technology.

Anthropological characteristics (4): ATV – body height, ATT – body weight, AOP- size of forearm, ANN- triceps skinfold

Motor abilities (11): backwards polygon (MPN) -coordination, long jump from still position (MSD) –power, hang time with flex (MIV) -static strength, hand tap (MTR) –speed of motion frequency, the forward arm stretch with legs apart (MPR) –flexibility, sit ups in 60 seconds (MPT60) -repetitive strength, floor dexterity (ONT) –coordination, lateral steps (KUS) –coordination, push ups in 60 seconds (SKL 60) –repetitive strength, squats in 60 seconds (CUC60) – repetitive strength, throw with two push-ups (BAC+2skl) –specific stamina.

Aerobic and anaerobic capacity (1): six minutes running (F6)

Descriptive statistics were used to work out the central and disperse parameters in all the variables for each group of subjects separately. Differences between the groups of judokas were established by using the t-test for independent samples.

Results

The older (12 year-old) judokas attained better results in the following variables used to assess anthropometric characteristics: ATV – body height, ATT – body weight, AOP- size of forearm, and in seven variables used to assess motor abilities: backwards polygon (MPN), long jump from standing position (MSD), sit ups in 60 seconds (MPT60), floor dexterity (ONT), lateral steps (KUS), push ups in 60 seconds (SKL 60) and squats in 60 seconds (CUC60).

Table 1. The results of testing the differences between 11 and 12 year-old judokas

	11 year-old judokas		12 year-old judokas			
TEST	**mean**	**S.D**	**mean**	**S.D**	**t-test**	**p=.05**
ATV	151.442	5.9818	157.563	7.5040	4.04859	0.000107
ATT	42.885	8.7405	49.540	11.1648	2.97683	0.003704
AOP	20.924	2.1091	22.804	2.1155	4.48723	0.000018
ANN	10.585	5.2540	12.179	5.0183	1.57341	0.118604
MPN	14.926	2.9530	12.176	2.8693	-4.78050	0.000006
MPR	55.130	9.7268	54.891	8.6629	-0.13306	0.894398
MSD	167.488	17.3268	185.284	21.0282	4.55277	0.000014
MTR	26.398	2.8541	25.458	7.4905	-0.76758	0.444492
MIV	26.514	16.7752	33.781	19.8565	1.94976	0.053871
MPT60	37.341	5.3507	45.522	9.2742	5.14303	0.000001
ONT	23.218	3.9853	19.015	4.3960	-4.95410	0.000003
KUS	11.019	1.0076	9.947	0.9520	-5.55747	0.000000
SKL60	18.098	11.3000	28.773	15.8937	3.74928	0.000291
CUC60	46.122	9.7575	50.606	9.1800	2.39787	0.018256
BAC+2SKL	13.634	2.6434	13.727	3.3766	0.15021	0.880884
F6	1150.122	181.3129	1171.638	137.9219	0.67050	0.504134

Legend: mean-arithmetic mean, SD-standard deviation, *t*-test-results of the *t*-test

Discussion

From the results given in table 1 it is clear that the 12 year-old judokas are taller (ATV), heavier (ATT) and have a bigger forearm (AOP). These indicators are understandable, seeing as the 12 year-old boys are going through an intense period of growth and development, while the 11 year-olds still find themselves on the verge of puberty. The reason for the bigger forearm can be found in a higher level of muscular mass, which is characteristic for full-contact sports and in

line with the anthropological profile of one's physical constitution in judo (Mišigoj-Duraković, 1995). A large number of grips that are used in performing techniques during training and competitions also definitely bring about muscular hypertrophy in the forearm and cause such results.

As for motor abilities, the 12 year-olds clearly have better coordination, more power and better-developed repetitive strength, because they achieved significantly better results in variables used to assess coordination - backwards polygon (MPN), power - long jump from still position (MSD) and repetitive strength – sit ups in 60 seconds (MPT60). It is obvious that an 18-month longer training tenure, a correctly planned and programmed training process (in line with the hierarchal structure of the equation of specification in judo for this age group), combined with the difference in chronological age (11 and 12 years old boys) between the two groups of subjects brought about the difference in results. A greater impulse was given to developing strength and coordination during the 12 year-old boys' training. This is understandable, seeing as these two abilities are the highest ranked in the equation of specification for this age group (Sertić 1994).

The 12 year-olds also produced better results in the next 4 tests, used to assess specific motor capabilities necessary for judo, floor dexterity (ONT), lateral steps (KUS), push ups in 60 seconds (SKL 60) and squats in 60 seconds (CUC60). The first two tests, floor dexterity and lateral steps, indicate coordination abilities which are essential for success in judo within this age group (Sertić 1994), and are suitably enhanced during training sessions. That is to say, during the first years of judo training, the boys go through a phase of learning and practicing numerous techniques that are demanding in a coordination sense, which leads to the development of this important ability for young judokas. Sertić and others (1999) conducted a research on a sample of 100 children of the age of 11, on the influence of coordination on success in judo bouts, where a statistically significant correlation was established between the mentioned variables by using regression analysis. Two variables for assessing coordination were particularly valuable in identifying the criteria: leaping dexterity and the long jump backwards.

The improvement in results for the next two variables that are used to assess repetitive strength, the push-ups and squats, can be attributed to the fact that these exercises are done in every training session. These exercises, in various different forms, are perpetuated throughout the training process, so it is only natural that the older boys are at an advantage, given their 18-month longer tenure.

The results of this research, in which certain basic and specific anthropological characteristics of the two different age groups of judokas were compared, show that better results were achieved by the older judokas. The influence that planned and programmed organised training in judo schools has on the boys' complete anthropological status is evident, especially on those abilities that rank highly in the equation of specification for success in judo in this age group. A greater number of hours spent training and suitably chosen training methods (including content and properly controlling the intensity), in line with the equation of specification for success in judo, produce positive changes on the boys' anthropological status.

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EFFECTS OF VARIATIONS OF THE PULLOVER EXERCISE ON THE EMG ACIVITY OF EIGHT MUSCLES

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Abstract

The acting of pulling the arms from an overhead position toward or raising body with arms when hands are secured in one place is important in javelin throwing, gymnastic, swimming, overhead forward throwing actions in sport games, wrestling and in all pulling-up actions such as free climbing and rope climbing. The pullover may be the most widely applied exercise used for above mentioned actions of arms and developing the different muscles of the upper body. This experiment investigated the effects of varying pullover hand spacing and type of the bar (barbell or dumbbell) on the EMG activity of eight muscles acting at the shoulder and elbow joint. One male weight trainer performed pullover under two conditions of hand spacing (joined hands and 100% of the biacromial diameter) at 62.5% of him predetermined maximum. Preamplified surface EMG electrodes were placed over the eight muscles in question. The triceps brachii and latissimus dorsi activity tended to increase during the pullover with barbell with 100% of biacromial hand grip.

Introduction

Weight training is one of the ways of training with external load which has become increasingly popular in physical preparation of top athletes. It is basically strength training which demands from the muscle system of an athlete the generation of force that is opposed to the force of external load of weight and acceleration of the mass of barbells, dumbbells or weight stacks. To be able to realize the aim of a training process, the exercises in this type of resistance training must be selected in concordance with necessity of athletes. Some of the weight exercises are more suitable for strength and power development, while some of them are same as previous for gaining muscular mass. Some of them (through muscle development relevance) has an influence to pull movement muscles (latissimus dorsi, biceps), while others has an influence to push movement muscles (chest, triceps). The most important criterion in exercise selection is to be acquainted with all attributes of exercises.

The acting of pulling the arms from an overhead position toward (or raising body with arms when hands are secured) is important in javelin throwing, gymnastic (rings, parallels bars), swimming, some sport games (overarm throw actions involving both arms), wrestling and in all pulling-up actions (free climbing, rope climbing, pull-ups). The pullover may be the most widely multi purpose exercise used for developing the upper body. It is believed that during the pullover exercise the lower chest muscles are preferentially activated (Yessis, 1992) and most body builders do this exercise for lower chest and serratus anterior. Some experts are assured that during the pullover exercise latissimus dorsi is more active (Chu, 1995). Some weight trainers claim that triceps brachii is more involved (agonist) muscle in that exercise. The pullover is not exercise that not only develops the muscles but also increases the size of chest by expanding the rib cage and improving the breathing capabilities (Weider, 1989). According to data of some experts (Yessis, 1992), in order to maximum benefit from the pullover exercise, athlete must concentrate on pulling with him/her shoulder joint muscles. If athlete do the exercise with him/her elbows bent, which is very common among bodybuilders, he/her may find himself/herself doing elbow joint extension to raise the dumbbell or barbell. Individuals who use the bent elbow technique could handle more weight, but technique with straight arms can create the same amount of tension in the muscle as a weight 2-3 times as heavy, but with arms bent. According to these different standpoints about these exercise qualities, weight trainers could not acquaint with target of this exercise (the primary muscle intended for exercise).

We believe, in order to maximum benefit from this exercise athlete must concentrate himself/herself to pull the weight in the most natural way, inherent in above mentioned sport activities (javelin throwing, movement on rings, parallels bars, swimming, overhead forward throwing, wrestling, free climbing, etc.). Based on the perceived differences between variations of the pullover, it has been advised that weight trainers include two main variations in their training program: barbell (wide hand spacing) and dumbbell (close hand spacing) pullover. It was the purpose of this study to examine the EMG activity of 8 muscles acting about the shoulder and elbow joint during different conditions of the two-handed pullover exercises barbell.

Methods

A male athlete with a five years weight training experience was recruited for this study. A subject was free of acute or chronic low back pain or injury prior to the study. Participation was voluntary and without remuneration. Physical characteristics were as follows:

- Age: 19 yrs
- Height: 171 cm
- Body mass: 70 kg
- Biacromial diameter: 39.1 cm

In the week prior to testing, maximum possibilities were obtained for subject under both condition of exercise (weight type and hand spacing). The maximum 10 reps load lifted in the wide hand spacing pullover (ez-barbell) was the same as in the pullover when hand spacing was narrow (dumbbell). The weights used during the experimental trials were 62.5 % of the predetermined 10 reps maximum in each condition (a common training load used by many recreational lifters). The equipment (bench, barbell, dumbbell) commonly seen in local gymnasiums were used. Two hand spacing on the weight bars were used. To standardize the narrow and wide hand placements, joined hands (narrow hand position) and 100% of the biacromial diameter (39 cm; wide position), respectively, were used.

Electromyographical recordings were collected using by SENIAM procedure (Surface EMG for Non-Invasive Assessment of Muscles; Hermens, 1999). Preamplified electrodes (Skintact, F 50, Leonhard Lang Gmbh, Innsbruck, Austria) were used to record surface EMG from 8 sites:

- M. biceps brachii short and long
- M. triceps long
- M. deltoideus anterior
- M. pectoralis major pars clavicularis
- M. pectoralis major pars abdominalis
- M. rectus abdominis (upper portion)
- M. latissimus dorsi
- M. serratus anterior

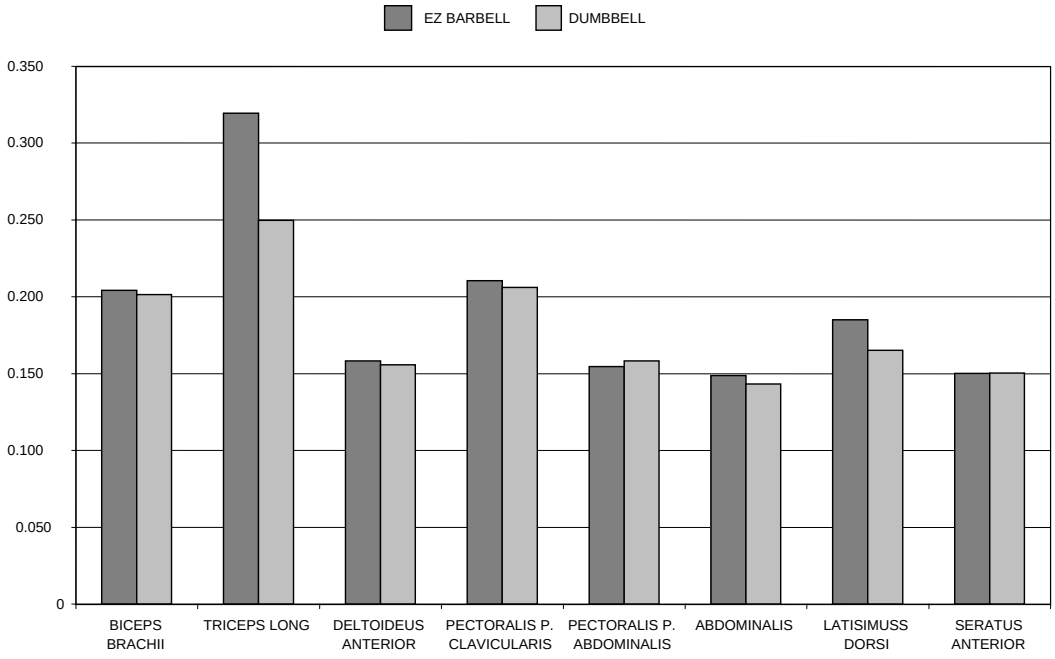
After receiving an explanation of the experimental protocol, subject did his usual warm-up, and then positioned himself on the exercise bench so that he was well balanced with his trunk and pelvic girdle on the bench and his feet on the floor. He had to hold the weight (dumbbell or barbell) above him chest with arms slightly flexed. Subject performed the exercise in a controlled manner with an appropriate one rep time of approximately 3 second. Once the subject was ready, the tester began a standard countdown procedure. Ten trials under each condition of hand spacing were recorded. Recording began approximately 1000 ms prior to the lowering the weight.

Results

EMG average 10 reps values (mV) for the clavicular and abdominal head of the pectoralis major, the anterior head of the deltoid, the long head of the triceps brachii, the latissimus dorsi, upper part of the abdomen, the serratus anterior, and the biceps brachii for each exercise tested are shown in Table 1 and Graph 1.

Table 1. EMG values (mV) for the 8 muscles of the shoulder and elbow joint during 10 reps of two variants of the pullover exercise.

bar	biceps	triceps long	deltoideus anterior	clavicular pectoralis	abdominal pectoralis	upper abdominal	serratus anterior
dumbbell	0.20140	0.24968	0.15578	0.20611	0.15832	0.14326	0.16507
barbell	0.20421	0.32239	0.15889	0.21138	0.15468	0.14878	0.18505



Graph 1.EMG values (mV) for the 8 muscles of the shoulder and elbow joint during 10 reps of two variants of the pullover exercise.

Discussion

Although, EMG signal is highly dependent on skinfold thickness and results obtained in different muscles are not comparable because it is not relativised using the EMGmax values of the single muscle, we want to accentuate that obtain results (in accordance with experience of weight trainers and body builders) are partially expected. According to EMG average 10 reps values (Graph 1) the three of eight contemplate muscles (bodybuilders use this exercise for these muscles) are predominately involved in this type of movement. These are:

- Long head of the triceps brachii,
- Clavicular head of the pectoralis major and
- Latissimus dorsi

Also, pullover is (among bodybuilders) frequently used for m. serratus anterior. The EMG signal on m. serratus anterior we obtain, however it is not relativised, the obtain EMG quantities may be because of typical serrated shape of that muscle.

The traditional view of the acting of the pectoralis major is that it produces medial adduction of the humerus and with triceps which extends the elbow joint, generally participates in pushing movements (movement away from center of body during the concentric contraction of the target muscle). The traditional view of the acting of the latissimus dorsi is that it adducts the humerus and with biceps brachii which flexion the elbow joint, chiefly takes part in pulling movements (movement toward center of body during the concentric contraction of the target muscle).

Indeed, as it mentioned in first part of this paper, results what we acquired indicate that pullover is maybe the most complex weight training exercise. Actually, it involves push (pectoralis major and triceps brachii) and pull (latissimus dorsi and biceps brachii) muscles in the same movement.

Furthermore, the long head of the triceps brachii was more active during the pullover with shoulder width grip with the barbell than from a narrow grip with the dumbbell. It could be because of slightly flexed elbow (Yessis, 1992). Also, the latissimus dorsi was no more active during the dumbbell pullover than during the barbell. It could be consequence of wider hand spacing on the bar (Weider, 1989). With respect to variation in hand spacing, it has been noted that a wider grip (barbell) requires more activity in the triceps brachii and latissimus dorsi muscles.

Conclusion

This experiment investigated the acting of pulling the arms from an overhead position toward during the most widely multi purpose exercise used for developing different necessities of top level athletes. We explored the effects of varying pullover hand spacing (wide or narrow) and type of the bar (barbell or dumbbell) on the EMG activity of eight muscles

acting at the shoulder and elbow joint. According to obtained results we consider that pullover exercise is some kind of pull-push movement which in the same manner activates push movement muscles (long head of the triceps brachii and clavicular head of the pectoralis major) and pull movement muscles (biceps brachii and latissimus dorsi).

We believe that the pullover is great exercise for athletes who require increasing the size of chest and bodybuilders, because the pullover exercise through involving most of upper trunk muscles may expand the rib cage. We also hold, that the exercise through develop respiration muscles is favorably option for athletes who need improving him/her breathing capabilities.

We also deem, in order to maximum benefit from this exercise, that athlete must concentrate himself/herself to lift the weight in the most natural way, which is inherent in concrete sport activities (such javelin throwing, gymnastic, swimming, sport games overhead forward throwing, wrestling, free climbing, etc.) without attempts to activating certain muscles.

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SOME DETERMINANTS AND PRINCIPLES IN PROGRAMMING PLYOMETRIC TRAINING*

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Abstract

In this paper the author wants to explain some determinants and principles which we must have in our minds when we are programming plyometric training. These determinants are: principle of adaptation, specificity of sport, strength ratio, body weight, age, footwear, clothes, training surface, training area, training accessories, frequency of training, volume, progression of intensity, fatigue, recovery, fleksibility and stability of body, techniques of performing plyometric exercises, duration of plyometric program. We must consider and ponder these determinants in order to execute plyometric training in the right way for our athletes. This is the only mode in which we are able to reduce mistakes on minimum when we are programming plyometric training.

Key words: *adaptation, training, volume, intensity*

Introduction

Plyometric training is one way to bridge the gap between the strength training program and the field of competition. It is essentially speed–strength training, with the load fairly constant (bodyweight) and the training stimulus being speed of movement and volume (Hedrick, 2003). Plyometrics are a subset of stretch – shorten cycle that emphaize rapid short range of motion prestretching and the maximal ballistic activation of muscle (LaChance, 1995). Plyometrics are known as drills or exercises aimed at linking sheer strength and speed of movement to produce an explosive – reactive type of movement often referred to as power (Chu, 1983), plyometrics bridge the gap between speed and strength (Chu, Plummer, 1984). Plyometrics use countermowement to overload the muscular system (Thomas, 1998).

In plyometric training we have some determinants and principles that we must consider in order to better understand plyometric training and to make the best possible plyometric plan and programme.

Important determinants in plyometric training

Principle of adaptation

Adaptation is proces in which you change characteristics and abilities of athletes and that can help them to achieve the best or acceptable functioning in prescribed or adjustable conditions.

Feature of adaptation is clearly seen in mechanism of homeopath always on higher respectively more effective level of activity in sport (Milanović, 2004). That we must have in our minds when we are programming plyometrics training because we could easy bring our athletes to overtraining.

Athlete must first adapt on low intensity plyometric exercises and later we can boost load, implement high intensity plyometric exercises, but we must be sure that our athlete is ready for that load and that athlete won't react negative.

Specificity of sport

Plyometric training must imply specific movements and exercises from given sport, that means that you must consider demands of that sport. Determine if movements in that sport are mostly linear, vertical, lateral or you have some sort of combinations. Specific exercises causes specific adaptation and specific training efects (McArdle, Katch, 1981 from Radcliffe, Farentinos, 1998). Specificity refers to neuromuscular and metabolic adjustment on different types of load. Stress in plyometric training also like other types of training (for example strength, endurance) comprises specific fitting of certain muscle area.

Level of strength

If athletes want to engage in plyometric training they must posses certain level of conditioning preparation. One of criterions is ability of athlete to do back squat with 1.5 to 2.5 body weight, 1.5 could be qouta (Čoh, 2004). For upper body plyometric athlete must be able to do five push ups with hand clapping and perform bench press equal body weight. Before implement plyometric training in your program athlete must perform 2 – 4 weeks of strength and speed training.

* *Young researcher award*

Table 1. Variations in volume based on body weight (Baechle, T. R. 1994).

VARIATIONS IN VOLUME BASED ON BODY WEIGHT (expressed in foot contacts)			
exercise	150 – 200 lbs	201 – 250 lbs	>250 lbs
Alternate leg bound	40	30	20
Double – leg tuck jump	40	30	20
Split squat jump	30	20	10
Lateral cone hop	30	20	10
Total	140	100	60

Body weight

Large athletes (>220 lbs) should not perform the same volume as small athletes because of the risk of the injury. In table 1 we can see concept of volume variations due to differences in body weight.

Age

Body maturity can't be judge with chronological age of athlete. Because of high intensity of some plyometric exercises and possible risk of injuries of bone tissue and connective tissue athletes under 16 years old shouldn't perform plyometric training of high intensity and especially not depth jump because they produce the biggest stres. Some researches proved (Carmelo Bosco, Paavo Komi, 1981. from Radcliffe, Farentinos. 1998) that maturity and immaturity of nervous and bone system have influence on plyometric training. Also some authors believe that athletes in age 12 to 14 can on appropriate way use plyometric training as preparation for future training of power (Valik,1966 i McFarlane, 1982 from Chu, 1992).

Footwear, surface, clothes

Footwear and surface in which you perform your plyometric training must have good abilities for shock absorption.

You need footwear that support ankle and foot, footwear that has good lateral stability and wide sole which doesn't slide. Ideal is footwear which athletes use in training in outdoors because it defends injury of ankle. Footwear with short sole and poore stability can cause problems with joints, especially in lateral movement. To prevent athlete from injury, surface must have good abilities for shock absorption. The best surface is natural grassland (must not be wet), need to be flat and soft. You can also use artificial grassland, then wrestling mats. In some circumstances you can use wooden surface (in gyms), tartan or rubber floors but you must beware of injuries. There is also special surfaces made especially for plyometric training and they satisfy all criterions.

Asphalt, muddy surface or surface made from hard wood are not recomended because they don't have good shock absorption. Mats that are too fat (≥15 cm) could cause extension of amortization, and by that they are blocking stretch – shortening cycle. (Birkić, Ž. 2004). Clothes must not limit performing of plyometrics exercises with (doesn't matter if they are for upper or lower body).

Training accessories

In modern technology of training there are great capabilities for using different training accessories for plyometric training. In that way our training could become more productive and effective. We can use hurdles, plyometric boxes, jumping ropes, plyometric shoes, plyometric steps, cones, plyo slides, vertical leaper, sand bags, ankle and wrist weights, weighted exercise vests (www.performbetter.com)

Frequency of training

Correctly defined load causes appropriate inanition and correctly defined rest period appropriate cours of supercompensation (Milanović,1997). Frequency is considered to be the number of workouts per week and it may range from 1 to 3 (2 or 3 in preparatory period and 1 in competition period). It also depends in which sport you use plyometric. For example; track and field athletes will have 3 workout in week and tennis players maybe just 1. Recovery between plyometric workouts should range from 48 hrs to 72 hrs (Allerheiligen, Rogers, 1995).

Volume of training

Volume is total work in one training or training cycle. In plyometric training volume is expressed in number of foot contacts and / or distance, also there is plyometric for upper body and in that case volume could be expressed with hand contacts or medicine ball throws.

Intensity of training

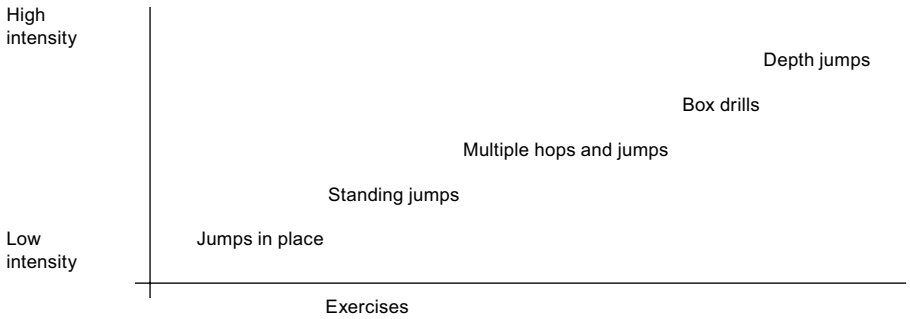
Some authors classifed exercises from low intensity exercises to high intensity exercises(Stone, O´Bryant, prema Chu,1984). That helps us in planning and programme plyometric training.

Athlete need 12 – 18 weeks of basic plyometric training and then athlete can perform more demanding plyometric exercises with high volume and intensity. (Chu, 1992).

Table 2. Number of foot contacts by season for jump training (Chu, 1992).

NUMBER OF FOOT CONTACTS BY SEASON FOR JUMP TRAINING				
	LEVEL			
	BEGINNING	INTERMEDIATE	ADVANCED	INTENSITY
Off – season	60 – 100	100 – 150	120 – 200	Low – mod
Preseason	100 – 250	150 – 300	150 – 450	Mod – high
In – season	Depends on sport			moderate
Championship season	Recovery only			Mod – high

Table 3. Intensity scale for jump training exercises (Chu,1992)



Recovery in plyometric training

Usually rest period of 1 – 2 minutes between sets is enough for recovering neuromuscular system in plyometric training. In exercises with low intensity you can rest 30 – 60 seconds but in high intensity exercises you must rest 2 – 3 minutes and even more. Some authors consider that you need rest ratio 1 : 5 or 1 : 10 to ensure proper execution and intensity of exercises (Chu, 1992). Short rest periods, 10 – 15 seconds between sets do not allow maximum recovery of neuromuscular system. Duration of plyometric training should be from 20 – 30 minutes plus warm – up and cool – down.

Flexibility and stability

You should pay attention on flexibility of ankles and calfs because it is very important for mechanic of foot. Also consider flexibility of shoulders, hips and spine because of proper posture of hips and amortization. You need to examine body posture and proper mechanic of trunk, elevation of pannikin, posture of cervical, pectoral and lumbar part of spine (Radcliffe, Farentinos. 1998). Explore balans, elevation of trunk and posture of every limb. Consider stability of foot, solidity of posture, solidity of joints and coordination. Look into case history to see injuries from past because they can limit plyometric training (especially knee, ankle and shoulder).

Techniques of plyometric exercises

There are some instructions that athlete must follow while performing plyometric exercises: toes must be direct upward (blocking ankles in dorsiflexion) and contact of foot with ground is on medial part with small emphasis forward. Knees and hips are also direct upward (to achieve maksimal swing of knees and extension of hips. Heels are direct upward for further projection of hips and longer fly (decreasing it's arc and speed of swing). Thumbs on hands are direct forward (blocking of upper body parts for continued application of force). Some authors call this instructions transfer of force (Jacobs, Fraley. 1995 from Čoh. 2004). First athlete must learn how to perform plyometric exercise in the way that direct you attention on lower leg (exercise like pogo, ankle hops, ankle flips, gallop etc.).

From movement that are directed on lower leg athlete moves to entire leg (exercise like squat jump, split – squat jump, tuck jumps with knees up or heel kick etc.). Then athlete is ready for exercises for entire body (exercises like standing jumps, alternate bounding with single or double arm action, combination bound etc.). With medicine ball athlete is first doing passing then throwing upward and forward and after that movements with multiple return action like pushing, sweeping and repetitive throws. Also very important is mechanic of breathing. There is certain sequence that athlete must follow: inhale during lowering, hold breath during phase of stretching and exhale when phase of stretching is over.

Duration of plyometric program

The length of programs usually range from 6 to 10 weeks and it depends about periodization and vary depending in which sport plyometrics is performed. Age and experience of athlete is also very important.

Table 4. Example of progression for plyometric program(Allerheiligen, Rogers, 1995)

WEEKS	DRILLS	SETS / REPS	REST PERIOD	SESSIONS A WEEK
1 – 2	4 low intensity drills	2 sets of 10 reps	2 min between sets	2
3 – 4	2 low & 2 med intensity drills	2 sets of 10 reps	2 – 3 min between sets	2
5 – 6	4 med intensity drills	2 – 3 sets of 10 reps	2 – 3 min between sets	2
7 – 8	2 med & 2 high intensity drills	2 – 3 sets of med & 2 sets of high intensity	10 – 15 sec between reps in box jumps, 2 – 3 min rest between sets	2
9 – 10	4 high intensity drills	2 – 3 sets of 10 for nonbox jumps, 2 sets of 10 for box jumps	3 min between sets	2

Conclusion

If trainer or athletes don't follow above mentioned determinants and principles in programming plyometric training, program is not going to be quality enough and ensure that we will reach our goal. Also we risk athlete's health and future sports results. Also every field and every method in which we have interest we must know well. Pliometrics is method that improves certain motoric abilities only if it is performed with caution and in wright way.

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TALENT IDENTIFICATION AND DEVELOPMENT IN SOCCER

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Abstract

The pursuit of excellence in soccer may be broken down into the key stages of talent detection, identification, selection and development. Various talent identification models have been promoted and adapted to suit local soccer and cultural contexts. Nature and nurture interact in the process of realizing soccer potential although not in a simple or predictable fashion. Scientific disciplines can be employed to inform personnel concerned with the processes of developing young soccer players; there are many sociological considerations also, especially related to supportive mechanisms. A multidisciplinary scientific approach towards providing a support system for practitioners is likely to be most productive in attempting to help gifted young players realize their aspirations.

Introduction

Professional soccer offers material rewards and acclaim for those who are successful. Adult players can command lucrative salaries if they are good enough to move to the top clubs whilst the clubs who had nurtured young star players benefit financially from their transfer. Clubs spend considerable effort in attempting to 'spot' potential stars and later draw their first team from the development of their own youngsters. Identification of players with good potential helps to ensure that these young players receive specialized coaching and training to accelerate the process of talent development. Furthermore, the reliable identification of talent allows the club to target its resources on the few individuals who are selected for systematic development, ensuring a more effective investment for the future.

As club and country need to produce young talented players, sports scientists can play a role in working alongside coaches, scouts and administrators, each of whom must underline key elements of the talent identification and development process. As professional clubs throughout Europe have systematized their 'football academies' as the cradle for their young players, they have increasingly utilized sports scientists for help in guiding and evaluating their talent identification and development processes.

Talent has several properties that are genetically transmitted and therefore innate. Nevertheless, talent is not always evident at an early stage but trained people may be able to identify its existence by using certain pointers. These early indications of talent may provide a basis for predicting those individuals who have a reasonable chance of succeeding at a later stage. Very few players are outstanding in each single domain; indeed if all children were equally gifted, there would be no means of discriminating or explaining differential success. Furthermore, talent is specific to that particular domain.

The complex nature of talent is highlighted by these principles. It is not surprising, therefore, that there is no consensus of opinion, nationally or internationally, regarding the theory and practice of talent identification. Usually professional clubs depend on subjective assessments made by their experienced scouts and coaches, employing a list of key criteria. These criteria are expressed as acronyms; for example, the key phrase incorporated in the scouting process of Ajax Amsterdam is TIPS, standing for technique, intelligence, personality and speed. Alternative lists include TABS (technique, attitude, balance, speed) and SUPS (speed, understanding, personality, skill).

Talent identification and development

There are four key stages in the path to excellence that culminates in the ideal of 'perfection'. These stages can be described as detection, identification, selection and development. Talent detection refers to the discovery of potential performers who are currently not involved in the sport in question. Due to the popularity of soccer and the large number of children participating, the detection of players is not a major problem when compared with minority sports. Talent identification refers to the process of recognizing current participants with the potential to become elite players. It entails predicting performance over various periods of time by measuring physical, physiological, psychological and sociological attributes as well as technique abilities either alone or in combination (Régnier et al., 1993).

An attempt is made to match various performance characteristics, which may be inborn or susceptible to learning or training, to the requirements of the game. Whether the individual has the potential to benefit from a systematic programme of support and training is a key consideration. Talent identification has been viewed as part of talent development in which identification may occur at various stages within the process. Talent development implies that players are provided with a suitable learning environment so that they have the opportunity to realize their potential. There has been a shift

in emphasis from talent detection and identification to talent guidance and development (see Durand-Bush and Salmela, 2001). Finally, talent selection involves the ongoing process of identifying at various stages players who demonstrate prerequisite levels of performance for inclusion in a given squad or team. Selection involves choosing the most appropriate individual or group of individuals to deliver performance requirements within a specific context. It is especially pertinent in soccer since only 11 players can be selected to play at any one time.

Scientists have, for many years, tried to identify key predictors of talent in different sports (for a review, see Régnier et al., 1993). In this type of research, particularly evident in Australia and former Eastern bloc countries, attempts are made to identify characteristics that differentiate skilled from less skilled performers and to determine the role of heredity and environment in the development of expertise. This research has embraced various sports science disciplines, including the natural, behavioral and social sciences.

Nature versus nurture

The age-old question is whether talented footballers are born such or whether footballing talent is developed with practice. It is intuitively apparent that soccer skills are common to many fathers and sons, and between siblings. The conventional approach towards quantifying respective contributions from heredity and environment was to measure either the distance or similarity between individuals of the same generation with known biological relationships. The influence of genetics was expressed as a heritability coefficient and data for a range of measures relevant to soccer are summarised in Table 1. For some measures such as maximal oxygen uptake, the variability within the population is greater than the improvements expected from an optimal training programme, implying the importance of genetic endowment.

The influence of heredity is strong in an anthropometric measure such as height. Coaches in soccer academies may wish to predict adult stature when dealing with underage players. Prediction nomograms using present stature and mid-parental stature may be used for this purpose but even so, the error of prediction is not insubstantial (see Reilly et al., 2000).

Table 1. Heritability coefficient estimates of variables related to talent in soccer (mean ± s or range)

Anthropometry	
Height	0.85 ± 0.07
Leg strength	0.80 ± 0.10
Height^3/weight	0.53 ± 0.19
Skinfolds	0.55 ± 0.26
Ectomorphy	0.35–0.50
Mesomorphy	0.42
Endomorphy	0.50
Physiology	
VO_{2max}	0.30-0.93
Slow-twitch muscle fibres	0.55-0.92
Anaerobic power	0.44-0.97
Muscle endurance	0.22-0.80
Field and performance tests	
Sprinting	0.45-0.91
Jumping	0.33-0.86
Flexibility	0.69-0.91
Balance	0.24-0.86
Static strength	0.30-0.97

There is also a systematic bias in judgments when young players have been selected for specialised training. It seems that those born towards the start of the competitive year have an advantage, as have those individuals who are biologically more mature than their chronological age. In contrast those born late in the competitive year and those whose biological age lags behind their chronological age tend to miss out when selection is made at an early age.

Physiological measures such as maximal oxygen uptake (VO_2 max) have been successful in distinguishing between expert and intermediate young players, but they may not be sensitive enough to distinguish players already selected and exposed to systematised training for national teams. Franks et al. (1999) analysed data from 64 players who attended the English Football Association's National School (14-16 years) between 1989 and 1993. Anthropometric variables as well as aerobic and anaerobic measurements were recorded. Players were categorized according to playing 'position' and whether they had signed a full-time 'professional' contract on graduation. No differences were found between those who were deemed to be more or less successful. In a group of youth players already highly selected, other factors may determine their employability as professionals. Talent may become harder to predict in later years since the population of players becomes smaller and more homogeneous, particularly with respect to their physical and physiological profiles. Those who have not developed the requisite characteristics tend to drop out of the sport at an early age.

Physiological measurements may be useful alongside subjective judgements of playing skills for initial detection of talent, but such measures do not appear sensitive performance indicators on a global basis and can not be used reliably on their own for purposes of talent identification and selection. Moreover, while research using twin siblings has indicated that physiological characteristics are highly genetically predisposed, appropriate training can have a pronounced influence (see Bouchard et al., 1997). Whilst some people may be more favoured genetically than others to adapt and benefit from training, physiological responses to exercise are highly dependent on regular training and practice.

Professional soccer is played nowadays at a higher 'tempo' than 10 years ago (Williams et al., 1999). It is likely therefore that physiological correlates of work-rate during games have gained in importance in the context of fitness

for soccer. Physiological values indicative of aerobic fitness, such as $\dot{V}O_2$ max, may be more influential in successful performance in the future. Consequently, a relatively high threshold for maximal oxygen uptake may be a significant criterion when young players are assessed. However, there is concern about the extent to which a high fitness indicator tracks through from childhood to adulthood.

An interdisciplinary approach

A glimpse into the requirements for elite football play is likely to be incomplete without incorporating different scientific disciplines. For example, a player who possesses the anthropometric and physiological predispositions for success must also have an array of psychological attributes. Whilst no single personality profile is predictive of talent in soccer, psychological factors such as stress tolerance, commitment to training and mental toughness are highly relevant.

An interdisciplinary approach was adopted by Franks et al. (1999) in amalgamating physiological, psychological and performance measures. The latter include skills tests (see Table 2) and fitness variables. The battery of tests was successful in separating elite from sub-elite young players, the elite youngsters having superior values in aerobic and anaerobic factors, were faster in running over short distances and in agility runs. A 'dribbling' test was a better discriminator than passing or shooting. The most significant mental function was the ability to anticipate forthcoming events, a cognitive faculty that is characteristic of game intelligence.

Table 2. Skills tests for 12-13 year olds.

Wall – volley test	4 x 30 s trials
Shooting test	9 shots with each foot
Slalom dribble	4 trials
Straight dribble	4 trials

The main value of applying a multivariable fitness assessment battery may be in establishing a database for each age group. These reference values may then be employed as a yardstick against which future assessments can be compared. The data collected may be located as a percentile on the reference database in order to provide feedback to young players and their mentors. In this way strengths and weaknesses may be identified and remedied by means of appropriate training programmes.

Whilst there may be physical, physiological and psychological factors predisposing towards successful performance in soccer, dedication to training over many years needs also to be underlined. At 16 years of age, recruits to Football Academies in England have experienced an average of 10 hours per week training over a 10-year period. This load amounts to 700 hours per annum, 7000 hours in total and 10,000 hours before a debut on the first team selection is expected.

As the training context is important in the development of potential talent, consideration should be given to making practices as enjoyable as possible. One way of doing so is by means of small-sided games. Platt et al. (2001) compared 3 vs 3 and 5 vs 5 for use with under-age players. The smaller groups spent more time in high-intensity activity, covered more distance and operated at a higher heart rate than did those playing 5 vs 5. Furthermore the 3 vs 3 players had more passes, shots, dribbles and tackles than those in the 5 vs 5 condition. The former therefore incorporated the superior physiological stimulus as well as the best context for practice of game skills. The size of the pitch and the specific age group are relevant considerations in such small-sided games.

Social factors

The validity of relying solely on physical, physiological or psychological measures to predict potential in sport has been questioned by sociologists. In their view, having supportive parents, a stimulating and permissive coach and the dedication and commitment to spend many hours practising and refining skills are the real determinants of excellence. According to this approach, there are no early predictors of adult performance. Instead, players should be provided with access to appropriate facilities and opportunities for meaningful practice. Investment in high quality coaches and coach education systems is crucial. Technical support in terms of sports science and sports medicine is essential to ensure that players have the opportunity to fulfill their potential. Football clubs have a responsibility to invest in youth, providing children of today with the opportunity to be nurtured into tomorrow's 'superstars'. To this end, a more equitable balance between players' current salaries and investment in talent identification and development is paramount.

The concept of readiness recognizes that learning is more rapid and enjoyable at a defined development stage of growing up. Readiness to learn occurs following an accumulation of events and/or experiences enabling the learner to acquire additional information, skills or values (Seefeldt, 1996). Yet, many young children are forced into competitive soccer before they are ready to do so. On average a child is first exposed to competitive soccer between the ages of 6 and 8 years, although exposure sometimes occurs as young as 3-4 years. These occurrences arise primarily from the assumption that early exposure enhances a child's chances of later success. Early exposure to competitive soccer may also increase the risk of injury and drop out. When there is a match between the child's stage of growth, maturity and development and the level of demand presented by the sport, readiness for competitive youth soccer applies.

The responsibility and impact of "significant others" towards the social, academic and sporting development of talented youngsters demands further investigation. Significant others can include, parents, teachers, coaches, team-

mates, school-teachers, friends and so on. A child's social development may be greatly enhanced by the experiences and opportunities afforded by top-level sport performance. If the appropriate support mechanisms are not in place (i.e. determined and provided by significant others) then the child's social development may be impeded. Social restrictions and authoritarian structures embedded within a child's talent programme may restrict peer relationships, development opportunities outside of soccer and ultimately affect participation and performance.

Environmental and cultural considerations can also impact on the young players' chances of successful development. These include social class, economic factors and the extent to which the environment is structured to facilitate improvements. It appears that those most suited to the demands of soccer and capable of adapting to them physically, physiologically, psychologically, sociologically and perhaps, economically are more likely to be successful. The dynamic and transient relationship that exists between a child, his/her peers, parents, coach, teacher in conjunction with natural growth and sexual maturation, and its impact on performance at any given time, is a major factor in the development of talented youngsters.

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MODELLING OF SPORT PERFORMANCE THEORY AND MANAGEMENT OF PREPARATION OF ATHLETES

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Abstract

The formation of new knowledge in the field of theory of sports is a demanding process; however, it is indispensable for the improvement and understanding of the culture of sports. One of the basic problems of the sports culture is successful performance in sports which represents the fundamental value or constituent of the culture of sports. Performance of athletes is dealt with by the theory of competition performance and the system of preparation of athletes. A special problem of the theory of performance of athletes represents the evaluation and assessment of performance. To assess performance it is necessary to formulate criterion and subcriterion variables and to set up qualitative categories by means of which performance will be assessed. From the aspect of cause and effect, performance of athletes could be divided into attained actual performance and into potential anticipated performance. Performance of athletes in the systemic-cybernetic sense depends on the web of three levels of factors (macro, meso and micro). The theory of performance and the system of preparation of athletes should solve several questions. The answers to these questions, however, require the formulation of a suitable knowledge base, the construction of a suitable expert system shell and the solving of certain problems. Expert systems are becoming a more and more frequent form of methodological aids in resolving the problems in the field of the theory of sport performance.

Key words: *theory of sport performance - modelling - experts' systems - evaluation*

Introduction

Through sports preparation we thus educate, teach and train, in an organised manner, man in the field of sports. The goal of sports preparation is, of course, to achieve a suitable level of performance on the basis of standards and criteria that are specific to sport. There is a variety of such standards and criteria and they depend on the given sport form and its prevailing goals. Irrespective of the prevalence of either recreative or health-preventive or agonistic goals, sport is always in the function of a general goal, which is the improvement of the quality of man's life at all its stages (Morgan, 1994). The role and the functions of sport change in every period of life. Through sports preparation we can, in addition to the development of psychomotor skills, knowledge and abilities, also develop other abilities which are important for success at basic live activities, such as: industriousness, assiduity, creativity, endurance, perseverance, communication skills, perceptual cognition, conative balance, stability and adaptability, social adaptability, health stability, etc.

The essence of sports preparation lies - in addition to increasing the level of theoretical knowledge of sport, locomotor abilities and techniques - also in the qualitative development of man's psychomotor status, i.e. psychomotor abilities, which are a "sine qua non" of successful performance in sports. This could help man in his everyday life in resolving the tasks, demands and obligations that life and work bring. At the same time, a person with a higher level of development of the psychophysical status would better cope with everyday psychological and social stresses, and overcome the unforeseeable effects of the environment in which he or she lives and works. Sport can also ensure man a more pleasant social form of life as it opens him, in the narrower and wider sports social environment, possibilities of playing, making friends, new acquaintances, personal affirmation and assertion and similar.

Athletes who are oriented towards competition, achievements and top-level sport must, in order to be able to attain top-level achievements, prepare regularly, systematically and continuously several years. This period is characterised by intensive growth of sports performance and represents as such the most complex and responsible stage of their sports life. In today's competitive, achievement-oriented and top-level sport, success is not possible without a high level of knowledge, technological support, financial support, appropriate organisation and successful management. A multitude of factors which affect the achievement in sports requires in itself that a corresponding treatment should be based on a permanent cybernetic systems approach. By the application of this approach this multitude is arranged, within the organisational form of sports management, in such a way as to enable - according to the principle of correlation and subordination - to achieve the desired sports results at a simultaneous elevation of the level of organisational culture of sport.

When we look for an answer to the question "How to succeed in sports?" we should first ask ourselves "What does the term successful performance mean?", and "What do we want to achieve?".

Successful performance in sports is today much more than just a result achieved by the athlete, it is culture in the sociological and anthropological sense as it reflects its basic values and achievements.

Successful performance does not exist by itself. It is only recognisable on the basis of standards and criteria which define it. The standards represent the contents of performance, and the criteria represent the level of performance attained on an individual standard. Everybody carries in himself and sets up his or her own standards and criteria of successful performance. On the basis of these standards and criteria, man then develops the methods and procedures for such actions and decisions which will ensure him to progress on the path leading to the attainment of the target criteria on individual performance standards (Puppe, F., 1993).

The culture of successful performance in sports has different standards by which we can recognise it. Thus we distinguish between performance of; athletes, sports pedagogues and coaches, from the aspect of the level of development of sports technology, organisers and promoters of sports competitions, managers of sports organisations, managers in charge of sports marketing and financing, judges, sports event from the aspect of response of the public, scientists in the field of research and theory of sport, professional counseling institutions and bodies, etc...

Between individual standards or factors of performance in sport there exists a more or less orthogonal relationship. This means that performance on one standard is independent of performance on the other, and that if we are successful on one standard, this has no real connection with performance on the other standard. Each dimension of performance has its own equation of specifying the factors which determine it in a cause-and-effect aspect.

General dimensions and values of a success-oriented culture

Sport is a constituent of man's personal and social life and therefore successful performance in sports has also the widest possible implications, such as are: moral ethical, technical, economical, social, political, psychological and survival-related implications.

Successful performance is based on specific values, among which there prevail competitive spirit, individuality, productivity, cooperation, collective spirit and participation. At every moment in history, culture of success, as a constituent of civilizational development of a given society and its members, depends on a system of symbols (Allaire Y. & Firsirot M.E., 1985) which are expressed in myths, ideologies, rules, values, paragons and other various cultural artifacts (rituals, customs, special vocabulary, metaphors, acronyms, stories, legends, tradition, architecture, etc.).

Understanding sportculture is interwoven with the influence of practical, reflective and discursive consciousness

To comprehend and understand culture is the first goal of human civilization. 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. He is interested in the acquisition of knowledge of his everyday world only to the extent to which he needs such knowledge 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, and 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 world view. With the aid of scientific-logical reasoning based on the principles of formal logic, man will faster and more successfully change the stock of knowledge of everyday life which is based on the rules of common sense.

Man tends to explanation of practice, its generalisation, ordering, systematisation and rational explanation. This, however, is already a transition from concrete life to the abstract, from practice to theory or to discursive (=rational, logical) consciousness. And this is a domain of science and theories which constantly strive towards the formation of new knowledge and its practical reintroduction into practice (Blahuš P. at.al., 1988). .

In order to understand the meaning of sports culture it is necessary to know, from the aspect of discursive consciousness (=cognitive approach), the theory of sport as a complex interdisciplinary theory which tries to encompass all the essential issues in sport. Typical of it is constant changing and supplementing. Every day new and new hypotheses are being tested and new theoretical problems opened. The formation of new knowledge in the field of theory of sports is an exacting process, yet it is indispensable for the elevation and understanding of sports culture. Knowledge can be acquired only by means of a scientific method of work whose basic characteristics are that it can be tested, that it is objective, systematic, reliable, valid, and constant.

Theory of sports has its own structure. According to Matwejev (1981), important roles within theory of sport play:

- philosophical, organisational and management aspects of theory of sports
- theory of performance
- theory of sports education
- theory of sports recreation
- theory of preparation of athletes
- theory of training
- special theories and methodologies of individual sports
- sociological and psychological aspects of theory of sport (history of sport, sociology of sport, aesthetics of sport, ethics of sport, psychology of sport)
- fields of natural sciences of theory of sport (anthropology of sport, morphology of sport, biomechanics of sports, biochemistry of sports, neurophysiology of sports)
- metrology of sports
- narrower scientific logic disciplines (expert modelling, statistical and mathematical methods, computer science, informatics)
- sports medicine
- sports hygiene.

A point of departure for the development of the theory of sport represent philosophical and general methodological aspects of sports. By means of these sciences we ask ourselves about the meaning of sport, about its essence, the position of man in sport. Philosophy is based on the study of natural matters in sports and searches for the most general rules which regulate man's activity in sports. Philosophy deals with sports always as a whole (Kretchmar, 1994), using exclusively methods of reasoning. In order to escape from ignorance in sports, we must philosophize, which helps us in seeking for the reasons and explanations of events and processes taking place in our empirical world. Sport is directly incorporated in the living environment in which man completely freely acts, creates and builds his external and internal intellectual and emotional world view.

Sport is such a complex area that it is dealt with by an array of philosophical fields ranging from anthropology, ethics, aesthetics, metaphysics and dialectics, ontology, logic, philosophy of sports in the narrower sense of the word, up to the theory of cognition and theory of sports science.

Organisational and management aspects of sports deal with the organisation of sports and the characteristics of management of sports organisations and their members. The basic goal of organisation of sports lies in the elevation of the organisational culture of sports. This culture reveals in the various visible and invisible constituents. The invisible constituents are those which attract people to sport. The visible ones are a system of values and the level of development of the elementary factors involved in the organisational culture of sport (competition rules, execution of competitions, response to sports competitions, staff engaged in sport, technology of sports, transformation processes, sports events, etc.

Managing sports organisations must be directed towards the development of the constituents of the organisational culture of sport. Management is a mental, intuitive, sensational activity of people in an organisational system. This is a key subsystem in sports organisations as it connects and directs all other subsystems towards the achievement of the desired quality or performance level.

Management as a science is based, from the aspect of its contents, on the theory of sports and above all on the theory of performance, while from the methodological aspect, it is based on modelling and cybernetics as a science dealing with the management of complex dynamic systems. In management of sports, we have to do - knowingly or unknowingly - with expert modelling within the space of the theory of performance in sports whenever we think, make a decision, describe phenomena, people around us; whenever we are involved in concrete practice, in the formation of a certain notion (=model of thought) about objects; whenever we carry out simple thought simulations of the behaviour of models, think about proper management decisions and similar (Mallach, 1994). The most important realisation for management is that in its management practice there exists the external world which is independent of us and which is outside our observation. In order to represent it, we set up simplified verbal, descriptive, physical, pictorial, mathematical models.

As long as in management of sports we have to do with simple matters, as long as the study of them is only of a subjective nature, thought models perhaps suffice. As soon as we get involved in complex phenomena which consist of a large number of mutually interwoven processes, thought models become deficient and insufficient for efficient management. Such a model does not anymore allow us to understand the dynamics of mutual interaction and changing of the factors within the sports management system; we cannot anymore distinguish between the cause and effect. The reason for it lies in a limited capacity of information processing on a mental level. Although we are able to understand the concept of the process as such, our notions concerning the process itself are too complicated and inexact as too allow application. Without the use of models there could be no progress in the management of sports. Managers would remain at

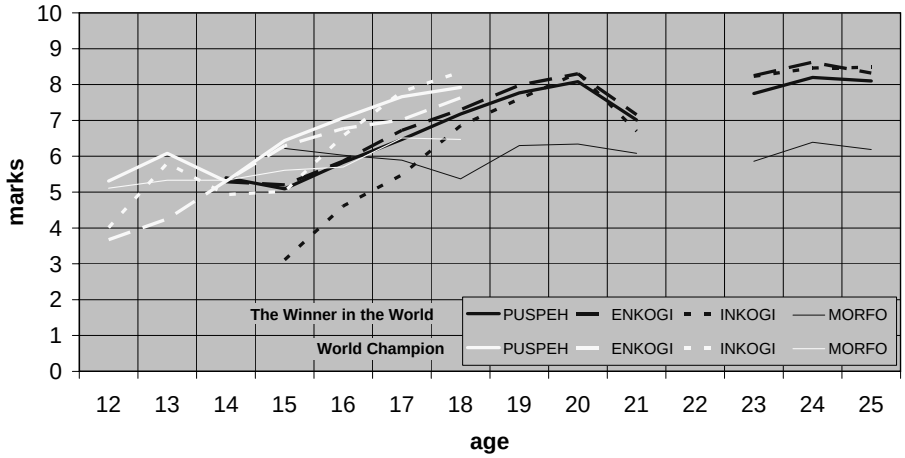
the level of "craftsmanship". Under the simplest modelling we understand that modelling of the performance and system of preparation of athletes, in which we describe our experiences and knowledge in one of the existing languages within the framework of the theory of performance and system of preparation of athletes.

In this way, our experiences and realisations become available also to others; they can be verified, confirmed, rejected, expanded or generalised. By the introduction of modern scientific methodology, the models as thought constructions in the management of sports become more and more scientific.

At the Faculty of Sports we have been monitoring the performance of athletes by means of the expert system Sport Expert for several years. To illustrate the application of this system, ski jumping was selected as in this sport; Slovene athletes achieve already by tradition top sports results which rank in the world class.

As an example of longitudinal monitoring of the development of potential performance from the aspect of morphological and motor variables, we have selected the winner in the world cup in ski jumping for the 1996/97 season and the World Champion for the 2005 (See table 1).

Table 1: Comparison of the results lines of the Potentiale Performance of the Winner in the Ski jumping World Cup in 1996/97 season and Ski jumping World Champion in the season 2004/05



Legend: PUSPEH – index of final potentiale performance, ENKOGI – index of energetics' component of motorics, INKOGI – index of informatics' component of motorics, MORFO – index of Morphological components of potentiale performance

The results of expert systems are only an aid which can enable better management of people in terms of elevation of performance on the selected standards and criteria. In this way, the decisions will be based on more scientific grounds; the value of information will be higher, and the system itself will be permanently oriented towards the growth of the quality of the organisational culture of sports.

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CHANGEABILITY OF LEVEL CO-ORDINATION ABILITIES AND SPORT TECHNIQUES IN WORLD ELITE SKI JUMPERS

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Introduction

Sport results are the resultant of many external and internal determining conditions. Their number rises considerably in the case of incommensurable sport disciplines. One of such sports is – ski jumping. The final result in ski jumps is composed of the length of the jump measured in an objective way, and the technical value assessed in a subjective way by the jury. Ski jumps which is considered as a co-ordination complex discipline requires the expression of precise and speed movements in varying conditions (Farfel, 1960; Starosta, 1988, 1989, 2003). The main component of this division is the precision of movements (Fig.1). High variability of conditions during ski competitions depend on: weather, temperature of the surroundings, wind, kind of ski jump and it's surface, illumination, reaction of the spectators, smearing of the skis, the length of the run etc. The complexity of the start in this discipline is enhanced by the fact that it is extremely difficult to correct the mistake committed during the "*take off at the threshold*". Recent years show the emergence of a large group of talented competitors in ski jumps, who demonstrate high levels not only in technical preparation. The outcome of it is the improvement of results, the rise in the number of competitors, the value of prizes, as well as the increased interest of the spectators. This year's competition in Garmisch-Partenkirchen for instance, gathered 10 thousand spectators, whereas the competitions in Zakopane – 11.4 million TV spectators. The discipline has lost its seasonal character, since competitions are also held in summer (on the igelite). Some competitors participate in 25-30 events a year. This requires the maintenance of high preparation level during many months. The competitor is not a bio-machine and the "*collapse of sport form*" may affect the best athletes. Hence, the continuously changing list of competitors who take up the leading positions during ski jump events, and also in general classifications of the World Cup are observed (Starosta, 2003b).

Suggested degree of sports discipline complexity			
	12	**III Precision and movement speed in changing conditions**	1. Ice and roller hockey 2. Handball, basketball 3. Football 4. Volleyball 5. Judo, wrestling free style 6. Karate traditional - fight with the real opponent (Kumite) 7. Wrestling classical style 8. Fencing 9. Table tennis 10. Tennis, badminton 11. Kayak sport, alpine skiing 12. Cycling 13. Sky jumps
	11		
	10		
	9		
	8	**II Precision and movement speed**	14. Karate traditional - fight with simulate opponeni (Kata) 15. Figure and roller skating 16. Sport gimnastics 17. Sport acrobatics 18. Diving 19. Rhythmic gimnastics 20. Track cycling 21. Speed skating 22. Weight lifting 23. CompulsoNfigures-figure and roller skating
	7		
	6		
	5		
	4	**I Movement precision**	24. Archery 25. Pistol shooting 26. Basic skating 27. Basic roller skating 28. Karate traditional - technique improvement (Kihon)
	3		
	2		
	1		

III - Spatial, ttme and strength precislon of movement perfomed in minimum time unfts under changfng condtttons.
II - SpaOal, time and strength prectston ot movement pertormed in minimum dme untts (under atmoststandard conditlons).
I - Spatial, time and strength precision of movement performed accordlng to pattern.

Figure 1. Suggested classification of selected sports disciplines according to their degree of complexity - coordination level (Starosta, 2004)

The new situation has created problems inexistent so far in this particular discipline, though they have long appeared in such sports like: tennis, boxing, sport games and combat sports. However, the risk of suffering serious injuries or even a loss of life in the above mentioned sports is not as high as in ski jumps. In addition, different tactical variations and ways of sustaining high [level of preparation] physical fitness for a prolonged period of time have already been elaborated in their case. Even the best competitors of these disciplines experience *"failures"*. Organizers of the competitions, competitors themselves and spectators have already got used to these facts. In the extensive literature dealing not only with ski jumps, very little has been written about the causes

of fluctuations of sport results (Botwina, Starosta, 2002; Starosta, Handelsman, 1990; Puni, Starosta, 1979; Starosta, 2003). It seems that the subject belongs to the *"Secrets of the coaches' practice",* because only people connected with sport training take up this complex problem and analyze it from the point of view of the science of movement.

The work hereby takes up part of this vast problem and addresses it also to sport fans, who expect a series of successes from their favorites. The aim of the work was the: 1. Presentation of the specificity and co-ordination complexity of the ski jumps. 2. Definition of significance, structure and conditions determining the expression of movement precision in this discipline. 3. Establishment of causes of level of sport form fluctuations in top competitors, including A.Malysz.

Conditions determining the high level of sport technigues

Form and content of the technique

Among the basic components of the sport techniques, the most common are: form and content of technique (Fig.2). The form is composed of the "*external"* picture of the technique expressed in specific, purposeful and mutually determined relocation, in the position and movements of the arms, legs, head and the trunk, characterized by the ampleness of the movements, their speed, pace, rhythm etc.

The internal determining conditions, called the contents of the sport techniques, are frequently neglected. They are characterized by the invisible: functions of the central nervous system, manifestations of will, contractions, tension and relaxation of the muscles, or the use of their resiliency. Relevant is also the way of using gravity strength inertia, accelerations, decelerations (Ozolin, 1964; Starosta, 1988, 2000, 2003, 2003a).

Coaches most often pay attention to the *"external"* picture of the movement. It is sufficient in order to achieve a relatively high level of technique, but **mastership requires the "*external*" picture of the movement to be complemented by the *"internal one".*** This applies also to the outstandingly motor talented athletes, belonging to the sensor group (feeling). Such complementation demands a thorough co-operation of the coach with the athlete and extensive competitor's experience of the coach. It is easier to provide the nuances of the technique if one possesses own movement experiences. **This "*internal*" picture accounts for the highest level of technical mastership.** They include kinesthetic sensations specific to every sport discipline, which are expressed in a form of various kinds of feelings.

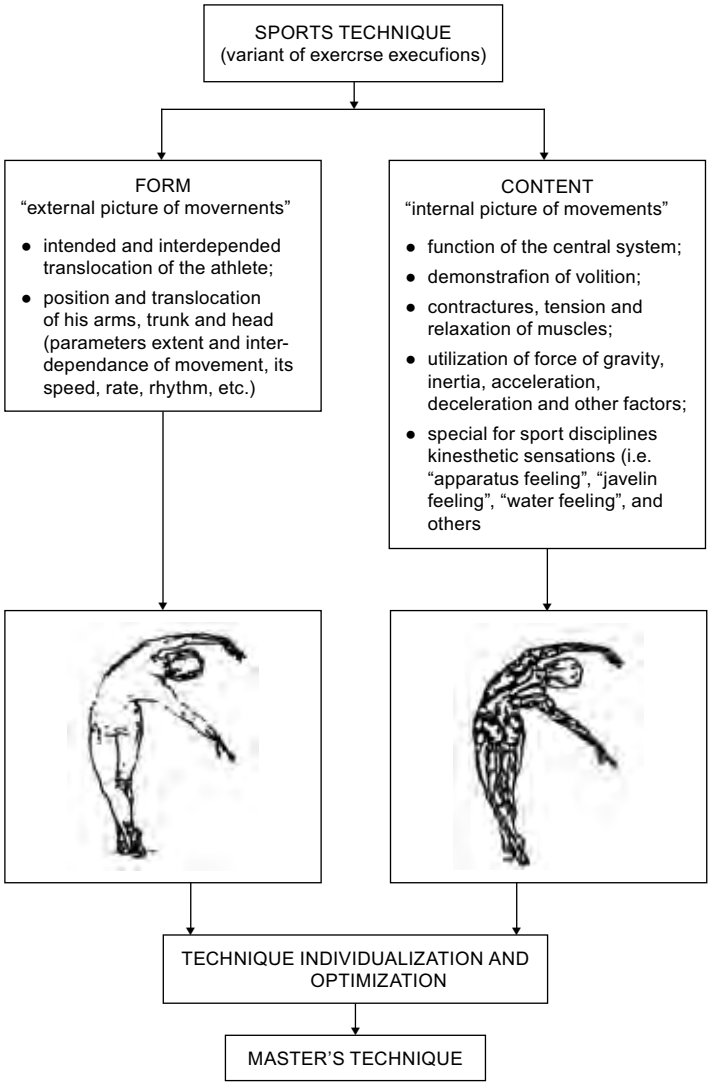

Figure 2. Components of sports technique (Starosta, 2001)

Specific variations of kinesthetic sensations (feelings)

In ski jumps there is a set of their variations characterizing every particular phase of the jump: i.e. "*feeling of the threshold", "body feeling" (*during "*take off at the threshold",* flight and *"landing"*), *"ski feeling'* (during different phases of the jump). The model technique of the jump involves the expressions of all kinds of feelings. The execution of such a jump occurs very rarely, even in the case of extremely sensory talented competitors. This refers to A. Malysz, S. Hannawald, M. Schmitt. The composition of such feelings is expressed by competitors being in a very high sport form, and it is of rather "*fleeting"* character. It changes often under the influence of various conditions: methods and training means, emotions, psychical and physical loads, kinds of exercises used, weather, psychical attitude, psychical micro-climate of the competitor (his nearest environment), value of the prize, results achieved by his rivals, pressure exerted on the competitor (i.e. expecting significant success) etc.

Sustaining a high level of these feelings for a prolonged period of time is extremely difficult, and is demonstrated only by the best athletes (Botwina, Starosta, 2002). This was the case of A. Malysz during the entire season, of S. Ammann during a short period (at the Olympic Games in Salt Lake Placid), and of S. Hannawald and M. Schmitt for a relatively long time.

The observation of the performance of the Polish competitors, the analysis of the interviews between the coach A. Tajner and A. Malysz, as well as the set of information from various sources, seem to confirm the fact that **coaches of the Polish national team in ski jumps, as in many other sport disciplines, focus primarily on the form of technique, neglecting it's content.** With a balanced level of movement forms of many athletes, the final result is affected by the content. In it the specific kinesthetic sensations are included: *"threshold feeling", "body feeling", "movement feeling", "ski feeling"* and other. (Starosta et al. 2002). The most important of them is the *"body feeling".* It may be defined as: "*...Ability of man to perceive consciously the position of his body within a specific environment and to use it rationally in order to achieve best sport results"* (Starosta, 2003*).* It differs whether in water or aerial environment. It may refer to the entire body or only to its parts. The expressions of this feeling are based on the ability of the spatial, time and strength differentiation of movements (Starosta, 1994, 2000, 2001, 2003).

The leading component of all kinds of feelings, which occur not only in ski jumps, is the precision of movements. It possesses 3 variations: referring to space, time and strength. In ski jumps these 3 kinds of precision form a rational succession of movement activities, and committing an error in one of its phases results in further errors. For example, performing a too strong take off at the threshold causes a high parable which shortens the distance of the jump. According to A.Tajner, such error was committed by A. Malysz (in this year's event of 4 ski jumps competitions). Suggesting an indispensable movement precision to the competitor is very complex. It depends on many kinds of specific feelings. Their deformation, as a result of training errors, may produce a significant and long-term lowering of the technical efficiency and sport results of the competitor. All the movement precision components are of crucial significance in competitors, whose main information channel is kinesthetic sensations. A.Malysz belongs to them. His sensor apparatus is extremely sensitive. It enabled him high (frequently recorded) and stable results in a long period of time. Such athletes are especially susceptible to the "snatching away" of the high level of the different kinds of feeling and to the deterioration of results following an irrational training program i.e. when applying excessive competition loads (too frequent participation in competitions) and training loads, improper development of strengths, making too high demands, etc.

Maximal strength and movement precision

One of the elements disturbing the exhibition of precision in various kinds of feelings is the intensive development of the maximal strength. In ski jumps, just as in many other disciplines, **the optimal strength is decisive in the use of appropriate technique.** On the other hand, maximal strength reduces the precision of movements and the efficiency of the technique (Starosta, 2001, 2003). The fact passed unnoticeable by some experts in bio-mechanics and experts in the science of movement. Acknowledging the matrimony of physical abilities (strength) and co-ordination (precision), a notion expressing briefly its essence "*strength precision*" was created (Rynkiewicz, Starosta, 2000). Attempts in this matter were made earlier: "*strength agility" or "strength deftness"* (Regner, 1973, Kuzniecow, 1975).

Excess of strength appearing in A. Malysz, which was widely discussed by A. Tajner, decreased the level of different co-ordination abilities, and mainly of the ability to differentiate movements (Fig.3). Strength belongs to these physical abilities, whose improper development adversely affects the level of some physical abilities (speed) and of all co-ordination ones. Excess of strength provokes the lowering of the ability to portion it, as far as strength, space and time. Lack of the portioning may adversely affect the following: the level of *"threshold feeling" "feeling of the take off force", "feeling of the optimal positioning of the body after exiting the threshold", and others.* All components depend on the kinesthetic differentiation of movements, including the contribution of the strength, spatial distribution of the movement, and of its components in time.

Substantial significance of movement precision was confirmed by the results of 11 researches conducted on juniors and seniors of the Polish national team in ski jumps (Starosta, 1994, 1997, 1998, 2001a, 2003). Particular attention should be given to the exceptional stability of results of the measurement of the ability to reproduce by heart the value of the movement amplitude in knee joints by the former best competitor – P. Fijas, who set the unofficial world record in ski flights – 194 m (Table 1).

The excess of strength of A. Malysz was the topic of discussion during one of the interviews conducted with his coach A. Tajner: *"He has got power in his legs, terrific power, but he uses it inadequately".* Significant was also his following statement: "*He has got even too much of it. In order to win it would be enough to have 80%. He wants to win and he turns on his full power, but it is impossible to jump so far".* Interesting were the recommendations given to Malysz; "*During the run he was to show calm and easiness, and at the threshold – delicacy".* The statement proves that the coach was fully aware of the error committed by Malysz, and provided the proper advice, since the delicacy of the take off signifies the portioning of the strength or "*strength precision".* However, he failed to observe the origins of this excess of strength, which he developed during the training. By the excessive development of Malysz's strength,

Table 1. Indicatory (hypothetical) correlation of physical and coordination abilities in sports training proces - free from the possibility of collisions area (space), discussion and threaten area (Starosta, 1999)

Kind of motor abilities		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Physical (fitness) abilities	1. Speed	x	!	0	0	!	0	0	0	0	0	0	0	0	0	!	0
	2. Strength		x	?	!	!	!	!	!	!	!	!	!	!	!	!	!
	3. Endurance			x	!	!	!	!	!	!	!	!	!	!	!	!	!
	4. Flexibility				x	0	?	?	0	?	0	?	0	0	?	0	0
	5. Jumping					x	0	0	0	0	0	0	0	0	0	?	0
Coordination abilities	6. Balance preservation						x	0	0	0	0	0	0	0	0	0	0
	7. Kinesthetic movements differentation							x	0	0	0	0	0	0	0	0	0
	8. Spatial and time orientation								x	0	0	0	0	0	0	0	0
	9. Movements rhytmisation									x	0	0	0	0	0	0	0
	10. Adequate speed reaction										x	0	0	0	0	0	0
	11. Movements connection											x	0	0	0	0	0
	12. Adaptation (transposition, combination)												x	0	0	0	0
	13. Cooperation													x	0	0	0
	14. Movement suggestiveness (expressiveness)														x	0	0
	15. Muscles relaxation															x	0
	16. Movements symmetrization																x

0 - free from the possibility of collision area ? - discussion area ! - threaten area

most probably the level of kinesthetic sensations that is – *"body feeling"* and its parts, including *"feeling of the take off strength"* - were decreased.

This can not be improved through recommendations, but only through exercises and activities directed at the restoration of the lowered level of the strength differentiation ability. Exhibiting optimal strength is only part of the problem. Proper *"exiting the threshold"* requires not only *"strength precision"* but also spatial and time. However, they should be exhibited in short time spans forming the feeling: of the *"correct exiting the threshold", "assuming an optimal position of the body", "of the body during the steering of the movements from the start till the end of the jump", " preparation to a proper landing" etc.* In order to harmonize these components, high level of many co-ordination abilities is needed: movement differentiation, space and time orientation, rhythmisation and symmetrization of movements (Starosta, 1984, 1994, 2001b), balance maintenance, relaxation of muscles and others. Their levels might have been lowered in the case of A.Malysz as a result of an intensive development of strength.

It seems that an analogous mistake was committed in the preparation of S. Hannawald. After an unsuccessful start of the season and the recognition of the mistake committed, he was recommended a break in competitions, after which he returned in top sport form. Most probably, during the break, a large number of relaxing and co-ordination exercises were applied. His recovery could have taken place much faster, because he was not the only competitor in the German team that would achieve significant results. A. Malysz being the only leader in the Polish team could not afford to have a break in the competitions. Moreover, parallel to the effects of training errors, a discordance between the evaluation of his form by the coach, his self-evaluation and the results obtained during competitions, appeared. This could have caused additional emotional stress, which could be determined as follows: *Everybody, including him, expected success, which failed to come".* Such pressure generates "*stiffening"* of muscles, which lowers the ability to differentiate movements.

The phenomenon of successful competitions of the competitors after a break

This happens in many sport disciplines. It was often described but never scientifically justified. It refers to the fact that a competitor, after a long break in competitions, obtains results nearing his life record and sometimes exceeding it. Very often breaks are caused by injuries suffered. Such phenomenon takes place also in ski jumps. The most frequently mentioned case is the one of S. Ammann, who after suffering serious injuries during the execution of the jump has been hospitalized for a long time. Next, shortly before the Olympic Games in Salt Lake, he resumed his starts to win 2 gold medals in the most important competitions. Similar cases concerned S. Hannawald, who began his season in a disastrous way. After several unsuccessful competitions he withdrew. He returned to the ski jumps after 3 weeks and started to achieve top places (2nd place in the World Cup in 2002).

How the phenomenon can be explained? Firstly, it concerns competitors who are exceptionally motor talented, and who achieve considerable results in the international arenas. Secondly, the phenomenon refers to well experienced athletes with a long practice. Thirdly, such *"come backs"* are described only in the case of those who achieved success. Little is known of the statistics in those whose returns were ineffective. Therefore, the phenomenon may not be treated as a common one, and it would be unwise to suggest others that they should stop competing (interrupt their training) because an improvement in their form would be noticed after the break. Successful *"come backs"* are the result of a

number of favorable circumstances: the injury suffered did not incite negative changes in the competitor's psyche; the break was caused by excessive physical loads and psychical fatigue; little diversified rhythm and content of the training applied; the competitor possessed a grounded motivation and strong will to prove that he can achieve better than before; the competitor practiced individual sports; he made a positive self-assessment of his own movement and psychical development (Botwina, Starosta, 2002).

These conditions strongly determine future success. However, they are not sufficient. Relevant is the realization of a precise program. As we learn from careers of top competitors, priority should be given to; a) the notional training aimed at the reproduction of specific for the given discipline kinesthetic sensations, particularly feelings (in ski jumps *"feeling of the take off", "feeling of exiting the threshold", "body feeling", "ski feeling" and other);* b), application of new exercises aiming at the rising of the levels of the necessary co-ordination abilities in a given sport discipline; c), practice of a related to the present specialization, or a contrasting sport discipline; d), use of the extensive self-educating program; e) sustaining visual contact with the discipline practiced, following and analyzing results of former rivals; f) expanding theoretical bases of the discipline practiced; g), maintaining an enthusiastic attitude towards the discipline practiced so far.

Fulfilling of part of these conditions may induce a successful return to the sport practiced. *"Refreshing"* kinesthetic sensations specific of a give discipline should be priority in such a program (Fig.3). In sensitive athletes (sensory)with a higher level of co-ordination abilities, the process of "*refreshing"* takes place faster and more effectively. A long break in the training lowers this feeling, and a short one lowers its "*refreshing"* , but in only in high class competitors. The break before the Olympic Games in Salt Lake was beneficial to A. Malysz, but much less to his colleagues from the team (Starosta, 2002).

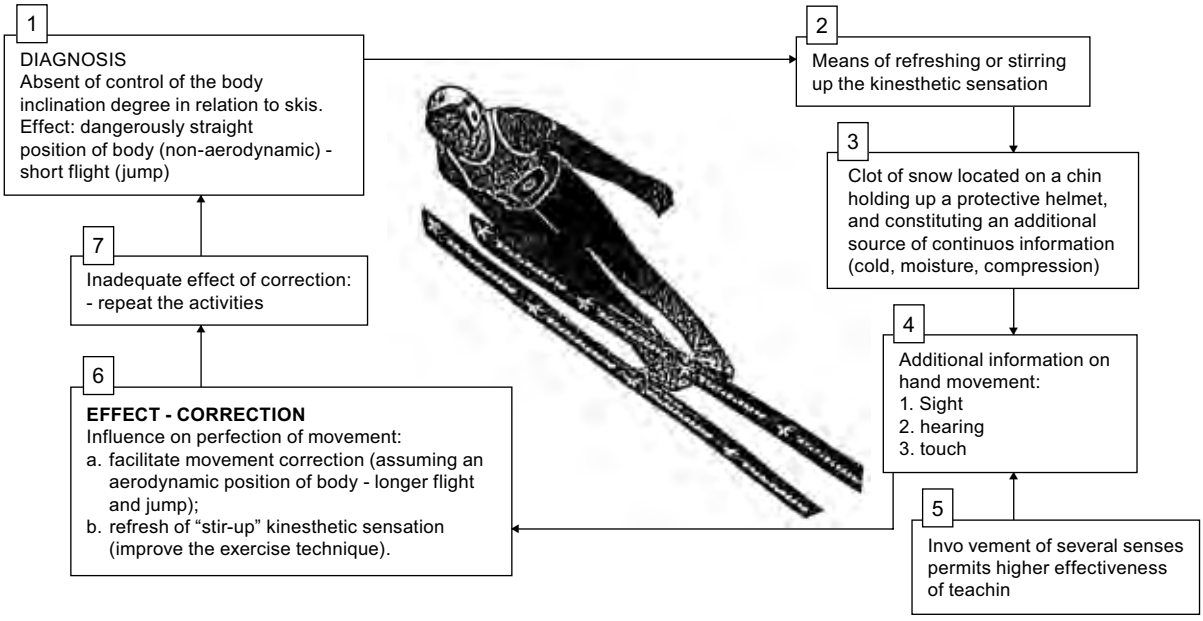

Figure 3. Refreshing or "stirring-up" of kinestetic sensations during the improvement of ski jumping technique (Starosta, 1994)

Conclusion

Appropriately to the aims, I tried to define the significance and determining conditions of the level of movement precision in ski jumps, as well as their effect on the stability of sport results. I tried to demonstrate strong connections of precision with an appropriate development of co-ordination abilities, as well as the destructive impact of the irrationally developed strength. The pretence for these considerations was a particular sport discipline. Many of the issues presented may refer to other disciplines. Ski jumps belong to co-ordination and technically complex disciplines. Most of the co-ordination abilities form a set of specific kinds of feelings. Sport result depends on their level. This level is, to a large extent, conditioned genetically, but it is also subject to development during the process of sport training. It is higher in exceptionally movement talented competitors, for whom the sensory information channel is the leading one. The set of these feelings is prone to fluctuations and is determined by i.e. high level of sport mastership, motor experience of the competitor, adequate methods and training means, motivation, emotions, ability to cope with stressful situations. One of the main factors adversely affecting the level of these subtle kinds of feelings is the irrational development of strength abilities. Their too high level may interfere in the correct course of movement abilities of the competitor, and may also

lower their quality. This happened with some ski jumpers, including A. Malysz. Some ways of restoring a higher level of specific kinds of feeling and their determining conditions were presented in the work hereby, however they do not exhaust the problem presented to which the author devoted part of his monograph (Starosta, 2003).

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METHODOLOGY OF SCIENTIFIC RESEARCH ON TEAM SPORT GAMES IN CROATIA

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Abstract

For a very long time great attention has been paid in Croatia to scientific research projects on the sport games. Several directions are recognizable in the research of the sport games, on the one hand, measurement and determination of latent structure of basic and specific anthropological characteristics and performance indicators, and on the other hand, researches on influence of training programmes on changes in indicators of preparedness of players.

Fifteen medals won at the most important competitions in the last 13 years is the fact that put Croatian national basketball, football, handball, volleyball and waterpolo senior teams at the top of the world quality.

Key words: *team - sport games, scientific research, methodology*

Introduction

Scientific approach to and methodological orientation in research on team sport games in Croatia has followed specific, but typical path: in the beginning pure theoretical, in fact hypothetical thesis were published, then empirical insights were revealed, and nowadays experts and researchers base their knowledge of theory, methods and programming in sport games on research methodology and experimentally obtained findings and concepts. Enlarged body of knowledge on sport games is also a consequence of the development of research methodology. Experimental orientation has been connected with the process of solving three crucial, interrelated methodological issues:

1) Procedures for analysis and evaluation of sport games' characteristics must have been applied to find out principles governing particular sport activity. Structural and biomechanical analyses of technical-tactical elements are compounds of the kinesiological analysis which implies segmentation of a complex sport activtiy into phases and subphases of the game, jobs and technical and tactical tasks players must perform during the game.
2) Kinesiometric issues should have been solved to find out instruments and procedures adequate for unbiased measurement and assessment of the components of training effects and sport form.
3) Issues related to data analysis methods should have been also solved, that is, certain ways should have been found to process the collected data and to transform them into clusters of useful information for operational purposes of designing training programmes.
4) Didactic issues should have been solved, that is, optimal methods and algorithms should have been defined for designing of efficient programmes of sport training, competition and recovery, as well as for training effects control in various points and cycles of sport preparation.

In the last 12 years great attention has been payed in Croatia to scientific research projects on sport games. The research projects have assimilated findings from the research projects started back in 1960's, but they have also included more advanced protocols of collecting data on characteristics of athletes and features of particular games, as well as new technologies in training programmes. Scientific approach to sport games has undoubtedly contributed considerably to glorious achievements of Croatian national teams. Giftedness of Croatian athletes, tradition and popularity of basketball, football, volleyball, handball and water polo in Croatia, together with the well organised scientific research activities and application of their inferences and findings to practice enabled Croatian national teams to win 15 medals at major international competitions (Table 1).

Table 1. Achievements of Croatian national senior teams at great international competitions (OG – Olympic games; WC – world championships; EC – European championships)

Sport game	Gold medal	Silver medal	Bronze medal	Total
Basketball		OG 1992	EC 1993, WC 1994, EC 1995	4
Football			WC 1998	1
Volleyball (W)		EC 1995, EC 1997, EC 1999		3
Handball	OG 1996, OG 2000, WC 2003	WC 1995	EC 1994	5
Water polo		OG 1996, EC 2003		2
Total	3	7	5	15

Factors of success in sport games

Analysis of sport activity, assessment of training effects and modelling of training process in sport games implies exact determination of several interrelated factors (Mraković, 1992): **first**, integral and clear insight into the state of fitness of athletes should be obtained at the beginning of the training process; **second,** exact definition of the eventual, targeted state should be provided, and **third,** training operators should be precisely defined by means of which optimal training effects and desirable sport form can be accomplished. Hence, for a training programme to be effective, one must first define its purpose in terms of transformations of abilities, characteristics and motor knowledge. Goals and tasks of training (Milanović, 2004) should be made operational by information on the structure and status of, for success in a particular game crucial, basic and specific anthropological features, motor skills and performance indicators (Figure 1).

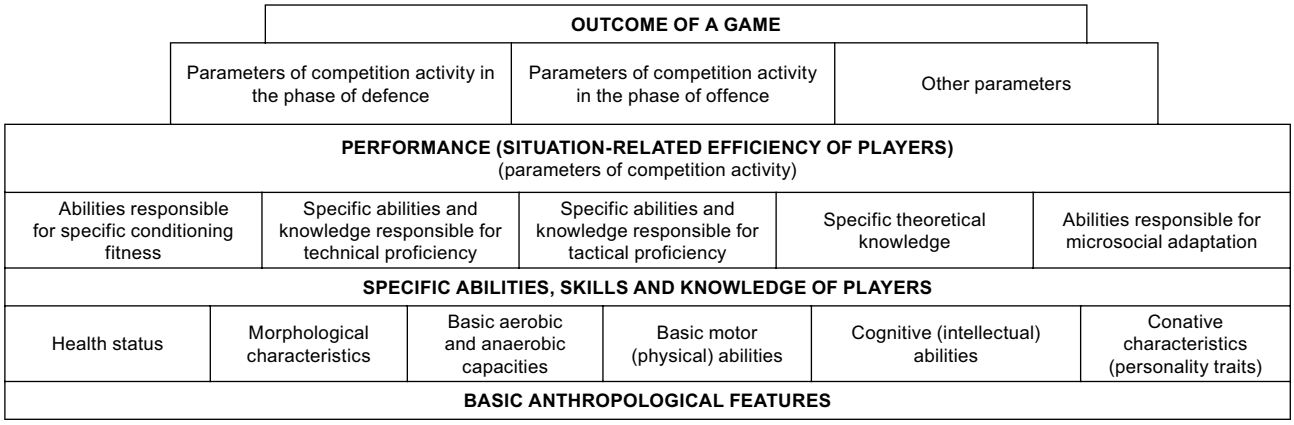

Figure 1. Hierarchical structure of factors of success in sport games (Milanović, 2004).

All the listed factors have strong influence on objective determination of training effects (planning) and on selection, prescription and distribution of training contents or operators (training programming; hypothetical equation of success) in the function of realisation of the desired goals or high sport achievements.

Methodology of research on team sport games

Several directions are recognisable in the research on sport games;

1. measurement and assessment of basic and specific anthropological characteristics and performance indicators,
2. factorial studies aimed at determination of latent structure of variedly structured manifest variables assessing particular components of preparedness (fitness) of players,
3. studies on relations between predictor variables and variedly defined criterion variables describing performance,
4. studies on the differences among samples of subjects in indicators of fitness and sport form, divided according to age, gender, sport experience and sport quality, ,
5. studies aimed at determination of training effects, that is, of influence of various progammes of training on transformation of abilities, characteristics and motor knowledge (skills) at various points in the periodization of sport preparation.

Research on basic and specific characteristics of players and performance indicators

Manifest characteristics of training effects are the measured features of players' sport condition, which are transformable under the influence of long-term sport preparation training programmes and on which features players' performance in the game depends. Training effects, that is, components of fitness or preparedness are assessed by reliable, objective and valid tests. Each training process should start with the initial measurement of sport condition of each player. The obtained results are then compared to the model values achieved by the top-level players. So, an insight into the strong and weak points of sport condition of each player can be gained, so the training process can be programmed to desirably improve these features. The same measuring instruments are used to control transitive states of training effects. Any deviation from the planned dynamism of transformation is corrected by adjustments of the training programme in accordance with the competition schedule. At the end of the transformation process (training programme) the same tests are used to determine the final state of training effects (preparedness).

In the last 20 years over 100 research studies have been conducted at the Faculty of Kinesiology, Zagreb, Croatia, the goal of which was to determine training effects and characteristics of conditioning of players of sport games, women

and men alike. In certain works optimal procedures have been defined for measuring and assessment of anthropological characteristics in basketball (Milanović et al., 1989; Milanović & Jukić, 1997) and volleyball (Janković, 2003). Good examples of assessment of morphological features of players can be found in studies of anthropometric characteristics of female basketballers (Matković Bo. et al., 1994) and female volleyballers (Matković Br., 1999). High developmental level of aerobic and anaerobic capacity was registered in the samples of Croatian basketballers (Heimer et al., 1990), footballers, the participants of the 1998 FIFA World Cup (Matković Br. et al., 1999), and top-level handballers, both men and women (Šentija et al., 1997). Motor abilities, as a crucial factor of performance, have been evaluated in numerous research studies. Milanović and associates (1996) and Vuleta and associates (1999) deal with diagnosis of functional and motor abilities as the criteria for selection of basketballers and handballers. Jukić and associates (2003) determined possibilities to form homogeneous groups of basketballers in the process of physical conditioning. Jerković and Barišić (1997) established quality systems for measuring and assessment of basic and specific motor abilities of top-level footballers.

One of the important subjects of studies on sport games in Croatia is registration and evaluation of standard performance indicators. Possibilities of game statistics registration have been determined in basketball (Trninić et al., 1999), water polo (Šimenc et al., 1997), volleyball (Janković et al., 1999), handball (Brčić et al. 2000), and football (Miljković et al., 2002). Criteria of competition performance have been defined in the studies.

Detemination of latent structure of indicators of fitness in sport games

The most important factors* that determine performance of players in the game cannot be directly measured. Directly measurable are only their manifestation which are under the influence of the same or similar regulatory mechanisms or functional systems. Therefore, procedures for determination of latent contents, that is, of manifest variables assessing various abilities, characteristics and knowledge of players, are used in research on sport games. The latent structure of training effects can be assessed in each and every period of training process by means of adequate tests with satisfactory metric characteristics (sensitiveness, reliability, objectivity and validity)

Unfortunately, nowadays, research studies on latent structure of training effects in sport games are scarce. It can be justified by an insufficient number of high-quality athletes who are willing to be subjects in research studies, so no wide generalisation of the obtained findings is possible.

First research investigations aimed at evaluation of latent structure of indicators of training effects were conducted twenty and more years ago. Analyses of reliability and factorial validity of the situational-motor tests as the indicators of training effects were performed by Blašković and associates in basketball (1982), Strahonja and associates (1982) in volleyball; Gabrijelić and associates (1982) in football, and Pavlin and associates (1982) in handball. Trninić and associates (1995) determined the latent contents of standard performance indicators in basketball, and Jukić and associates (2002) the latent structure of physical conditioning as an important factor of general basketball efficiency.

Research on relations among abilities, characteristics, motor knowledge (skills) and indicators of performance in sport games

Training programes are mainly focused on those dimensions of anthropological status that are positioned high in the hypothetical hierarchical equation of success in a particular sport game. For quite a long time now research studies have been conducted in Croatia the purpose of which is to determine relations among various groups of anthropometric, functional, motor, cognitive, conative and social variables and variedly defined criterion variables of success in sport games. Methods of canonical and regression analyses were used in several studies to assess predictive power of particular manifest and latent features (basic, specific and situational) of fitness of players in terms of their playing efficiency. On the basis of the obtained information on relations among the variables assessing basic motor abilities, like strength, speed, agility, coordination, flexibility and others, and the variables assessing situation efficiency in the game, clusters of training operators of general and basic physical conditioning can be defined in the function of improving performance. It is crucial because all the procedures of teaching and exercising are oriented to full utilization of motor potential in performance of technical-tactical tasks during the game.

In several investigations, made in 1980's, significant positive relations were determined between situation-related and motor factors and rates of performance in basketball (Blašković & Milanović, 1983), football (Gabrijelić et al., 1983), volleyball (Strahonja, 1983), handball (Šimenc & Pavlin, 1983). Ten years later significant predictive power of performance indicators was determined in several studies as regards success in football (Jerković & Barišić, 1993), volleyball (Marelić, 1994), basketball (Trninić et al., 1995; Dizdar et al., 1996). Recently, several studies indicated to significant relations between shooting variables and final match outcomes in basketball (Jukić et al., 2000) and handball (Vuleta et al., 2003).

* *Defined as latent dimensions obtained by statistical procedures (methods and algorithms for data processing) in which n measured manifest variables can be reduced to smaller number of k latent dimensions.*

Research on the differences among groups of subjects in indicators of training effects

The differences between groups of subjects in the variables assessing morphological, functional, motor (basic and specific), microsocial, conative and cognitive dimensions are analysed, as well as performance indicators. The obtained information can be used in the process of selecting potential top-level athletes. And vice versa, selection criteria are appearing as a generator of the differences among the groups of adult athletes. The second important generator of differences is a long-term training process concentrated on the development of all components, but particularly on crucial components of efficacy in the game. Statistical significance of differences is most commonly tested by univariate and multivariate analyses of variance and covariance and by discriminant analysis.

Considerable contribution to understanding of the differences among different groups of subjects in sport games was made by the studies on the morphological differences of footballers playing on different positions (Matković Br. et al., 2003) and on the differences in functional abilities of footballers of various age (Milanović et al, 1998). The significant differences between the winners and the defeated teams were determined by Trninić and associates (2002) and in water polo Šimenc and associates (2000). Milanović and Jukić (1997) made a significant contribution to understanding of differences in physical conditioning of cadet, junior and senior basketballers. The findings may be applied topractice as the selection criteria as well.

Research on influence of training programmes on changes in indicators of training effects

Two main directions may be recognised: on the one hand there are research studies on effects of exercise methods (physical conditioning) and teaching methods (technical-tactical training), and on the other, there are investigations on the effects of training programmes conducted in various cycles of sport preparation. The obtained results directly improved technology of sport preparation in particular sport games. Various methods, algorithms and programmes for analysing changes in indicators of, most frequently, physical conditioning, induced by the training programmes, are used nowadays. This includes verification of hypotheses on differences among numerous transitive states of fitness and sport form during the annual and/or perennial periodisation cycle. Scientific foundation of the process of designing transformational processes in sport games was enabled by the findings of the following research macroprojects: *Anthropological, methodological and didactical issues of kinesiology – programming and control of transformational processes* (Milanović et al., 1985 - 1989), and *Programming kinesiological transformational processes* (Milanović et al., 1991 - 1995). The research findings have been verified in several studies on training effects in basketball (Milanović & Jukić, 1992; Milanović et al., 1994, 1996; Jukić et al., 1998), handball (Bojić et al., 2002; Vuleta et al., 2001, 2002, 2003) and football (Jerković e al., 1999). A high quality level of planning, programming and control of training, as well as of training effects measurement and evaluation has been achieved in Croatia.

Conclusions

Adequate research methods and procedures have provided insights and findings which, on the one hand, have confirmed that it is feasible to scientifically analyse sport games, and on the other, the obtained findings have been built in the sport games training technologies thus strongly contributing to reputation of Croatian basketball, football, volleyball, handball and waterpolo in the world. Certain approaches to scientific research on sport games, in which Croatian athletes have achieved remarkable results, have been presented in the article. Fifteen medals won at the European and world championships and Olympic games in 13 years – it is a fact that put Croatian national senior teams at the top of the world quality, shoulder to shoulder with the national teams of Russia, Germany, Spain; France, Argentina and USA.

In future, further advances in measurement systems are expected, aimed at registration of training effects in all phases of training process, as well as development of methods which will enable the obtained findings and inferences to be integrated in everyday practice of sport games.

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EVALUATION OF ACCURACY-RELATED TESTS IN TENNIS

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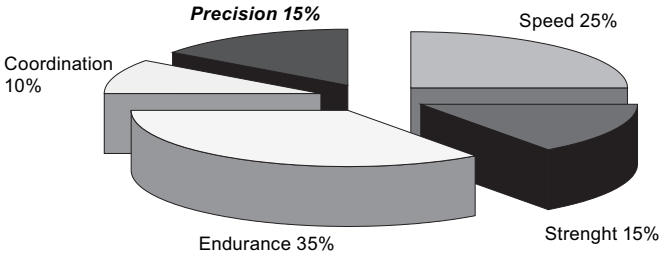
Abstract

The object of this research is to determine the metric characteristics (homogeneity, reliability, sensitivity) of the test "forehand", used to evaluate the situation-related accuracy of tennis players aged 12, 14, 16 and seniors. Samples of 30 tennis players of the aforementioned age, coming from different tennis centres in Croatia, have been used for the purpose of making this research. According to the obtained data of the metric characteristics (Cronbach alpha, Average Inter-Item Correlation) it is possible to use the test "forehand" to evaluate the situation-related accuracy in the training process of tennis players of every age (α_{Cr} a.c.14 = 0.88; α_{Cr} a.c.16 = 0.92; α_{Cr} senior c. = 0.95), except at the age of 12 (α_{Cr} = 0.69), where, presumably, the situation-related accuracy hasn't yet been sufficiently developed and therefore, cannot be properly evaluated by the above mentioned tests.

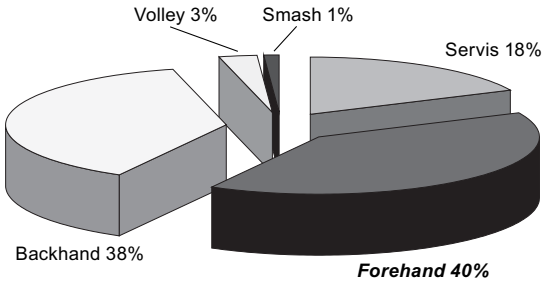
Key words: *tennis, forehand, reliability, performance*

Introduction and problem

Accuracy as a motor ability, in scientific sense, has been the least explored. In previous research projects of motor abilities, a hypothesis was established indicating that the accuracy didn't exist as an autonomous dimension, but as a certain aspect of coordination linked to the neuromuscular control (Čitaku, 1985). The results of aiming and targeting activities are the after-effects of an interaction between a larger number of different factors, so, the accuracy is categorized as a basic motor ability. By enhanced scientific conceptions of the motor abilities, it has been accepted that accuracy exists and is present in various kinesiological activities. Tennis, as a poli-structural motor activity requires a great deal of accuracy (Graph 1.).



Graph 1. Dominant motor abilities in tennis



Graph 2. Relations of the tennis techniques within the monitored match (Burcar, 1999.)

In tennis, accuracy exists as a form of the space-time coordination. Its importance is especially noticeable in situations where the dynamics of the match requires quick solutions, change of direction and accurate playing. Simultaneously with the development of the tennis play, dynamics of the game increases to a maximum degree, so the demands for a high level of safety and accuracy in a match increase as well. This leads to the idea that a top player must possess and develop all significant motor abilities. Accuracy is one of the most variable motor abilities. It is liable to external influences, as well as various psychological conditions of the player during the match.

The statistical procedures of monitoring the single technical elements in a tennis match have been known for a long time. However, they don't point out to the degree of accuracy. Looking through the available literature it is noticeable the shortage of the tests used to control the accuracy in tennis. Therefore, it has been constructed motor situation-related test of the accuracy to evaluate one basic technical element - forehand. To apply this test in praxis it is important to determine its metric characteristics.

The purpose of this research is to determine some metric characteristics (homogeneity, reliability, sensitivity), of the recently constructed measuring tool for evaluating the accuracy of tennis players aged 12, 14, 16 and seniors, and to apply the above mentioned tool as a mean of controlling the tennis training process.

Methods

Subjects

Subject sample consists of 120 male tennis players registered in Croatian Tennis Association, aged between 9 and 23. Aforementioned competitors participate in age categories 12, 14, 16 and seniors.

Each category counts 30 competitors from Croatian tennis centres. Subjects were in the preparatory period at the time, with good health and no significant injuries that could have influenced their performance. Regarding the subject draft, it cannot be considered random, but occasional.

Testing procedures

The sample of variables consists of motor situation-related test of accuracy - test "forehand" (Babić, 1999), described as follows:

A coach takes place at the T-line. The starting position of the competitors is placed at the centre of the court behind the base line.

Dimensions of the targeted space: width (no regards to the age category) - 3.21m, length (age 12) - 5.48m, (age 14) - 3.21m, (16 and seniors) - 2.14m. The position of the targeted space is placed left and right in the base field, along the base and side line. The test consists of 3 series, 16 tennis balls each.

The coach directs 16 balls serially, performing a spin diagonally from the T-line towards the court corner onto the competitors forehand side. When receiving the ball, the competitor must be 1m away from the base line. The tempo of receiving the balls is dictated by the coach who directs four balls serially, each ball consecutively after the competitor has returned to his starting position. 5 seconds break follows after the series of 4 and again, after the series of 16 balls.

From his starting position, the competitor moves towards the ball and tries to direct it using the forehand stroke, to the designated space using only the spin. The direction of the first and the third ball is parallel to the court, second and fourth are diagonal. If an error in order of playing occurs, the couch points out to it, never stopping the task performance. X marks a ball which has hit the targeted space or the border line, and 0 is a miss. The competitors are not entitled to practice the task.

Testing has been conducted by the coaches who have been prepared earlier. Measuring was carried out through the 3 months period. A testing process for four players took a training session of 90 minutes.

Data processing methods

Descriptive parameters (means, SD, Min, Max) were calculated for each trial of the forehand test. Reliability was assessed by calculating Cronbach's Alpha reliability coefficient. Homogeneity of items and tests has been evaluated by the Average Inter-Item Correlation, and the sensitivity on the grounds of dispersion measures.

Results and discussion

Table 1 shows mean values of items in the test "forehand" for the age category of 12, ranging from 10.07 to 10.40, which comes to 62-65% of the hits into the targeted space, in proportion to 16 strokes in one repetition. Mean values of this test show a minimal decrease between the first and the second measuring, however, in the third and last measuring a slight improvement in the task performance has been noticed. Although there were some changes in mean values, the differences are minimal, so one might believe that the test evaluates the same subject in all items. Regarding the size of the S.D. a relatively good sensitivity of the test can be noticed, which is also observed in the results range.

However, the test "forehand" didn't show good homogeneity and reliability when applied to this age category. The Average Inter-Item correlation value was 0.43, and the reliability 0.69, when evaluated by the Cronbach's Alpha. A slightly better reliability (0.72) would be presented if the third item had been excepted, but the reliability coefficient values didn't change much. Given data showed that not even by increasing the number of items there wouldn't be a more significant influence on a better reliability. For example, if the number of items grew by six, the reliability would be only 0.87 and the test would become utmost impractical.

Mean values of items in the test "forehand" for the age category of 14, range from 8.9 to 9.7 which comes to 56-60% of the hits into the targeted space, in proportion to 16 strokes in one repetition. Mean values of items show a minimal decrease between the first and the second measuring, and increase in the third and last. Values of the dispersion measures showed good delicacy of the test. This was supported by the test items results ranging from 11 to 14 strokes.

Table 1. Basic descriptive parameters: Mean, minimal (Min) and maximal (Max) value and standard deviation (SD), and reliability coefficient of the test "forehand" evaluated after the single item was excepted (Alpha if deleted) in the age category of 12.

	Mean	Min	Max	SD	Alpha if deleted
FH 1	10.30	6	15	2.68	0.64
FH 2	10.07	3	14	2.90	0.38
FH 3	10.40	5	16	2.88	0.72

Cronbach alpha = 0.69; Average Inter-Item Correlation = 0.43

Based on the mean values of Average Inter-Item Correlation (0.72) and reliability coefficients (0.88), relatively good homogeneity and reliability of the test "forehand" can be concluded in this age category. Assuming that the Inter-Item Correlation will remain

unaffected by the item increase up to five, the parameters of reliability would show 0.93, but that could significantly affect the practical aspect of this test. Therefore, practical use of this test is recommended using three items, for the given reliability is considered satisfying.

Table 2. Basic descriptive parameters: Mean, minimal (Min) and maximal (Max) value and standard deviation (SD), and reliability coefficient of the test "forehand" evaluated after the single item was excepted (Alpha if deleted) in the age category of 14.

	Mean	Min	Max	SD	Alpha if deleted
FH 1	9.4	0	14	3.23	0.77
FH 2	8.9	4	15	3.12	0.84
FH 3	9.7	4	15	3.10	0.87

Cronbach alpha = 0.88; Average Inter-Item Correlation = 0,72

Table 3. shows total mean value of items for the test "forehand" in the age category 16, which comes to 25.73 or 54% of the hits, out of 48 strokes in the test. The means are ranging in an interval from 8.53 to 8.63, which shows a minimal decrease of its value after the repeated measuring, so it can be assumed that repeated measuring didn't affect the changes of the subject significantly.

Average Inter-Item Correlation was 0.81, reliability coefficients 0.92, which indicates a good homogeneity and reliability of the test "forehand" in this age category.

Reliability contribution of the first item was somewhat poorer (when the parameters value has been excepted, it grows to 0.95), for the test was performed with no preliminary training. Therefore, this could be the reason for the unsystematic varying of the results in the first item.

Table 3. Basic descriptive parameters: Mean, minimal (Min) and maximal (Max) value and standard deviation (SD), and reliability coefficient of the test "forehand" evaluated after the single item was excepted (Alpha if deleted) in the age category of 16.

	Mean	Min	Max	SD	Alpha if deleted
FH 1	8.63	4	14	3.21	0.95
FH 2	8.57	2	15	3.50	0.86
FH 3	8.53	3	15	3.31	0.84

Cronbach alpha = 0.92; Average Inter-Item Correlation=0.81

Table 4 shows a senior category and a mild increase of the means, from first to third item, which points out to a small influence of the learning factor. An increase of the means for the test "forehand" range from 10.00 to 10.20, in proportion to 16 strokes in one repetition, which comes to 62-63% of the hits into the targeted space. Regarding the size of the S.D., it can be assumed a very good sensitivity of the test "forehand" in this category.

Results from the Table 4 show excellent homogeneity and reliability of the test "forehand" in the senior category. The value of the Average Inter-Item Correlation was 0.89, reliability coefficients 0.95. Reliability contribution of the third item was somewhat poorer, but no significantly better reliability would be presented by its exception. Presented facts show that not even an increase in the number of item wouldn't do much for the improvement of the reliability, which, considering the size of the reliability coefficients, isn't necessary at all.

Table 4. Basic descriptive parameters: Mean, minimal (Min) and maximal (Max) value and standard deviation (SD), and reliability coefficient of the test "forehand" evaluated after the single item was excepted (Alpha if deleted) in the senior category.

	Mean	Min	Max	SD	Alpha if deleted
FH 1	10.00	3	15	3.57	0.90
FH 2	10.13	2	15	3.45	0.92
FH 3	10.20	4	16	3.51	0.97

Cronbach alpha = 0.95;Average Inter-Item Correlation =0.89

Conclusion

The object of this research is to determine the metric characteristics (homogeneity, reliability, sensitivity) of the test "forehand", used to evaluate the situation-related accuracy of tennis players aged 12, 14, 16 and seniors. Based on the determined characteristics of the test "forehand" for all four age categories, it can be concluded:

- good sensitivity for all four age categories
- unsatisfying reliability and homogeneity of the test for the age category of 12
- homogeneity and reliability coefficients grow continuously from the youngest age category (12) to senior category
- reliability and homogeneity of the test for the age category of 14 is at the borderline, and for the category of 16 and seniors is satisfying.

The results of this research show a possibility of using this test "forehand" for the evaluation of the situation-related accuracy in the tennis training process for all age categories, except for the age category of 12. Situation-related accuracy in the age category of 12 is obviously insufficiently developed to be reliably evaluated by the above mentioned test.

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METRIC CHARACTERISTICS OF SELECTED TESTS FOR THE EVALUATION OF BASIC TRAINING STATUS IN TOP LEVEL WRESTLERS

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Abstract

The aim of the investigation was to determine the metric characteristics (mostly concerning its reliability) of selected Polish tests for the assessment of the basic training status, on top-level Croatian wrestlers. The sample of participants was comprised of 35 top cadet wrestlers (15 to 17 years of age) from the discipline of classic style. The determined metric characteristics for the tests are: maximum turn in jump, zig-zag run, run with turnover, maximum high jump with both feet, 20 meter run with flying start, trunk bending. Each test was measured three or four times, and the given results were subjected to a series of statistically methods for the determined metric characteristics. The results of the investigations indicate that the selected tests have very good metrical characteristics on the representative sample of top-level Croatian cadet wrestlers.

Key words: *classic style, co-ordination, speed, agility, explosive strength, and flexibility*

Introduction

There is a small number of batteries of tests with a tradition of over 24 years of use in training like the Polish battery of tests of basic and specific training status for advanced wrestlers (Starosta & Tracewski 1981). Such a long tradition of using the battery of tests, and the subsequent success of Polish wrestlers (5 Olimpic medals in Atlanta 1996), lead us to the conclusion that the Polish battery of tests confirmed its validity in practice. In favour of this thesis there are the results of researches of the investigations the professors of the Faculty of Kinesiology in Zagreb (Marić, Soršak and Cvetković) on boys and juniors in Croatian summer wrestling camps in sport centres on the island Badija (1976, 1977, 1978 and 1980). They were made with battery of tests that consisted of some tests from the above mentioned Polish battery of tests. Some of these researches were published, and one part is stored in the archives of university for combat sports, the Faculty of Kinesiology in Zagreb. Many authors wrote about the importance of the basic readiness of wrestlers (Starosta & Tracewski 1981, Marić, Baić & Aračić 2003). The wish of the author is to find out whether the metric characteristics of lesser-known tests for basic training status have high results on some other populations of top level wrestlers.

Methods

The sample of participants was comprised of 35 top level cadet wrestlers from the discipline of classic wrestling, from 8 different Croatian clubs. The average age of the wrestling group was 16.24+/- 0.74 years. Their average number of training sessions per week was 4.65 +/- 0.94, years of training 5.69+/- 0.29, body height 172,28+7-1.49 cm, and body weight 66.47+/-1.92 kg. This sample we can consider as a representative sample of Croatian top wrestlers. All of these wrestlers were chosen according to their ranking (1-4 place) at the national championships in 2004. A small number of the participants who did not respond could not be foreseen, and that was the result of injuries, sickness or some other objective circumstances. All the tested wrestlers were healthy, which was determined by a physical examination. Selected tests for the assessment of the basic and specific training status for advanced wrestlers (Starosta & Tracewski 1981) were: maximum turn in jump (MAKS_OKR_LD) for assessment of co-ordination, zig-zag run (TR_CI_CA) and run with turnover (TR_S_ZAD) for assessment of agility, maximum high jump with both feet (SKOK_UVIS) for assessment of explosive strength, 20 meter run with flying start (TR_20M) for assessment of speed, trunk bending (back bench) (ZA_TR_LE) for assessment of flexibility. A longer description of these tests can be found in the written work (Starosta & Tracewski 1981), and the translation of the tests into Croatian (Baić 2003) can be found at the university for combat sports, the Faculty of Kinesiology in Zagreb. The research was conducted in January 2005 at the Faculty of Kinesiology in Zagreb, and 7 basic and 8 specific wrestling tests were conducted. The tests went from one test to another by random choice, and for the necessity of this research only the above-mentioned four tests were analyzed. The gyms were the tests were done were normally heated according to the season, and the testing took place between 9am and 2pm.

Results

The descriptive parameters include: arithmetic mean (Mean), minimum value (Minimum), maximum value (Maximum), standard deviation (Std. Dev) and they were calculated and presented in table. In that table were also presented correlations of items (n) with first main component (Factor 1), and evaluated Cronbach's- a coefficient of reliability if the particle item (n) was excluded (Cra id). The reliability of composite tests was tested by Spearman-Brown (SB), Kaiser-Caffrey (ac), and Cronbach's – a (Cra) metods (table 2). In table 2 were also calculated: the estimated Cronbach's - a coefficient of reliability if there are two items less (Ecra), average inter-item correlation (R), absolute amplitude of characteristic values of the matrix of item correlation (Eigenval) and percentage articulated cumulative part of characteristic values of the matrix of item correlation (Cumul. %). The given results indicate that the selected tests have very good metrical characteristics.

Table 1. Descriptive parameters of particles and their influence on the test reliability (n=35)

R.b.	Test	n	Mean	Minimum	Maximum	Std.Dev.	Factor 1	Crα id
1.	MAKS_OKR_LD	1	755.914	615	998	104.366	0.993	0.994
	(stupnjevi)	2	753.971	609	978	104.277	0.995	0.989
		3	756.600	608	1004	106.085	0.995	0.991
1.1.	MAKS_OKR_L*	1	384.457	305	594	65.105	0.987	0.987
	(stupnjevi)	2	383.543	283	560	67.394	0.991	0.982
		3	381.343	291	553	62.797	0.991	0.902
1.2.	MAKS_OKR_D**	1	371.457	280	487	48.680	0.985	0.975
	(stupnjevi)	2	370.429	293	478	44.850	0.992	0.966
		3	375.257	307	490	49.298	0.978	0.987
2.	TR_CI_CA	1	23.841	21.63	25.91	1.128	0.977	0.842
	(sec)	2	23.517	21.67	25.88	1.143	0.929	0.749
		3	23.736	21.8	26.2	1.210	0.869	0.854
3.	TR_S_ZAD	1	12.647	11.72	13.9	0.649	0.916	0.710
	(sec)	2	12.275	11.36	13.51	0.600	0.914	0.719
		3	12.271	11.31	14.84	0.732	0.792	0.895
4.	SKOK_UVIS	1	47.526	36.5	72	7.982	0.955	0.941
	(cm)	2	49.086	37.8	70	7.569	0.933	0.950
		3	49.923	41	67	6.523	0.940	0.950
		4	49.740	38.8	71	7.374	0.953	0.941
5.	TR_20M	1	2.509	2.12	3.07	0.202	0.945	0.923
	(sec)	2	2.543	2.19	3.1	0.207	0.952	0.912
		3	2.520	2.1	3.17	0.222	0.949	0.918
6.	ZA_TR_LE	1	53.000	31	72	7.550	0.959	0.983
	(cm)	2	53.657	33	72	7.239	0.987	0.971
		3	53.486	39	72	7.278	0.979	0.974
		4	53.314	38	73	8.040	0.975	0.977

Legend: MAKS_OKR_LD - maximum turn in jump; MAKS_OKR_L*- maximum turn in jump to the left is part of the test MAKS_ OKR_LD, and can be performed as a separate test for co-ordination to the left; MAKS_OKR_D** - maximum turn in jump to the right is part of the test MAKS_OKR_LD, and can be performed as a separate test for co-ordination to the right; TR_CI_ CA - zig-zag run; TR_S_ZAD - run with turnover; SKOK_UVIS - maximum high jump with both feet; TR_20M- 20 meter run with flying start; ZA_TR_LE - trunk bending (back bench)

Table 2. Analysis of reliability selected tests for top level wrestlers (n=35)

R.b.	Test	n	SB	αc	Crα	Ecrα	R	Eigenval	Cumul. %
1.	MAKS_OKR_LD	3	0.994	0.995	0.994	0.980	0.983	2,965	98,843
1.1.	MAKS_OKR_L	3	0.990	0.990	0.989	0.968	0.970	2,939	97,976
1.2.	MAKS_OKR_D	3	0.985	0.986	0.984	0.953	0.960	2,912	97,073
2.	TR_CI_CA	3	0.871	0.871	0.870	0.690	0.697	2,385	79,502
3.	TR_S_ZAD	3	0.846	0.848	0.837	0.631	0.666	2,301	76,697
4.	SKOK_UVIS	4	0.960	0.960	0.959	0.921	0.860	3,574	89,351
5.	TR_20M	3	0.945	0.945	0.944	0.848	0.850	2,700	90,001
6.	ZA_TR_LE	4	0.983	0.982	0.988	0.965	0.940	3,801	95,073

Legend: MAKS_OKR_LD - maximum turn in jump; MAKS_OKR_L*- maximum turn in jump to the left is part of the test MAKS_OKR_LD, and can be performed as a separate test for co-ordination to the left; MAKS_OKR_D** - maximum turn in jump to the right is part of the test MAKS_OKR_LD, and can be performed as a separate test for co-ordination to the right; TR_CI_CA - zig-zag run; TR_S_ZAD - run with turnover; SKOK_UVIS - maximum high jump with both feet; TR_20M- 20 meter run with flying start; ZA_TR_LE - trunk bending (back bench)

Discussion

The reliability of the tests maximum turn in jump (MAKS_OKR_LD, MAKS_OKR_D and MAKS_OKR_L) for an assessment of co-ordination, is very high (Table 2). The average coefficient of the correlation between the items shows very high values, which indicates a very high homogenity of the tests (Table 2). The arithmetical means of items are mostly unchanged, as well as the minimal and maximal results (Table 1). The size of the projections of the first important main component, and the evaluated Cronbach's -a coefficient of reliability, suggest that two attempts should be enough to obtain similar reliable results in this test (Table 1). This is very important information for these tests because too much time would be spent if the test was repeated three or more times. On the validity of the test (MAKS_OKR_LD) for the assessment of co-ordination results of former researches (Baić 2003) are indicated, where these tests get the biggest number of statistically important correlations with other tests for evaluating co-ordination (forward pass, forward somersault in squat position, backward somersault in squat position, backward pass). The same test was used to define the factor of turn-ability in the air. The reliability of tests zig-zag run (TR_CI_CA) and run with turnover (TR_S_ZAD) for assessment of agility, is relatively satisfactory (Table 2). However, in the tests of agility the average coefficient of correlation between the items shows the smallest level of all the selected tests. According to this we can assume that these tests are contaminated by the adaptation of the wrestlers to this test situation, and probably with fatigue ness in the last attempt. That is confirmed by the tendency of the smallest result being achieved in the first item of these two tests, and the smallest correlation coefficients of the first and last result on the first main component (Table 1). Because of that, the authors suggested in the case of a large number of tests throwing out the last item, because it has been detected that by throwing out the last item, the evaluated Cronbach's - a coefficient of reliability becomes bigger (Table 1). On the validity of the test for the assessment of agility results of former researches (Baić 2003) are indicated, where these two tests define the factor of agility. The validity of the test according to the success criterion in wrestling is confirmed by researches (Baić 2003, Baić, Starosta & Marić 2003), where the results in these tests were better as the group of wrestlers was better. The reliability of the test maximum high jump with both feet (SKOK_UVIS) for assessment of explosive strength, and 20 meter run with flying start (TR_20M) for assessment of speed, is very high (Table 2). The average coefficient of correlation between the items shows very high values, which indicates a very high homogeneity of the tests (Table 2). The arithmetical means of the items mostly are unchanged, as well as the minimal and maximal results (Table 1). The size of projections of the first important main component, and the evaluated Cronbach's - a coefficient of reliability, suggest that three attempts should be enough to obtain similar reliable results in the test maximum high jump with both feet (SKOK_UVIS), and two attempts in the test 20 meter run with flying start (TR_20M) (Table 1). On the validity of the tests for the assessment of explosive strength results of former researches are indicated (Baić 2003), where those tests have statistically important correlation test bridge from a standing position. The same test was used to define the factor of explosive strength. The reliability of test trunk bending (ZA_TR_LE) for the assessment of flexibility, is very high (Table 2). The average coefficient of correlation between the items shows very high values, which indicates a very high homogeneity of tests (Table 2). The arithmetical means of items mostly are unchanged, as well as the minimal and maximal results (Table 1). The order and size of the projections on the first important main component, and the evaluated Cronbach's - a coefficient of reliability, suggest that three attempts should be enough to obtain similar reliable results in this test. On the validity of the tests for the assessment of flexibility results of former research are indicated (Šadura at all, 1974) where an almost identical test (zaklon –z) has a high correlation with the specific test for the assessment of flexibility (most), where those two tests define one of the factors in the space of flexibility. The validity of the test according to the success criterion in wrestling is confirmed by researches (Baić 2003, Baić, Starosta & Marić 2003), where the results in this test were better as the group of wrestlers was better.

Conclusion

The authors conclude that the tests used have very good metrical characteristics on the representative sample of top-level Croatian cadet wrestlers. They also conclude that, in the case of the use of a greater part or the whole set of Polish tests, the number of items in every test has to be less and in accordance with the proposals of the authors (Starosta & Tracewski 1981). Namely, the number of tests for advanced wrestlers is very large (cadets and juniors 23, seniors 15), and already in this minor research it has been noticed that the accumulative fatigue was on the upper line of tolerance of the sportsmen and also their trainers. The authors think that in the researches of a greater number of top-level wrestlers, in which they are subjected to a larger number of tests, and for some dimensions we have even a few tests, it is not the most important factor to have tests with a large number of items for good metrical characteristics (reliability). That is also in accordance with the former researches (Bala 1990). The authors state that it is, for this kind of large set of tests, much more important to have an optimal number of items determined by many years of practice and with the number of researches, to distribute correctly the tests during each day of testing, to have determined normative values and to have the top-level sport results of sportsmen that were observed with the proposed set of tests. Only that way the motivation of top-level sportsmen for testing would be preserved under the influence of increasing fatigue and a also the real metrical characteristics of the used tests.

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ANALYSIS OF ENERGY EXPENDITURE RATIOS THROUGHT THE BASKETBALL GAME*

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Abstract

The varying levels of exercise intensity and duration relate specifically to the two energy systems providing energy to the athlete. When a player begins exercising (the ATP-PC, glycolysis, and aerobic system) are involved. However, the relative contribution of each energy source varies according to the demands of the exercise, which is turn vary as functions of the intensity and duration of the activity. The exact energy system regimen depends of team style of play (e.g., fastbreak versus half- court offense, full court man-to-man defensive pressure versus zone defense, etc.), position and amount of played time. There is a different energy expenditure ratio for different positions in team. Aerobic and anaerobic time showed decreasing tendency during the analyzed game.

Key words: *Basketball, energy systems, work to rest ratio.*

Introduction

Basketball is one of the most popular team based sports played and watched throughout the world. For optimal performance during play at an elite level a variety of areas must be addressed. These include the high skill level, flexibility, muscular strength, endurance and importantly the specific use of both the aerobic and anaerobic energy systems. It must be recognized that play is characterized by various intensities and durations. MacLean (1984) notes on average work to rest ratio of 1:1.7 ranging from 1:0.5 to 1:2. McInnes et al (1995) analyze the active time of play defining this as "live" time which is seen to be 54% of the total game time. There are several categories noted by McInnes (1995) revealing the varying levels of exercise intensity throughout a game. The varying levels of exercise intensity and duration relate specifically to the two energy systems providing energy to the athlete. When a player begins exercising (the ATP-PC, glycolysis, and aerobic system) are involved. However, the relative contribution of each energy source varies according to the demands of the exercise, which is turn vary as functions of the intensity and duration of the activity. Basketball is about 20% aerobic and 80% anaerobic (Brittenham, 1996). Many factors, however, influence the exact energy expenditure ratio for individual players. For example, same players continually move to "get open," whereas others sprint the floor. Moreover, if we examine the total energy demands for an entire 2-hour game, we find the percent contribution of the energy systems changes continually. While the body does not select one energy system exclusively, over another during the exercise, it does have preferred fuel source given the intensity and duration of the activity. The exact energy system regimen depends of team style of play (e.g., fastbreak versus half- court offense, full court man-to-man defensive pressure versus zone defense, etc.), position and amount of played time. The energy to perform high-intensity efforts was derived primarily from the anaerobic system during the activity. Recovery for subsequent bouts of exercise was facilitated during the periods of rest and low-intensity efforts by the aerobic system, via the replenishment of ATP. Assigning exact ratios that would be specific to all styles of play would be impossible. In this work I will try to determined ratio of world best team in 2002.

Materials and Methods

For the purpose of this paper the pieces of data were collected by using a video recording of the basketball game Argentina – Yugoslavia, played at the 2002 FIBA World Championship in USA. The sample of variables and their modalities was used in attempt to find any differences between rest, low intensity efforts (aerobic) and high intensity efforts (anaerobic). Moves involving speed, acceleration, explosiveness, changing direction, rebounding, lay ups, jump shooting, shot blocking, blocking out, holding position, fats breaks, defensive presses, running offensive plays, continuous dribbling, repeated bouts of running with short periods of rest were considered as high intensity efforts (anaerobic). Running at moderate intensity was considered as low intensity efforts (aerobic), and standing at same position was considered as rest.

Results and discussion

The analysis of the match between the Argentina and Yugoslavia showed that the Yugoslavian players had different energy expenditure ratio for different positions in team. If we analyze only the active playing time (APT) (10 minutes) without time-outs and breaks during free throws, we will see that guard (playmaker) had less rest time then other players. His anaerobic time showed tendency of dropping down during the game.

* *Young researcher award*

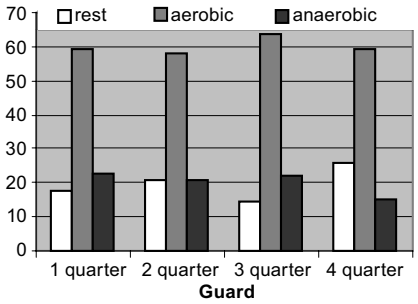

Chart 1. APT for guards

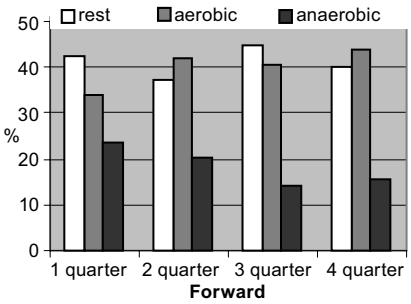

Chart 2. APT for forwards

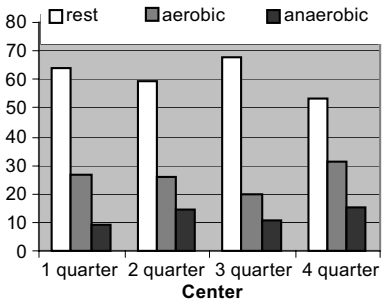

Chart 3. APT for centers

Forwards had biggest anaerobic time (Stojakovic, Bodiroga and Gurovic were most important players of this team.). Theirs anaerobic time also showed decreasing tendency during the game. Center had the biggest rest time then players on other positions.

Many time outs, short half breaks and stoppage in play all lead to better recovery time for the basketball players throughout the game. If we analyze active time with all breaks (ATAB) during every quarter we will get actual work-rest ratio (table 4-6). Actual anaerobic ratio is from 4-5% at centers to maximally 10% at guards and forwards. Aerobic ratio is from about 10 % at centers to maximally 30 % at guards and forwards.

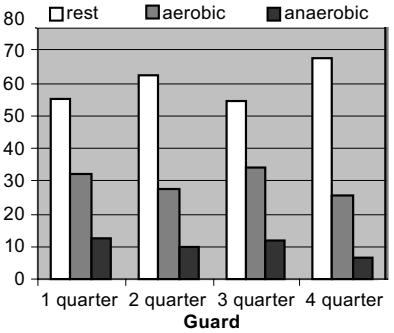

Chart 4. ATAB for guards

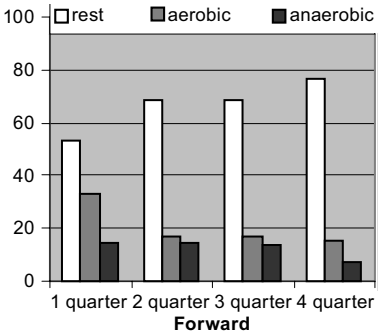

Chart 5. ATAB for forwards

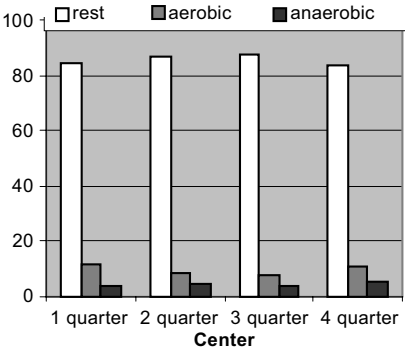

Chart 6. ATAB for centers

Conclusion

Understanding the concept of the work rest ratio is important in organizing a training program which specifically stresses the energy system required to play basketball. All systems should be addressed in designing an individual training regimen. And, in order to train all three energy systems, the work rest ratio must be carefully controlled; because that ratio determines which energy system is being trained.

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BIODYNAMIC CHARACTERISTICS OF FEMALE SPRINTERS

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Abstract

The purpose of the study was to identify those biodynamic parameters that differentiate between trained female sprinters in terms of 100-metre sprint results. Biodynamic parameters of sprint running were identified on the basis of the start acceleration test and the maximum speed test. The criterion for start acceleration was a 30-metre run from a low start and the criterion for maximum speed was a 30-metre run from a flying start. In these two tests measurements were carried out using the Opto–Track system. Statistically significant differences ($p < 0.05$) between the two groups of female sprinters were established by a T-test. The differences between the athletes were statistically significant in the start acceleration test and the maximum speed test ($p < 0.01$). In both tests, the most important generator that differentiated between the superior and the inferior sprinters was the stride length. The contact phase time was on the edge of statistical significance only in the case of start acceleration. Superior sprinters develop higher starting speed (difference of 0.28 $m.s^{-1}$), due to shorter average contact time, longer stride and the same frequency compared to the inferior group.

Key words: *sprint, female sprinters, biodynamic characteristics.*

Introduction

Sprint running is a complex cyclic movement defined by stride frequency and stride length. Both parameters are interdependent and each is conditional on the central movement regulation processes, biomotor abilities, energetic processes and morphological characteristics (Mero & Komi, 1987). Sprint running as a movement stereotype consists of repetitions of strides in a time unit. The length of stride depends mainly on body height and/or leg length as well as the force developed by extensor muscles of the hip, knee and ankle joints in the contact phase. Execution of contact phase is one of the most important generators of the sprinting speed efficiency (Mero & Komi, 1987). The contact phase has to be as short as possible with an optimal ratio between the braking phase and the propulsion phase. Stride frequency depends on the functioning of the central nervous system and is to a large extent genetically predetermined (Mero, Komi, & Gregor, 1992). The ratio between stride frequency and stride length is defined individually, and it is automatised. The higher the frequency, the shorter the stride length, and vice versa. Sprinting speed is in fact an optimal ratio between length and frequency of athlete's strides. In biomechanical terms, sprint running is a cyclic movement with central neuromuscular regulation which also manifests itself through the peripheral – locomotor system. The objective of the study was to identify differences between female sprinters in terms of biodynamic parameters in the start acceleration test, and the third one was to discover differences between biodynamic parameters in the maximum speed test. The efficiency of start acceleration was assessed with the test involving a 30-metre sprint from a low start and the maximum speed was assessed with the test involving a 30-metre sprint from a flying start. In both tests measurements were carried out by the Opto–Track system.

Methods

The research included 17 women sprinters of the senior and junior national teams of Slovenia. They were divided into two groups by the quick cluster statistical method, in view of the criterion result of their 100-metre sprint. In the first, superior group (group A) the average age of athletes was 19.7 ± 4.31 years and the average 100-metre sprint result 12.14 ± 0.32 seconds. In the second, inferior group (group B) the average age was 18.8 ± 1.57 years and the average 100-metre sprint result 12.96 ± 0.17 seconds. The measurements within the start acceleration test and the maximum speed test were carried out in the sports hall of the Athletic Centre of Slovenia in Šiška, Ljubljana. In both test an entirely new technology was used, namely the Opto–Track system manufactured by the Italian company Microgate. The basis of the measuring system are the interconnected rods (100 cm x 4 cm x 3 cm) fitted with optical sensors and a computer program for data storing and processing. Each rod is fitted with 32 sensors – photocells, arranged 4 cm one from another and 0.2 cm above the ground. The length of the interconnected rods was 20 metres. The rods were distributed along the width of the sprint athletic track (1.22 m). The measuring chain enabled the measurement of the following sprint parameters: contact time, flight time, stride length, stride frequency, speed in every stride, change of speed. In addition to the Opto–Track measuring system, the infrared photocell timing system (BROWER) was also used in the start acceleration test (30-metre sprint from a low start) and in the absolute speed test (30-metre sprint from a flying start) to measure time each 5 metres. At the start, the electronic starting blocks REACTIME FINISH LINX were used to register latent reaction time

(RT). The athletes performed the start acceleration test and the absolute speed test twice in a row. The athletes had a break of at least 10 minutes between the tests. The SPSS software package was used for statistical processing. Statistically significant differences between the groups were established by the T-test.

Results

Start acceleration and maximum speed are two extremely important phases, defining the result in sprint running (Table 1 and 2). It was precisely these two capabilities that were the subject of this study, and they were studied in terms of biodynamic parameters of trained female sprinters. There are relatively few experimental studies of this kind drawing from a sample of female athletes. The results in Table 1 show differences in biodynamic parameters of a 30-metre sprint from a low start in terms of quality of the sprinters. As regards the position of the starting blocks with respect to the starting line, no statistically significant differences were found. In superior female sprinters the first starting block was placed 50.7 ± 5.4 cm from the starting line, while in inferior sprinters the distance was 49.7 ± 3.3 cm. The distance between the blocks in groups A and B was 26.0 ± 3.4 cm and 23.4 ± 2.0 cm, respectively.

Table 1: Differences between the female sprinters in terms of biodynamic variables of start acceleration

		GROUP A (N= 10)		GROUP B (N= 7)		T-TEST	
Variable	**Unit**	**M**	**SD**	**M**	**SD**	**T**	**SIG**
100-metre sprint result	**s**	**12.14**	**0.32**	**12.96**	**1.17**	**-6.09**	**0.00 ****
30 m from a low start	**m.s^{-1}**	**6.45**	**0.14**	**6.17**	**0.08**	**4.60**	**0.00 ****
First starting block - line	cm	50.7	5.43	49.7	3.35	1.74	0.10
Distance between blocks	cm	26.0	3.46	23.4	2.07	0.42	0.67
Reaction time	s	0.150	0.02	0.146	0.03	0.39	0.70
0-5 metre sprint	m.s^{-1}	3.51	0.12	3.39	0.10	2.17	0.04 *
5-10 metre sprint	m.s^{-1}	6.79	0.17	6.54	0.15	3.07	0.00 **
10-15 metre sprint	m.s^{-1}	7.56	0.38	7.01	0.10	3.65	0.00 **
15-20 metre sprint	m.s^{-1}	7.73	0.37	7.56	0.23	1.07	0.30
20-25 metre sprint	m.s^{-1}	8.38	0.18	7.82	0.32	4.54	0.00 **
25-30 metre sprint	m.s^{-1}	8.55	0.40	8.24	0.20	1.84	0.08
Stride length	cm	148.7	7.32	140.8	5.07	2.54	0.02 *
Stride frequency	Hz	4.11	0.12	4.12	0.06	-0.25	0.80
Contact time	ms	149	5.22	153	4.09	-1.85	0.08
Flight time	ms	95	7.30	89	6.00	1.61	0.13
Length of stride 1	cm	102.2	4.46	94,4	4.99	3.29	0.00 **
Length of stride 2	cm	114.1	9.33	107.0	4.54	1.84	0.08
Length of stride 3	cm	125.0	5.19	119.6	6.72	1.82	0.08
Length of stride 4	cm	140.5	9.63	132.0	6.37	2.02	0.06
Length of stride 5	cm	147.3	7.21	145.0	7.61	0.62	0.54
Contact time of stride 1	ms	200	12.55	194	9.59	1.14	0.27
Contact time of stride 2	ms	183	10.50	184	13.04	-0.26	0.79
Contact time of stride 3	ms	154	9.78	160	6.79	-1.50	0.16
Contact time of stride 4	ms	146	13.35	155	5.85	-1.67	0.12

* p < 0.05 ** p < 0.01

Table 2: Differences between the female sprinters in terms of biodynamic variables of maximum speed

		GROUP A (N= 10)		GROUP B (N= 7)		T-TEST	
Variable	**Unit**	**M**	**SD**	**M**	**SD**	**T**	**SIG**
30 m from a flying start	**m.s^{-1}**	**8.84**	**0.34**	**8.28**	**0.19**	**3.91**	**0.00 ****
Contact time	ms	110	11.90	113	5.55	-0.56	0.58
Flight time	ms	121	9.41	116	4.49	1.09	0.29
Stride length	cm	205.9	12.40	192.4	5.92	2.66	0.00 **
Stride frequency	Hz	4.35	0.28	4.36	0.15	-0.14	0.89

* p < 0.05 ** p < 0.01

Discussion

Reaction time was dealt with by many researchers (Moravec et al., 1988; Bruggemann & Glad, 1990; Mero & Komi, 1990; Ferro et al., 2001). In most of the studies the authors could not establish any correlation between the reaction time and the final result in a 100-metre run. Reaction time accounts for only 2-3% of total result in a 100-metre run. Apparently, there exists a specific, genetically conditioned ability enabling a rapid transmission of afferent and efferent nerve impulses. In this study only one component of reaction time was measured by means of the REACTIME FINISH LINX starting block, i.e. premotor time. Premotor time is defined as the time interval lasting from the starting signal to the beginning of EMG muscle activation (Mero & Komi, 1990). On the other hand, motor time lasts from the EMG muscle activation to the moment the foot leaves the front starting block. The results show that the inferior group of female sprinters had shorter reaction time (RT = 146 ± 0.03 ms) on average compared to the superior group (RT = 150 ± 0.02 ms), which is rather surprising. For the sake of comparison, the average reaction time of the 100-metre run finalists at the 1999 World Championship in Athletics in Sevilla was 135 milliseconds (Ferro et al., 2001). Obviously, the starting action is conditioned by very specific motor abilities, with reaction time being only one of them. In the superior group the reaction time accounted for 11.7% of start acceleration time in the first 5 metres, while in the inferior group the respective figure was 10.9%. The share of reaction time in aggregate results of 30-metre sprint from a low start was 3.3% in group A and 3.1% in group B. These percentages are not negligible; quite on the contrary, many times these hundredths of seconds determine the positioning of athletes on crossing the finish line.

The quality of transition of starting action to start acceleration is seen in the segment of speed from 0 to 5 metres. There were statistically significant differences between the athletes. The average speed of group A in this segment was 3.51 ± 0.12 $m.s^{-1}$, while that of group B was 3.39 ± 0.10 $m.s^{-1}$. The groups statistically significantly differed in terms of speed realisation in other segments as well, except in 15-20 metre start acceleration. The final part of the " pick-up acceleration" from 25 to 30 metres was on the edge of statistical significance differentiating between superior and inferior female sprinters. In start acceleration some biodynamic parameters of sprinting stride such as length, frequency, contact time and flight time change very dynamically. The groups A and B statistically significantly differed in terms of average length of stride and were on the edge of statistical significance in terms of contact time duration. Progression of stride length along with appropriate stride frequency is typical of start acceleration. In a 30-metre sprint from a low start, group A developed significantly higher speed, owing to greater average leg length, while in terms of stride frequency, there were no differences whatsoever between the groups. The average stride length of group A was 148.7 ± 7.32 cm and group B 140 ± 5.07 cm. According to some studies (Schot & Knutzen, 1992) realization of the first three strides after the starting action is extremely important. This has also been confirmed by our study. The superior female sprinters have longer first four strides and at the same time shorter contact phases – both at the edge of statistical significance.

Luhtanen and Komi (1980) divided the contact phase of sprinting stride into a braking phase and a propulsion phase. Both phases sup up in total contact time, which in the sampled female sprinters' start acceleration reached 149 milliseconds (group A) and 153 milliseconds (group B). These are the average values that vary by stride execution and depend on biomechanical characteristics of the position of a runner's centre of gravity during the start acceleration. In the first two strides the projection of the centre of gravity is located behind the foot's point of contact with the ground. It is not until the third and fourth strides that the projection of the centre of gravity shifts to the front of the foot's point of contact with the ground. Owing to the changing biomechanical conditions and the increasing speed, the ratio between contact and flight phases changes. The contact phases are becoming shorter and the flight phases longer. In group A the contact phase in the first four strides shortened on average by 54 milliseconds and in group B by 39 milliseconds. The contact time in the first stride (group A) accounted for 76% of total stride time. In the fourth stride the contact time accounted for only 60% of total stride time. In group B the share of contact time in the first stride was 78% and in the fourth stride 63%. Table 2 shows that the female sprinters statistically significantly ($p < 0.01$) differed in terms of maximum speed. The maximum speed of the superior group was 8.84 ± $m.s^{-1}$ and that of the inferior group 8.28 $m.s^{-1}$. According to some studies (Mero, Komi, & Gregor, 1992), maximum speed results from an optimal ratio between stride frequency and stride length. Changing the stereotype of maximum speed is an extremely demanding task, as it involves a motor pattern that is firmly rooted in the central nervous system. In addition to start acceleration, maximum speed is the most important sprinting ability. Based on the analyses made during some top competitions (1999 World Championship in Athletics in Sevilla), it may be established that women achieve their maximum speed (10.31-10.87 $m.s^{-1}$) within 50-60 metres and men 50-70 metres (Ferro et al., 2001). Duration of maximum speed is very limited, lasting only from 2 to 3 seconds.

The most important generator of differences in maximum speed ($p < 0.01$) is the parameter stride length. This is rather surprising. Namely, some of the previous studies showed that frequency specifically influenced the speed of sprint running in men and women (Mero, Komi, & Gregor, 1992). Stride length is a complex parameter that depends on many factors among which morphological characteristics (leg length), muscle structure, reflex mechanisms and transmission of force to the ground in the contact phase are of particular importance. The contact phase is undoubtedly the key kinematic factor, defining economical sprint running from the point of view of the ratio between the braking phase and the propulsion phase. This ratio should be 40% : 60% (Luhtanen & Komi, 1980). The shorter the braking phase, the lower the reduction of horizontal speed of the centre of gravity. In the sampled female sprinters the contact phase in group A

was 110 ± 11.9 ms and in group B 113 ± 5.5 ms. There were no significant differences between the two groups in terms of this parameter. The duration of contact phase is slightly longer than that of elite athletes, since the contact times of the latter range from 90 ms to 100 ms. In group A the contact phase accounted for 47.6% of total time of sprinting stride (contact phase + flight phase) and in group B 49.3%. Superior female sprinters obviously have shorter contact times and longer flight times, while in inferior female sprinters it is the other way around. Stride frequency correlated with duration of contact phases, however, there were no differences between the groups in terms of start acceleration and maximum speed. Stride frequency is above all a parameter bearing a specific genesis and is more difficult to change than stride length. It has a strong genetic code which is rooted in the central nervous system. Changing of the movement stereotype of maximum speed with special tools and methods (method for developing supramaximal) speed is a very risky pursuit, especially in young female and male athletes.

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ANALYSIS OF THE QUANTITY OF RUNNING OF ONE CROATIAN FOOTBALL TEAM DURING A MATCH

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Abstract

The aim of this study was to quantify and compare the distances covered by football players in a match of the Croatian first division. The distances sum were divided according to running velocity (slow, moderate and fast) and team position (defender, midfielder, attacker). The ANOVA revealed no statistically significant differences between players at different team positions for any running speed category as well as for overall running distance ($p>0,05$). However, the distance sum in the second half (1477±310 m) was significantly lower than the distance sum in the first half (1800±243 m, $p<0,01$), mostly for the higher quantity of slow running in the first half of the matches. Correlations between match success and running distance sums are not statistically significant ($p>0,05$) although presence of tendency with moderate and overall running sum. The most often players repeated section of running on 10 m and minimum number of times section of running on 50 m.

Key words: *football, match analysis, match performance, match fitness, team position*

Introduction

Football belongs to the group of complex sports activities, which are characterized by a cooperation of two or more players with the aim of outwitting the opponent team in order to make a score. This kind of definition implies high, mostly energy related, demands and high dynamics of the game. The best proof of that can be found in the high number of contacts, kicks, running at different speeds, jumps, tackles and other movements. All mentioned technical-tactical elements have an influence on the final outcome of each football game to a higher or a lesser degree, but nevertheless running becomes more and more important for the achievement of the positive result. Performance at sub-maximal and maximal intensity significantly increases the dynamics of a football match, and these levels are possible to achieve only by a long-term quality training based on contemporary knowledge from the field of sport science.

To achieve a high training standard and to improve the sport specific performance capacities, it is necessary to know the starting level of each player and the physical and metabolic requirements during the match (Nowacki, Preuhs, 1991.)

The aims of this research were: to see whether there is a significant difference in the quantity of running at different speeds between the players of different positions of a Croatian top football team, to see whether there is a significant difference in the quantity of running between the first and the second half of the match, and to show the connection between the quantity of running to the success of the game. This analysis also gives insight into the representation of particular running sections during a match, and the comparison of the overall quantity of running of the Croatian team with some top teams of the European leagues.

Methods

Subjects

Examinees were 17 professional football players of the NK Dinamo team, of the senior level, which were monitored during 7 matches (5 home matches and 2 away matches) in the spring part of the 2001/2002 championship. Average age of the players was 23±4, average height 182,7±6,0 cm, average weight 78,4±5,9 kg, and the percentage of the body fat 12,1±4,1%. The team played in the tactical game system 4:4:2.

Experiment realization procedure and variables sample

Examiners were 10 students of the Faculty of Kinesiology, University of Zagreb, specially trained for this research. Each examiner monitored one football player during the whole football season and recorded his movements. Movements in all directions and lengths of 5, 10, 20, 30, 40 and 50 meters were recorded. The run distances were joined to one of the three previously determined intensities: slow, moderate and fast running, during the active play time. Also, research exhibits values of several different variables: slow running in the first halftime (L1), slow running in the second halftime (L2), moderate running in the first halftime (S1), moderate running in the second halftime (S2), fast running in the first halftime (B1), fast running in the second halftime (B2), overall quantity of running in the first halftime (UK1), overall

quantity of running in the second halftime (UK2), overall quantity of slow (LUK), moderate (SUK) and fast (BUK) running, overall quantity of running (OVERALL) and success in the match (SUCCESS) valued by points (1 for lost match, 2 for equal and 3 for win).

Methods of data analysis

The data were processed in the programme package Statistics for Windows 5.0 at the Faculty of Kinesiology of the University in Zagreb. For each variable a univariant analysis of variance (ANOVA) determined difference in the quantity of running at different speeds, considering players at different positions. Student's t-test for dependent samples analyzed the significance of differences in same variables considering match halftimes. Basic descriptive parameters were used to show the distribution of quantity of running according to section distances and its frequency during a match. Correlation is used to test relations between match success and sums of running at different intensities and overall.

Results

Table 1 shows results of the analysis of variance (ANOVA). There are no statistically significant differences (p>0,05) between the players of the three positions (defense, midfield, forward) in the quantity of running at different speeds in the first and the second half of the match - (slow (L1, L2), moderate (S1, S2), fast (B1, B2) and overall (UK1, UK2)), and in the overall quantity of running (LUK, SUK, BUK, OVERALL).

Table 1. Univariant analysis of variance between the players of the three positions

ANOVA - Summary of all Effects 1-POSITION		
	F	p-level
L1	1,018	0,3866
S1	1,664	0,2248
B1	1,836	0,1958
UK1	1,392	0,2810
L2	0,660	0,5323
S2	0,248	0,7840
B2	0,544	0,5924
UK2	0,202	0,8190
LUK	1,222	0,3241
SUK	0,505	0,6140
BUK	1,521	0,2524
OVERALL	0,986	0,3976

F-test results (F), error size (p-level)

Table 2 shows the results of the student's t-test for dependant samples used to determine differences in quantities of running at different speeds (L, S, B) and overall (UK), between the first and the second halftime. The data point to a statistically significant difference (p<0,05) in the quantity of slow running in the first halftime (L1) and slow running in the second halftime (L2) and in the overall quantity of running between the first (UK1) and the second (UK2) half of the match.

Correlation between the quantity of running at different speeds and the success of a match is shown in table 3. It is visible that there is no statistically significant correlation (p>0,05). However the tendency toward a more considerable correlation of the variables SUK and OVERALL to the variable SUCCESS should be pointed out.

Table 2. Results of t-test for dependent samples

T-test for Dependent Samples *Marked differences are significant at p < 0,05 N=17					
	Mean	Std.Dv.	t	df	p
L1	909	182			
L2	701	192	4,178*	16	0,0007
S1	670	205			
S2	568	261	1,811	16	0,0889
B1	222	125			
B2	206	105	0,560	16	0,5832
UK1	1800	243			
UK2	1477	310	3,498*	16	0,0030

Mean, Standard Deviation (Std.Dv.), t-test results (t), degrees of freedom (df), error size (p)

Table 3. Correlation between the quantity of running and the match success

Correlations *Marked correlations are significant at p < 0,05 N=7				
	LUK	SUK	BUK	OVERALL
SUCCESS	0,18	0,65	0,18	0,56

Legend in the text

Table 4. shows the distribution of repetitions of different running length sections, and the percentages describe their contribution to total distance. Of the overall quantity of running expressed in metres, the players ran 49,1% at a slow tempo (L), 37,8% at a moderate tempo (S), and 13,1% at a fast tempo (B). Of the run sections in the whole match, 54,9% were run in the first and 45,1% in the second half of the match (results of the table 4.), which points to the decrease of play intensity in the second half. In the case of slow and moderate speed running, sections of 10m are predominant, whereas in the case of fast running sections of 5 metres were mostly run. After 5 metre sections the number of repetitions decreases with the length of the sections. It is also interesting that sections of 30, 40 and 50 metres were run, on average, less than once in the whole match per player (0,7; 0,5, 0,2).

Table 4. Number of repetition of different length sections

AVERAGE VALUES		Number of sections repetition						m	%
		5 m	10 m	20 m	30 m	40 m	50 m	Overall	Overall
L	1st half	22,6	29,7	15,5	3,9	1,3	0,4	909	27,7
	2nd half	18,6	25,3	13,7	1,7	0,5	0,2	701	21,4
	All	41,2	55	29,2	5,6	1,8	0,6	1610	49,1
S	1st half	13,8	20,6	11,7	3,5	0,9	0,4	670	20,5
	2nd half	11,2	17,6	11,1	2,8	0,5	0,2	568	17,3
	All	25	38,2	22,8	6,3	1,4	0,6	1238	37,8
B	1st half	10,6	8,2	2,9	0,4	0,3	0,1	222	6,8
	2nd half	9,8	7,9	2,8	0,3	0,2	0,1	206	6,3
	All	20,4	16,1	5,7	0,7	0,5	0,2	428	13,1
OVERALL	1st half	47,2	58,3	30,1	7,8	2,5	0,9	1800	54,9
	2nd half	39,6	51	27,6	4,8	1,2	0,5	1477	45,1
	All	86,6	109,3	57,7	12,6	3,7	1,4	3277	100

Total distance in meters (m), percentage of total distance (%)

Discussion

Distribution of the results concerning the position in the game (Table 1.) and the average value of the overall run distances of 3277 m during a match (Table 2.) are what differ the monitored team from some top European teams, since the research has shown significant difference in the quantity of running according to different positions in those teams (Bangsbo, 1994.)

For the decrease of distance sum in the second halftime, we assume that the players changed slow running into walking in the second halftime. The results of moderate and fast running in the second halftime (S2 and B2), which weren't statistically significantly different ($p>0,05$) from the results in the first halftime (S1 and B1), point to this conclusion. Statistically significant difference ($p<0,05$) in the quantity of overall running in the first (UK1) and second (UK2) halftime is noticeable. We assume this is predominantly because of the considerable difference in slow running in the fist and second halftime.

Quantities of running at different speeds were not significantly correlated with the result of the match (Table 3.), despite the tendency of moderate running speed and the overall quantity of running. In other words, with a lager number of monitored matches we assume it would be possible to correlate the overall quantities of running and quantities of running at moderate intensities with the success in a match.

According to measurements in France, of the overall movement during a football game, 31,3% falls of on walking, 38,7% on slow running, 20% on fast running and 10,3% on sprint (Dujmović, 1997, according to Goubet 1988.). Top European players showed movement between 7000-10000 metres (Dujmović, 1997, according to Bauer 1975.). The authors call attention to the fact that the movements of players in the named researches implicate a certain quantity of walking, and quantity of running on average amounts to around 70% of the overall movement, which would mean that running of the top players during a match amounts to around 6000-7000 metres. Mentioned results cannot simply be compared to the obtained results in this research because of the non-standardized method of collecting data. However, the results point to the conclusion that the analyzed matches were below the level of running for top European teams.

We assume that Croatian football players have lower fitness capacity than players of international caliber which could be one of the reasons of bad results in the international competitions. In conclusion, the monitoring of the distances sum in competition can help to improve the process of training and selection in football.

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"FASTSKIN" IN TEST

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Abstract

There is no doubt that many swimmers do benefit from wearing bodysuit. The questions whether these suits improve performance and should they be allowed in competition are still being asked. The aim of the study was to determine the influence of " FastSkin" on 50m crawl overall time as well as to determine whether there are differences in influence of particular part of the race on total time while swimming in the regular and "FastSkin" suit. Fifteen male national and international level Croatian swimmers completed two times 50m-crawl swimming in regular and "FastSkin" suit. Block-off time, Start time (15m), Turn time (7,5-7,5), Split time (25m), Race time (50m), Heart rate (30 sec) and number of strokes per 50m were recorded. "FastSkin" appears to enhance performance on 50m crawls. The results indicate that turn time, split time and race time were significantly faster in second swim. Most of the difference (0,31 s) was gained after first 25m and turn had been completed. In this research "FastSkin" improved performance 1,6% (0.41 sec.). It appears that the suit is more beneficial for start and turn (streamlining and kicking) than for swimming the full stroke.

Key words: *swimming suit, swimming performance*

Introduction

After four years of research Speedo developed the "FastSkin" suit with material designed to reduce resistance. The suit mimics shark's skin. At the Sidney 2000 Games 83% of all medals were won by swimmers wearing Speedo swimsuit. At the same time, swimmers in "FastSkin" broke 13 out of 15 world records.

There is no doubt that many swimmers do benefit from wearing bodysuit. The questions whether these suits improve performance and should they be allowed in competition are still being asked. The "FastSkin" suits were first introduced at the FINA World Swimming Championship (Athens, March, 2000). To date over 60 swimmers wearing "FastSkin" have broken world records. Manufacturers claim that the suit reduces friction drag and that a body slips through water more smoothly. The suit appears to reduce muscle vibration thus increasing productivity from muscles. According to manufacturers, the suit reduces resistance by 7% and improve results by 3% Some test in flumes have shown that passive drag can be reduced up to 10% in some swimming positions for some of the suits. The full-length swimsuits appear to have most benefits in streamlining. The benefits decrease as the swimmers perform the flutter kick and full stroke (Benjanuvatra et al., 2001). Scientists still dwell whether the suit has beneficial effect on buoyancy. Speedo claims that the suit is neutrally buoyant. One result of underwater weight of swimmers when wearing "FastSkin" indicated also that the swimsuit does not aid buoyancy (Benjanuvatra et al., 2001). Swimmers claim that the suit help to uphold the legs in the water. Distance swimmers, on the other hand, claim that the suit feel buoyant for the first 200-250m of the race but after that they begin to feel "dragged down" by the suit.

Drag reduction and result improvement issue

A basic problem with researching the effects of bodysuits on swimming performance is that the testing itself cannot be done in competitive environment. Those made in flume may not be good indicators for establishing the real effect of "FastSkin" suits.

Method used by Toussaint at al. (2002) with MAD system is considered to yield very good estimation of active drag. In their research a non-significant reduction in drag of 2% (p= 0.31) was found. On the other side *Speedo* claims that "FastSkin" reduces passive drag by 7% and improves results by 3%.

There have been several researches where test conclusions were based not on drag reductions but on swimming speed. Swimmers would conduct a practical test in regular and traditional suit. The main problem of these researches is that swimmers were not shaven when wearing regular suits. Also a regular suit can increase drag resistance if stretched and loosen. Some coaches estimate a significant advantage of bodysuit on underwater kicking and above-water swimming in crawl stroke and butterfly; no advantage for backstroke and negative effects on breaststroke. An international level backstroker and butterfly specialist used an aqua pacer to compare the condition of wearing full Speedo bodysuit and regular suit. It was found that swimming velocity was higher when wearing the bodysuit (Speedo report, 2000).

The aim of the study was to determine the influence of " FastSkin" on 50m crawl overall time as well as to determine whether there are differences in influence of particular part of the race on total time while swimming in the regular and "Fastskin" suit.

Methods

The subjects, 15 male national and international level Croatian swimmers completed two times 50m crawl. First swim was done in standard swimming suit, meaning swimming briefs, and not shaven and second, two days after, in "FastSkin". The age of the swimmers were 15 to 20 years. Out of 15 swimmers 12 wore legskin, 2 had full body knee-skin and 1 wore jammer (shorter pantsuit). Six variables were measured to test the influence of "FastSkin" on speed:

- Block-off time
- Start time (15m)
- Turn time (7,5-7,5)
- Split time (25m)
- Race time (50m)
- Heart rate (30 sec.)
- Number of strokes per 50m

Results

Descriptive statistics and Student-t-test were used to compare the data obtained in two trials, with and without Fast-Skin swimming suit (Table 1).

Table 1. Means, SD and p level of significance between two trials

	Regular Suit		"FastSkin" Suit		p values
	Mean	SD	Mean	SD	
Block-off time (s)	0.76	0.54	0.78	0.50	0.135
Start time (s)	6.34	0.36	6.29	0.36	0.287
Turn time (s)	7.44	0.39	7.33	0.44	0.023*
Split time -25m (s)	12.34	0.65	12.14	0.66	0.0001*
Race time -50m (s)	25.53	1.29	25.12	1.30	0.0003*
Heart rate (n)	157.4	13.14	154	10.96	0.064
N of strokes	37.5	3.38	37.46	3.13	0.843

*Marked values significant on level p<0.05

Multiple regression analysis was used in order to determine the influence of particular part of the race on total race time while swimming in regular and "FastSkin" suit.

Table 2. Regression summary (influence of particular part of the race on total race time while swimming in regular and "FastSkin" suit)

	Regular Suit		Fastskin Suit	
	BETA	p-level	BETA	p-level
Block-off time	0.08	0.083	-0.06	0.253
Start time	-0.12	0.531	0.18	0.384
Turn time	0.18	0.264	0.57	0.021*
Split time (25m)	0.96	0.003*	0.18	0.465
Num. of strokes	0.05	0.144	0.04	0.202
	R= 0.99 p< 0.000		R= 0.99 p< 0.000	

*Marked values significant on level p<0.05

The first part of the race (Split time at 25m) had the highest influence on the overall 50m time while swimming in the regular suit which could be concluded by analysing individual variables when swimming in regular suit. The turn time was the most significant variable in predicting the race time while swimming in the "FastSkin" (Table 2).

Discussion

"FastSkin" appears to enhance performance on 50m crawls. The results indicate that turn time, split time and race time were significantly faster in second swim. Swimmers improved 0.11 seconds in turn, 0.20 seconds in 25 and 0.41 seconds in 50m when wearing "FastSkin". Most of the difference (0,31 s) originated from first 25m and the turn.. Although the block off time in "FastSkin" was somewhat slower (0.02 s) swimmers had better start time (0.05 sec.). Number of strokes in both swims was the same, but it is noticeable that swimmers had lower heart rate while wearing "FastSkin" (3-4 beats/min). Insight into individual data revealed that only one swimmer was slower while wearing the suit.

Altogether "FastSkin" improved performance 1,6% (0.41 sec.). In this study we confirmed some previous findings that "FastSkin" improves performance more through the improvement of the diving phase meaning during the turns (Toussaint et al., 2002., Benjanuvatra et al., 2002) and less during the swimming phase. It appears that the suit is more beneficial for start and turn (streamlining and kicking) than for swimming the full stroke.

The limitations of this study were that all swimmers did not wear the same type of "Fastskin" regarding the surface of body coverage. The question that was not answered in this study was whether the differences between the two trials would have been even bigger if all of the subjects had worn the full body suit. Though it would be very hard to conduct that type of study because top level swimmers refuse to swim in suit that they are not comfortable in.

At the end, the placebo effect of the suit cannot be excluded but the interesting conclusions might be drawn if we look at the comments about "FastSkin" of 3 Junior European Champion finalists who participated in this study said:

- *"The main reason why I use it is that my legs do not fatigue as much as without it. Also, I feel that it keeps my legs higher in the water."*
- *"I don't think that the suit itself makes you faster. It's more a mind game. If you think that it makes you faster than you probably will be faster."*
- *"I feel that it helps me most during underwater kicking although there is no difference in my results with or without it."*

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THREE DIMENSIONAL EVALUATIONS OF SHOT PUTTING TECHNIQUE OF HIGHLY SKILLED PERFORMER

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Abstract

The aim of this paper is to evaluate the rotational shot put technique of highly skilled Croatian shot put performer. The analyzed put (the best attempt) was picked out of the competitive season as the best put between 10 maximum efforts trails. The performance has been recorded by three video cameras operating at 50 frames per second positioned to provide 3D analyses. The collected video images were digitized using APAS. Transformation into 3D space was made by DLT method. The obtained 3-D coordinates of the digitized body and the shot parts were then filtered using Cubic Spline smoothing method. Complete stereotype was divided into five phases. The smoothed coordinates were used to calculate kinematics' parameters (release parameters, duration of the phases, speed of the shot and changes in speed of the shot in different phases), necessary for comparison with the data of others researchers.

Key words: *kinematic analyze, track and field, throwing movements*

Introduction

The measured distance of shot put contains two components. The first is horizontal distance traveled by a shot released at s certain angle to the horizontal, and it depends on three parameters: Release speed, release angle and release height. The second component that contributes to the measured distance is the release position relative to the point of the measurement (the toe board).

Much scientific research has been performed on the shot put. The most frequently these studies examined release speed, release angle and release height as parameters which determine the trajectory of a simple projectile (such as shot). Unfortunately, these do not provide helpful information to coach. It explains what needs to happen, but not what it takes to make it happen. The aim of this paper is to evaluate the rotational shot put technique of highly skilled performer with the 18.36 m best record put. The measured distance of the analyzed put was 17.20 m, and athlete in that time could not achieve more than 14.70 in putting from a standing position. By that difference (2.50 m) in putting from a standing position and putting with the turn we considered athlete's skill as a top-level shot put skill.

Methods

The analyzed put was picked out of the competitive season as the best put between 10 maximum efforts trails. Every trail was videotaped and the best throw was selected for the analysis. The performance has been recorded by three video cameras 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 (Abdel-Aziz and Karara, 1971.). The obtained 3-D coordinates of the digitized body and the shot parts were then filtered using Cubic Spline smoothing method.

Complete stereotype was divided into five phases. The first double support phase starts at the end of the final preliminary (t_1) swing and continues up to the instant the athlete's right foot breaks contact with the ground (t_2). The first single support phase extends from the end of the first single support phase (t_2) to the instant to thrower's left foot breaks contact with the ground (t_3). The flight phase proceed from the end of the single support phase (t_3) to the instant the athlete's right foot regains contact with the ground (t_4). The second single support phase is from the end of the flight phase (t_4) to the instant the athlete's left foot regains contact with the ground (t_5), and the second double support phase is from the end of the second single support phase (t_5) to the instant of realize of the shot (t_6).

Results

The release parameters (release height, release angle, release velocity) and the official distances of the world best shot putters and the release parameters and the distance of the analyzed throw are shown in the table 1.

Table 1. Release parameters and performance results of top shot-putters (Luthanen, 1997) and analyzed throw

Shot putter	Distance (m)	Release height (m)	Release angle	Release velocity
MH	20.41	2.13	35.98	13.21
CH	20.48	2.22	37.69	13.19
Analyzed throw	17.20	2.07	38.50°	11.73

The duration of the phases of the best world shot putters and analyzed throw are shown in the table 2.

Table 2. The duration of the phases of the best world shot putters (Luthanen, 1997) and analyzed throw

Subject	d (m)	t_2-t_1 (s)	t_3-t_2 (s)	t_4-t_3 (s)	t_5-t_4 (s)	t_6-t_5 (s)	t_6-t_1 (s)
CH	20.41	0.83	0.46	0.11	0.22	0.21	1.84
MH	20.48	0.41	0.44	0.12	0.18	0.21	1.35
Analyzed throw	17.20	0.66	0.46	0.08	0.16	0.26	1.62

Speed of the shot at the and of the phases of the best world shot putters and analyzed throw are shown in the table 3.

Table 3. Speed of the shot at the and of the phases of the best world shot putters (Luthanen, 1997) and analyzed throw

Subject	d (m)	vt_2(ms^{-1})	vt_3 (ms^{-1})	vt_4 (ms^{-1})	vt_5 (ms^{-1})	vt_6 (ms^{-1})
CH	20.41	2.26	1.74	1.21	2.71	13.27
MH	20.48	2.36	2.42	1.15	2.24	13.19
Analyzed throw	17.20	1.98	2.15	1.66	1.55	11.73

Changes in the speed of the shot during the phases of the best world shot putters and analyzed throw are shown in the table 4.

Table 4. Changes in the speed of the shot during the phases of the best world shot putters (Luthanen, 1997) and analyzed throw

Subject	d (m)	vt_2-t_1 (ms^{-1})	vt_3-t_2 (ms^{-1})	vt_4-t_3 (ms^{-1})	vt_5-t_4 (ms^{-1})	vt_6-t_5 (ms^{-1})
CH	20.41	2.26	-0.51	-0.53	1.49	10.50
MH	20.48	2.36	0.06	-1.27	1.09	10.95
Analyzed throw	17.20	1.98	0.17	-0.49	-0.11	10.18

Speed (ms^{-1}) of the body segments (right side) of variously skilled shot-putters (Lanka, 2000) and analyzed throw are shown in the table 5.

Table 5. Speed (ms^{-1}) of the body segments of variously skilled shot-putters (Lanka, 2000)

Registered indices	Performance results in shot put (m)				
	19.60	18.30	13.30	12.26	Analyzed throw 17.20
Maximum speed of hip joint	5.74	5.13	4.28	4.81	2.44
Speed of hip joint in release	2.75	1.05	0.83	1.96	1.24
Maximum speed of shoulder joint	6.77	7.66	4.91	5.32	4.00
Speed of shoulder joint in release	6.34	5.46	3.10	4.82	3.33
Maximum speed of wrist joint	11.00	10.64	8.02	7.95	8.82
Speed of wrist joint in release	10.90	9.25	7.51	7.85	6.86
Release velocity of the shot	13.12	12.51	10.49	10.12	11.73

Discussion

The greater difference in release parameters between the analyzed throw and the best putters' throws is the difference in release velocities (table 1). The most important factor in shot putting is release velocity and the main intention in shot putting is increasing the release velocity. The release speed and angle of release are dependent variables and the possible way to enhance release speed is to lover the release angle. This possibility may not be rational because release height (which is lower in analyzed throw, mostly depends on the length of the athlete's body and arms) and the angle of release are depended variables. In fact, the smaller release height requires the increasing in angle of release (Lanka, 2000).

The duration of the complete technique, the first double supported phase, the first single supported phase and the second single supported phase of the analyzed throw is similar as the duration of the technique of the top shot putters. The duration of the flight phase, which is very important (Luthanen, 2000; Young, 2005) is shorter than the duration of the flight phase of the top shot putters. The duration of the second double support phase is longer than the top level shot putters, which is reasonably, because they are probably much stronger and have better gradient of the force production than the observed shot putter.

Changes in the speed of the shot during the phases of the best world shot putters and analyzed throw (table 4) indicate the greater difference in the second single supported phase. Observed shot putter refers decrease of the shot speed during second single supported phase. Is this rationale or not? Great enhance of the shot speed of the observed shot putter (he is not very strong) in the final phase indicate that the decreasing of the speed may be not denote worthless technique.

Observed thrower has a great difference between the put from standing position and the put with a complete technique, and probably, he uses some in science not confirm principle (such as inverted pendulum) to achieve such progress in final phase. The speed and acceleration of the shot are shown in the figure 1. According to presented graph most of the shot velocity was generated during the second double supported phase.

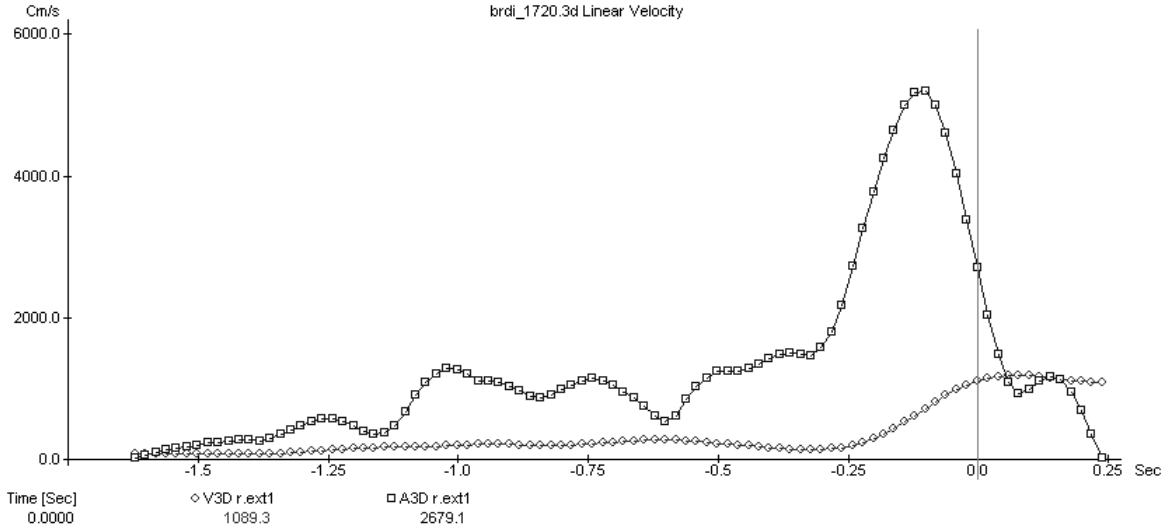

Figure 1. Speed and acceleration of the shot of the analyzed throw

The important question of shot putting is how the movements of the segment should be coordinated to make the measured distance maximal. According to data (Zatsiorsky, 1981; Lanka, 2000), the release velocity of the shot will be reduced if the maximum speed of the extending arm is added to the sub maximal speed of the extending lower extremities and if the greater the difference in time between the maximum trunk and lower extremity velocities. According to presented data (table 6) observed shot putter achieve peak speed of the right wrist (0.08 s before instant of release) before he achieve peak speed of the right shoulder (0.06 s before instant of release). It can denote that contemplate thrower may be start extension of the elbow to early.

Table 6. Temporal coincidence of the peak speed of different body segments in the final part of a put (Lanka, 2000)

Time from the instant of maximal speed of a segment to the instant of release (s)	High-skilled athletes	Low-skilled athletes	Analyzed throw
Right knee joint	0.18	0.14	0.12
Right hip joint	0.09	0.09	0.10
Right shoulder joint	0.06	0.07	0.06
Right wrist joint	0.02	0.03	0.08

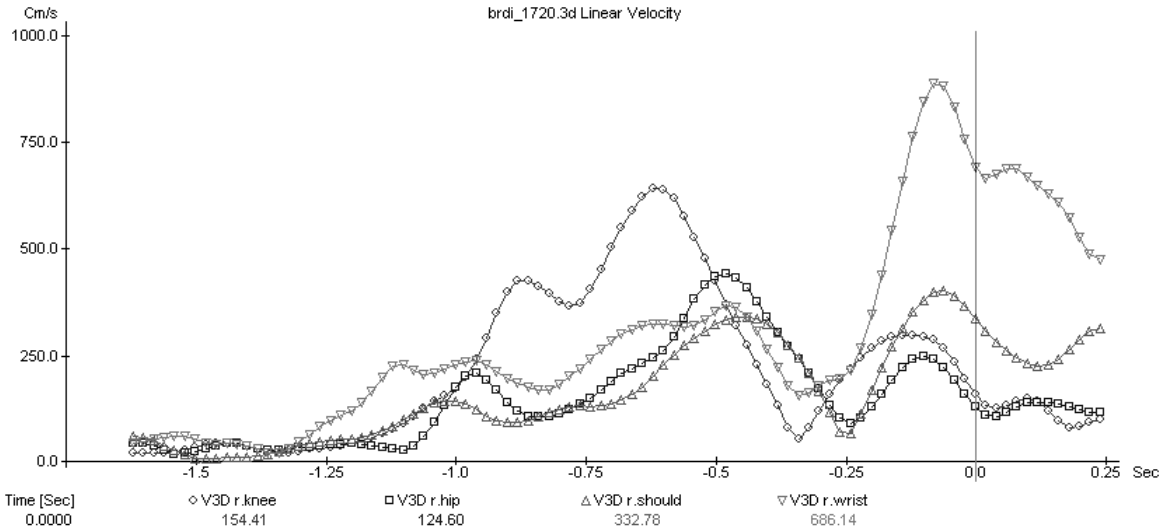

Figure 2. Resultant speed of the segments of the right side of the body

The data presented in the table 6 can be note in the figure 2. The peak speed of the right wrist accomplished 0.08 s before instant of release and the peak speed of the right shoulder accomplished 0.06 s before instant of release.

The very important movement of the kinematics' chain takes action of trunk rotation and action of the arm extension and temporal coincidence between these two actions. The utilization of the body rotation can be partly explained by the relative motion of the shoulder axis and hip axis. It can be noticed in the figure 3. The rapid extension of the right elbow starts exactly when the shoulder axis rotates over the hip axis.

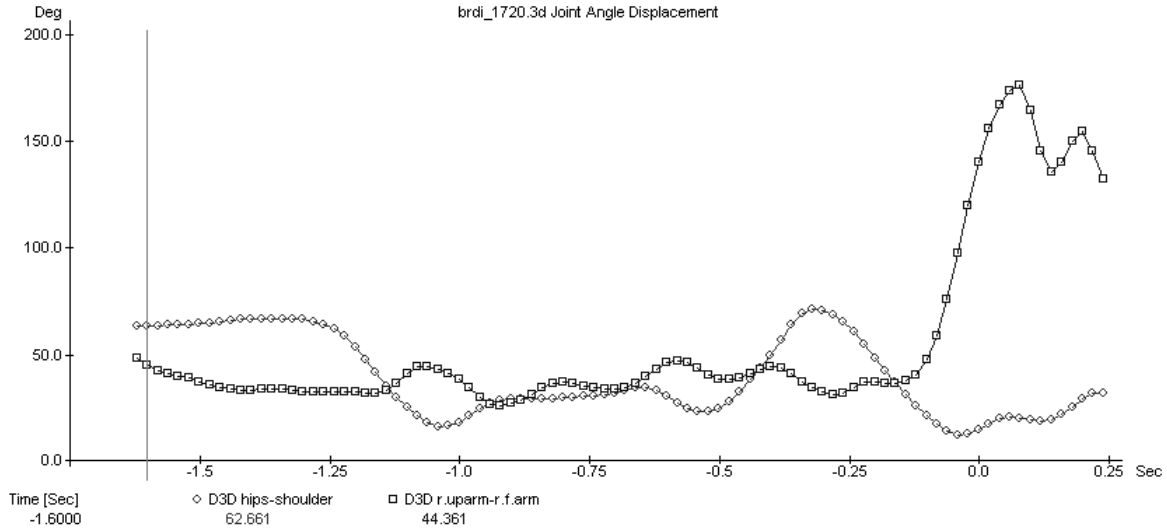

Figure 3. The angle of right elbow and angle difference between shoulder and hip axes

Conclusion

The goal of this paper is to provide helpful information to coach and the athlete in hopes of directing their technical development. We analyzed the technique of our best skill shot put performer through this relevance. After collecting the data we calculate release parameters, duration of the phases, speed of the shot and changes in speed of the shot in different phases of the our shot putter and compare magnitude of the calculated parameters with the top level world shot putter. According to great difference between the put from standing position and the put with a complete technique of the observed thrower, and some specificity in the technique we considered that he may be emphasizes some in science not yet confirm principle (such as inverted pendulum) to achieve such progress in final phase. The major flow, we considered is poorly temporal coincidence of the right wrist and right shoulder movement.

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KINEMATIC ANALYSIS OF ALEŠ PAJOVIČ JUMP SHOT TECHNIQUE

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Abstract

The jump shot is one of the most important elements of specific handball motorics. We therefore wanted to analyze some basic kinematical parameters of jump shot technique used in handball by top-level right handed male handball player Aleš PAJOVIČ (height = 197 cm, weight = 100 kg, age = 26 years). Two SVHS Video cameras operating at 50 frames per second were used for the acquisition of the data. Data processing was performed by APAS (Ariel Performance Analyses System). Fifteen segments model of the human body was defined by digitized co-ordinates of 16 reference points. Additional point was the ball. We can say that our results are fully in accordance with previous results of other authors. The velocity of movement of the smaller and lighter parts of the body with lesser inertia is added to the velocity of the bigger ones, achieving the greatest possible velocity at the end part of the kinematic chain. It means that by our subject angular velocity of the elbow is greater after stopping the movement of the shoulder, wrist after stopping the elbow, etc. .

Key words: *kinematic, handball, jump shot.*

Introduction

All activities in handball are being performed in specific conditions, with the presence of players of the opposing team and while observing playing regulations. Their selection and execution therefore depends mostly on the situations in the match. Even if a player can execute the individual elements sometimes in a non-typical way, certain kinematic parameters do exist for most elements that show the greater or lesser efficiency of the element's execution.

The aim of this study is to analyze some basic kinematical parameters of jump shot technique used in handball by top-level right handed male handball player Aleš PAJOVIČ (height = 197 cm, weight = 100 kg, age = 26 years). The jump shot technique is the most typical one among various shooting techniques used in handball. Usually jump shot take-off is from the leg which is opposite the throwing hand (right handers use the left leg for take-off). In this case the player gains the correct natural co-ordination which allows successful – forceful and accurate - shot towards the goal (Taborsky, Tuma, & Zahalka, 1999).

Methods

Top-level right handed male handball player Aleš PAJOVIČ executed, after 20 min. of warming-up, three jump shots. First he chose a starting position for approach in the middle of the playing court. His approach consisted from two parts. First he did three steps, bounce a ball and after that he did three steps of approach. He performed take-off in an area, which was marked on the free-throw line. He performed all shots with maximal effort towards the goal. Among all attempts, we chose the most characteristic jump shot, for further analysis. Two SVHS Video cameras operating at 50 frames per second were used for the acquisition of the data. The cameras were positioned in such a way that, after the registration of eight points, a reference frame (500cm x 100cm x 100cm) provided the possibility of an analysis in 3 D space.

Data processing was performed by APAS (Ariel Performance Analyses System). Fifteen segments model of the human body was defined by digitized co-ordinates of 16 reference points. Additional point was the ball. Reference points represented joint centres of limbs on both sides of the body and additionally atlas, vertex and the ball. Centre of body gravity (CG) was calculated from Dempster via Miller, Nelson anthropometrical model (by Winter, 1990).

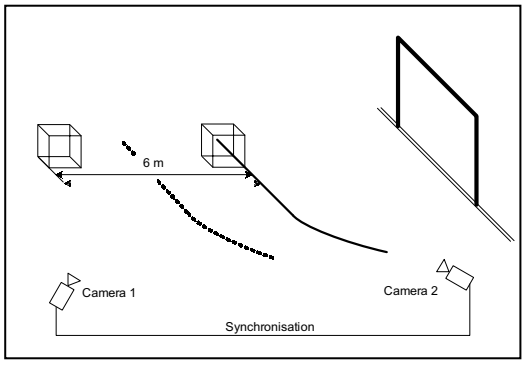

Fig.: 1: Schema of the measurement experiment.

Results

According to its basic structure the jump shot could be divided into five phases: approach, take-off, flight, throw and landing (Zvonarek, & Hraski, 1996; Zahalka, Tuma, & Bunz, 1997) In this study we took into consideration only the three of them – take-off, flight and throw. In Figures and Tables 4, 5, 7, 8, 9 are represented angles and angles velocities for the chosen points on different body segments.

Table 1: Kinematic parameters of the analysed jump shot.

	Placement	Take off	Throwing moment	Landing
A_Forearm_X XY		90.81	122.75	259.04
Av_Forearm_X XY		33.61	1507.18	176.70
A_Upperarm_X XY	84.78	190.18	307.02	472.98
Av_Upperarm_X XY	295.23	394.60	896.53	367.87
A_Trunk_X XY	87.25	78.53	107.68	91.77
Av_Trunk_X XY	-58.18	-70.65	10.97	-109.28
A_Hip axis_X XZ	98.29	65.04	83.69	89.93
Av_Hip axis_X XZ	-225.45	-13.75	69.28	-10.32
A_Shoulder axis_X XZ	82.18	133.90	73.75	92.03
Av_Shoulder axis_X XZ	52.10	216.84	-169.70	177.01
v_BALL XYZ	7.53	5.21	25.77	
v_R.HIP XYZ	4.92	4.15	2.91	4.67
v_R.SHOLDER XYZ	4.04	3.55	3.06	3.73
v_R.ELBOW XYZ	3.62	4.30	6.70	2.51
v_R.WRIST XYZ	5.67	4.83	16.45	3.28
v_BCG XYZ	4.723	3.959	3.276	4.186
A_Elbow XYZ	137.97	109.93	166.84	147.88
Av_Elbow XYZ	40.53	60.23	522.33	-155.60
A_Upperarm-shoulder XYZ	107.33	156.28	145.09	111.94
Av_Upperarm-shoulder XYZ	164.60	-23.20	-422.55	307.38
A_Upperarm-trunk XYZ	28.23	95.67	142.55	33.45
Av_Upperarm-trunk XYZ	214.85	327.25	-235.65	365.73
A_Hip-Shoulder axis_X XZ	186.62	231.58	-378.20	332.28
Av_Hip-Shoulder axis_X XZ	277.55	230.59	-238.98	187.34

Take-off. This phase is the interval from the beginning to the end of the contact with the ground of the take-off leg in the last step of approach. In this phase begins the decrease of horizontal speed and increase of vertical speed at the same time. The duration of complete take-off was 0.22 s (Fig. 4, 5, 7, 8, 9). At that moment the angle between shoulders and horizontal axis in the sagittal plane was 133.9^0. The hip line in the same axis was 65.0^0 (Table 1 and Fig. 8). Simultaneously with the take-off the subject finished the preparation of the throw by swinging his throwing arm back and up-so called circle-or semi-circle contra swing (Fig. 3).

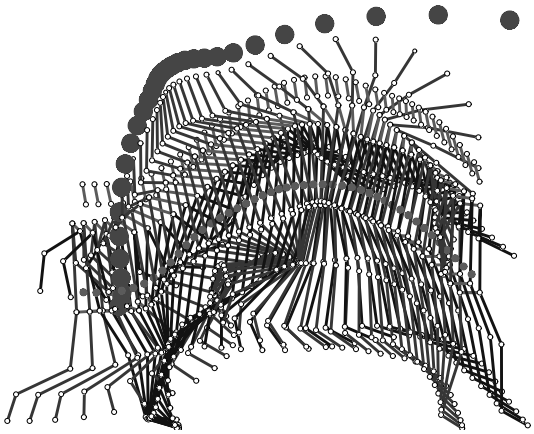

Fig. 2: Kinogram of the analysed jump shot.

Fig. 3: Video images of the analysed jump shot.

Flight. Because the flight of the body (if air resistance is neglected) is determined by the characteristics of the parabola, the previously mentioned parameters, describing the horizontal and vertical take-off velocity, define the basic flight characteristics of Aleš's jump shot. His CG rose from 142 cm to 178 cm achieved at the top of the flight. CG moved forward before the shot 115 cm (Fig. 6). The whole flight lasted 0.64 s.

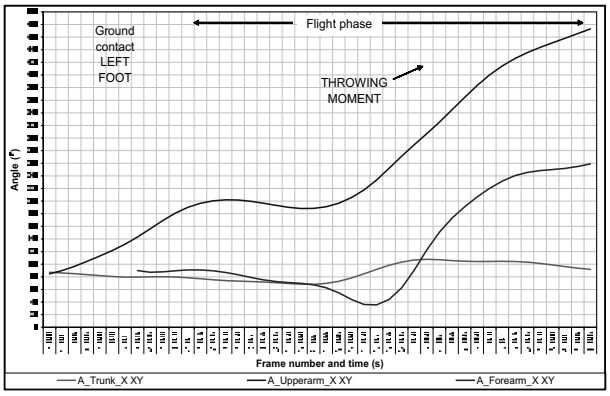

Fig. 4: Angles between trunk, upper arm and forearm during the jump shot in xy plane.

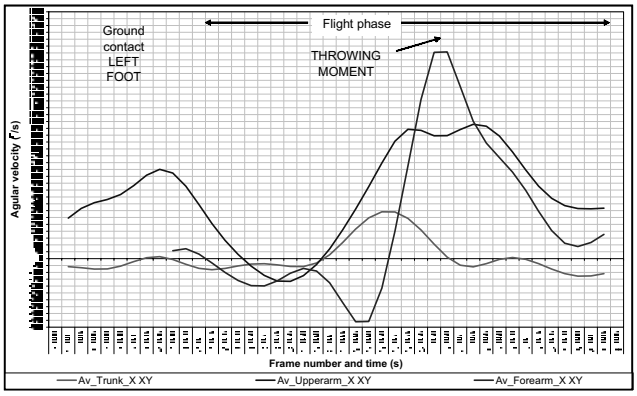

Fig. 5: Angular velocities of forearm, upper arm and trunk during the jump shot.

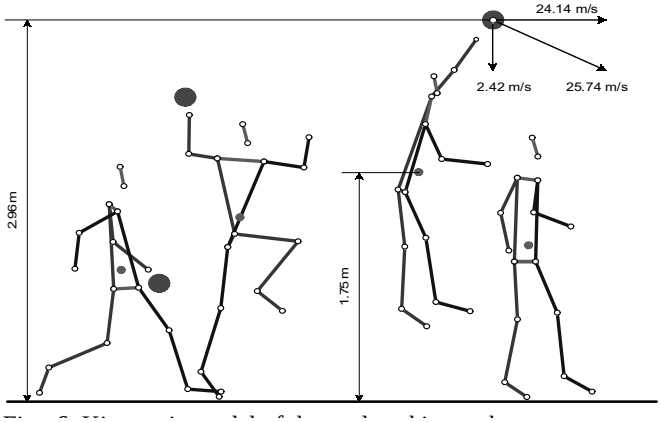

Fig.: 6: Kinematic model of the analysed jump shot.

Throw. The height of the throw was 2.96 m (Fig. 6). Decrease of maximal CG height till the throw was 3.0 cm. Beside this the most interesting characteristics are those which describe the functioning of kinetic chain: peak joint centre speeds, and of course, the speed of the ball throw. The functioning of the kinetic chain is based on the energy transfer from the proximal to the distal segments to the ball (Müller, 1982; Bon, Šibila, & Erčulj, 1997).

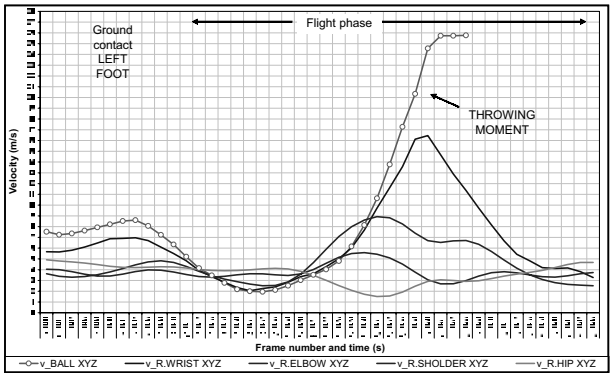

Fig. 7: Hip, shoulder, elbow, wrist and ball velocities during the jump shot.

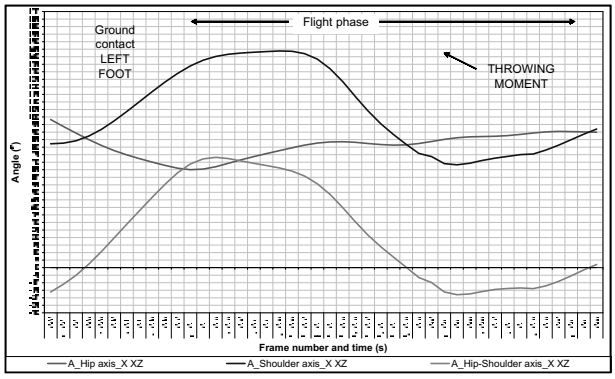

Fig. 8: Angles between hip axis, shoulder axis and hip-shoulder axis in the xz plane.

Thus it could be expected that peak joint speed, relevant for the throwing movement, will increase and follow the same order: hip, shoulder, elbow and wrist. It was also the case in analyzed Aleš's jump shot (Fig. 10). In the throwing phase the peak hip speed after take-off was 4.92 m/s, shoulder 5.59 m/s, elbow 8.92 m/s and wrist 16.45 m/s. Accordingly it could be expected that peak joint speeds will be reached in the same orderly progression. The peak hip speed had been produced in the moment of the ground contact, shoulder within 0.50 s, elbow within 0.52 s, while peak wrist speed was produced within 0.60 s after take-off. The speed of the ball moving towards the goal was 25.74 m/s (Fig. 10). The greatest angle between shoulders and horizontal axis in the sagittal plane was achieved in 0.14 s after the take-off and amounts together to 143.8^0 (Fig. 8).

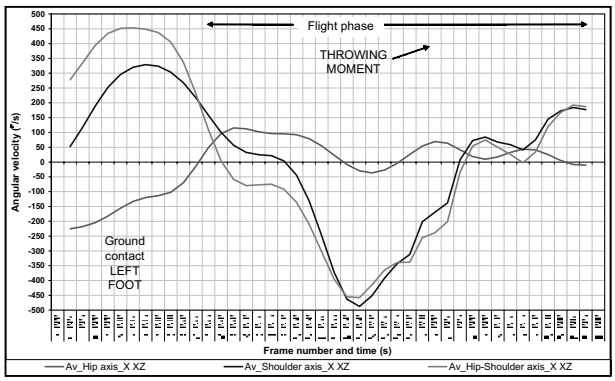

Fig. 9: Angular velocities of hip, shoulder, and hip-shoulder axis in the xz plane.

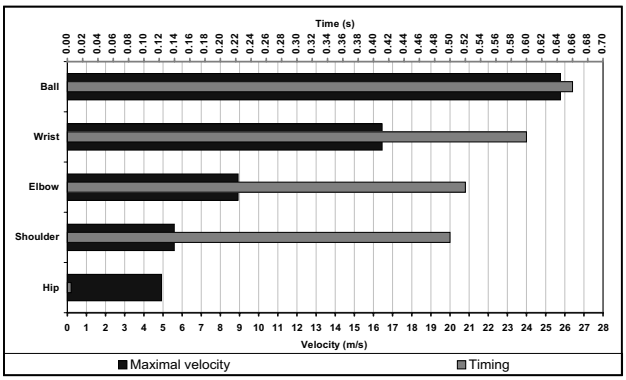

Fig. 10: Timing of the peak joint centre's velocity.

Disscusion

We should say that our results are fully in accordance with previous results of other authors (Zvonarek, & Hraski, 1996; Zahalka, Tuma, & Bunc, 1997; Bon, Šibila, & Erčulj, 1997; Šibila, & Bon, 1999; Šibila, Bon, & Štuhec, 1999; Taborsky, Tuma, & Zahalka, 1999). It means that our subject achieved correct order of recruitment of the individual parts of the body, thus allowing the development of maximal velocity and control of these parts – from the proximal (central) parts to the distal (distant) parts of the body (Fig. 10). The most proximal part (hip) began the action; it was then followed by the next, and so on till the most distal part – the wrist. The velocity of movement of the smaller and lighter parts of the body with lesser inertia was added to the velocity of the bigger ones, achieving the greatest possible velocity at the end part of the kinematic chain (each proximal part offered support for the next, more distal part). The increase of angular velocity of the individual segment of the kinematic chain was connected to the stoppage of the proximal part (angular velocity of the elbow was greater after stopping the movement of the shoulder, wrist after stopping the elbow, etc).

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MODELLING OF SITUATION PARAMETERS IN TOP LEVEL VOLLEYBALL

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Abstract

Using computer software DATAVOLLEY, the data from 20 games of A1 Italian volleyball league were collected. On the basis of five situation parameters of the game, differences between the won and the lost sets have been defined for the purpose of developing an efficiency model of performing of volleyball actions. Such a theoretical – numerical model will help coaches in planning and programming team training activities, but also for the objective evaluation of their team's situation efficiency.

Key words: *volleyball, situation parameters, efficiency model*

Introduction

It is well known that for an effective training program in volleyball, the amount of scientific notions is very important, especially those related to the specification equation, learning and conditioning methods, selection of contents in training, dosage of load, and finally, the notion of the relations between technical and tactical elements during the competition.

Reasons of the successful and unsuccessful outcome of the match depend on a number of factors, however, what we can measure is related to the indicators of the situation efficiency of elements or phases during the match.

This group of researchers gathered around institutions of kinesiology (Ljubljana, Zagreb and Split) is trying to develop a theoretical model of efficiency of certain phases in volleyball game. Primarily such a numerical model in the first place would be used by the coaches of elite volleyball teams during training programme and for the outcome analysis of their own matches.

The reason for greater attention to be paid to this issue are the last changes of the rules of volleyball game, due to which the importance of some elements, phases and complexes came into different relations.

Considering the model that would be based on the performance of a certain phase differentiate success from poor success in the set, it is logical to take the data from the best league in the world.

The prerequisite for the correct monitoring of the matches was that the game statistics performance was recorded by an educated statistician from Data Project, company whose software was used to obtain needed statistic data at all important world competitions (FIVB, CEV).

Using DATA VOLLEY, a specialized computer program, the data from twenty matches of the first Italian league were collected.

Observation of the matches was based on the evaluation of the efficiency of five phases in volleyball game: SERVE RECEPTION, SPIKE IN THE PROCES OF ATTACK, BLOCK and SPIKE IN THE PROCES OF COUNTER-ATTACK. All phases of the game where a point could be won were observed and the phase of reception was added.

It is believed that the phase of reception is indirectly responsible for the success in the phase of spike in the process of attack. The phases of setting in the both complexes of the game are mostly evaluated in the realization of some of the attacking techniques, and this is the reason why they are omitted from this research.

Materials and methods

For the needs of making the model, 76 volleyball sets were analyzed. Teams which were observed are: Brescia-Montichiari, Modena, Zetaline-Padova, Sisley-Treviso, Cosmogas-Forli, DelMonte-Ferrara, Maxicono-Parma, Piaggio-Roma, Tnt Alpitour-Cuneo, Lube-Macerata, Iveco-Palermo and Vallever-Ravenna.

Each of the observed situational parameters was evaluated on the scale of five degrees. This method is a standard and it is used by the top-level national teams within all big competitions. Considering five degrees and five phases of the game 25 variables were needed for the game analysis:

SERVE

SERVIS=, SERVIS-, SERVIS/, SERVIS+, SERVIS#

RECEPTION

PRIJEM=, PRIJEM-, PRIJEM/, PRIJEM+, PRIJEM#

SPIKE IN THE PROCES OF ATTACK

SMNAP=, SMNAP-, SMNAP/, SMNAP+, SMNAP#

BLOCK

BLOK=, BLOK-, BLOK/, BLOK+, BLOK#

SPIKE IN THE PROCES OF COUNTER-ATTACK

SMKNAP=, SMKNAP-, SMKNAP/, SMKNAP+, SMKNAP#.

First degree (+) defines an error and a point lost.

Second degree (-) defines inferior performance which puts opponents team in advantage in continuation of outplaying.

Third degree (/) defines such a performance where one team did not make an advantage.

Fourth degree (+) defines performance where one team after a certain action makes an advantage in relation to opponent.

Fifth degree (#) defines an excellent realization and conquest of a point.

Data from the matches were collected using a specialized computer program Data Volley. Given frequencies were then analyzed with Statistica 5.0 computer program at the Faculty of Kinesiology.

Descriptive parameters were calculated for each of five degrees of the performance of a certain volleyball phase. For each degree arithmetic mean (MEAN), maximal (MAX) and minimal (MIN) value, and standard deviation (SD) were calculated.

Results and disccusion

Analyzing the SERVE variables in Table 1 we could see that the average frequency values of the successful serve (#, +, /), but also of the unsuccessful serves (=,-) was higher in the sets won. We assumed that the tendency in the game was serving of an aggressive and dangerous serve with a goal to win a point and disable the opponent's attack, and to decrease the number of the negative, i.e. harmless serves. From above mentioned the value of the serve error was understandable and justified (3.27-sets won, 2.91 sets lost).

Comparing the sets won and the sets lost we could notice that at the RECEPTION variables the average values during the performance of the successful reception were approximately the same, but there was a significant difference in the performance of the unsuccessful reception (=,-,/) in favour of the sets won.

Low number of errors and high average value of the successful reception, expressed in percentage 66% (sum of variables + and #, Table 2), showed a high level of preparedness of specialists for the reception ("libero" and outside hitters), and possibly, the knowledge of a preferred serve typical for a certain team.

Inspection of the results of the BLOCK variables showed that the higher values of the successful and unsuccessful performances were found at the sets won. Reason of such a distribution was that at the sets won a team formed a group block in more cases contrary to the lost sets where a team did not form a group block in more cases, so at the sets won a team had more errors but, at the same time, more positive and excellent performances.

Compared with the other variables, the SPIKE IN THE PROCESS OF ATTACK had the highest average values (8.83 SMNAP# at sets won and 8.09 at sets lost) and low values at the sets won with the unsuccessful performances (=,-,/) which explained error, negative and blocked spike in the process of attack and also showed high efficiency of a spiker.

Such values were the results of a successful reception which enables a setter to accurate setting and showed his art to outwit the opponent's group block, and eventually, spiker's versatility in terms of his knowledge of the different spike techniques.

At the BLOCK variables we found the higher values of the successful performance at the sets won and the lower values of the unsuccessful performance at the sets lost.

At the SPIKE IN THE PROCES OF THE COUNTER-ATTACK variables the highest values of the average frequencies were achieved with an excellent spike i.e. a spike with which we win a point (SMNAP# 5.60 at sets won against 3.63 at sets lost), and in the other degrees of performance, the values were approximately the same. At the sets won with the spike in the process of the counter-attack a lower number of errors were achieved in relation to the points won, contrary to the sets lost where a number of errors were higher.

At the reception variables, the spike in the process of attack, the spike in the process of counter-attack the successful frequencies were dominating over the unsuccessful ones.

At the block the successful and unsuccessful frequencies were equal, and at the variables of serve the unsuccessful frequencies dominated.

Table 1 - Descriptive statistics for each one of five degrees of a certain volleyball phase

VARIABLES	SETS LOST				SETS WON			
	Mean	Min.	Max.	SD	Mean	Min.	Max.	SD
SERVIS =	2.91	0	7	1.59	3.27	0	6	1.62
SERVIS -	11.83	5	20	2.99	14.53	8	20	3.25
SERVIS /	3.20	0	9	2.02	4.07	2	8	1.57
SERVIS +	0.80	0	4	0.91	1.13	0	3	1.07
SERVIS #	1.09	0	3	0.94	1.60	0	5	1.28
PRIJEM =	2.04	0	6	1.30	1.27	0	4	1.01
PRIJEM -	1.15	0	5	1.21	0.97	0	3	0.93
PRIJEM /	4.41	1	9	2.05	4.07	0	8	2.07
PRIJEM +	2.02	0	5	1.32	1.73	0	4	1.01
PRIJEM #	11.00	4	18	3.31	10.60	4	19	3.05
BLOK =	4.91	0	11	2.85	5.33	2	9	2.06
BLOK -	0.85	0	3	0.89	1.20	0	7	1.45
BLOK /	0.00	0	0	0.00	0.00	0	0	0.00
BLOK +	1.61	0	8	1.68	2.80	0	6	1.67
BLOK #	2.02	0	5	1.34	3.57	0	8	1.96
SMNAP =	1.15	0	4	1.07	0.97	0	4	1.19
SMNAP -	4.28	1	8	1.68	2.77	0	6	1.72
SMNAP /	1.80	0	6	1.45	1.10	0	4	1.16
SMNAP +	1.83	0	6	1.43	2.50	0	8	1.89
SMNAP #	8.09	3	13	2.59	8.83	3	17	2.80
SMKNAP =	0.76	0	4	1.04	0.77	0	2	0.77
SMKNAP -	1.63	0	6	1.39	1.60	0	5	1.10
SMKNAP /	1.30	0	4	1.09	1.07	0	3	0.98
SMKNAP +	0.70	0	6	1.19	0.90	0	4	0.99
SMKNAP #	3.63	0	8	2.27	5.60	1	10	2.37

On the basis of the observed top level volleyball teams which were wining in certain sets the ***Efficiency model of performance of the volleyball phases expressed in percentages*** i.e. model of the top level game was established (Table 2).

Values were calculated on the basis of arithmetic means, i.e. the percentages for each degree of the performance of a certain phase at the sets won were calculated.

As it was already mentioned, the data were collected from the top level sample (A1-Italy), so a model like this one could be ideal for other teams. We could use this model for planning and programming, or to compare our own team or an individual player with the model.

With the inspection of the established model an individual or a team should aim to achieve these values when performing a certain phase if they want to be successful.

Table 2 - Efficiency model of performance of the volleyball phases expressed in percentages

PERFORMANCE/PHASE	SERVE	RECEPTION	SPATTACK	BLOCK	SPCATTACK
=	13%	7%	6%	41%	8%
-	58%	5%	17%	9%	16%
/	17%	22%	7%	0%	11%
+	5%	9%	15%	22%	9%
#	7%	57%	55%	28%	56%

Values in Table 3 show the distribution of points in volleyball set, which includes the phases of the game where direct points were won (serve, attack, counter-attack, and block) as well as the opponent's errors.

The structure of the points was also used as a model that team has to aspire to, in order to be successful at WINNING THE SET.

If a certain volleyball team wants to win, it should approximately win per set: **1.6 points with serve, 8.83 points with attack, 5.6 points with counter-attack and 3.57 points with block. The rest of the points that are missing to win a set with the average of 5.4 points are the opponent's errors (spike in the net or out, net touch etc.).** On the basis of these values coaches could find statistics showing in which segment of the game their team was good or bellow standard, and if there is a need for further correction.

Table 3 - Efficiency model expressed with point structure in volleyball set

PHASE	SERVE	ATTACK	COUNTER-ATTACK	BLOCK	OPPONENT ERRORS	TOTAL
PERCENTAGE	6.4	35.3	22.4	14.3	21.6	100%
POINTS	1.6	8.83	5.6	3.57	5.4	25

In the research conducted by Fojkar (2001), results were gained from a sample of the games of the lower level of competition (2nd Slovenian national league-men) and expressed in points.

It showed that in order to be successful a team should win 1.5 points with serve, 13.5 points with spike in the both complexes (attack and counter-attack), 3.2 with block, while, 6.8 points go to the opponent's errors.

Comparison between the lower level competition model and the top level model clearly showed differences. Assumption was that it was possible to achieve more points with the serve because of the weak reception. Probably, the lower quality of attackers also affected the lower number of points in the actions of attack, and simultaneously made possible a higher efficiency in block to the opponent's blockers. In this research, spike was elaborated together in the both phases (attack and counter-attack) which made a good interpretation impossible. We could notice that the teams of the lower level of competition did not significantly make more errors than the top level teams (6.8 points against 5.4 points in the top level model). It showed that the data collected from the top level model could also be used for the lower level of competition, what requires further researches.

Conclusion

With this research we wanted to make the efficiency model of the performance of the volleyball phases expressed in percentages, with the structure of points achieved within a certain phase of game that a team should achieve in order to win a volleyball set.

According to the results, we concluded that the teams which had lost sets need to decrease the number of errors during the performance of all five phases which have been the object of the research.

Under that we consider only the unforced errors, for example spike in the out, net touch, spike in the net, wrong rotation position, service error, making exceptions to referee, etc. Teams which had lost set in the observed games need to serve more aggressively in order to increase the serve in which they make points and to increase the serve where they are still in advantage after serving, what should result in a more successful performance of the block.

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MODEL OF FOOTBALL MATCH PERFORMANCE EVALUATION OVER THE PREPARATION PERIOD

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Abstract

This paper presents an evaluation model for the match performance of players and preparatory effects. Examinees were 4 promising midfield players of the football team NK Dinamo's B team, all 18±1 years of age. Parameters of match performance have been described as quantities of run distances (low, moderate and high speed, and overall) and as time spent in each of the 4 energy zones measured by heart rate monitors. The examinees were observed during two football matches, in the preparatory and competitive part of the season. The analysis data have pointed to higher differences in run distances (19,6 - 56,4%) than differences in durations of energy zones (8,2% - 47,3%). We assume this points to an improvement of the player's competitive fitness. The model proved to be simple and efficient for evaluating match performance and as such is used in the football practice.

Key words: *football, match analysis, match fitness, preparatory effects*

Introduction

The demands that a football match makes on the players are a combination of energy and information component, i.e. they are mostly physiological and psychological in nature. (Bompa, 2000). The energy component is predominantly a part of all technical and tactic elements of the game (e.g. running at different speeds, contact play, jumps, groundings and liftings etc.). A good competitive effect is often the result of carefully planned and conducted trainings, especially in the preparatory part of the season. The aim of each preparation is to bring about adaptation processes, by which fitness reaches its peak in the competitive part of the season by supercompensation. (Bompa, 2000).

The primary goal of the research is to present the model as one of the possibilities of match performance evaluation, and the secondary goal is to give insight into the preparatory effects. The indicators of the states used in order to evaluate match performance are: distances run at different intensities and the strain that running represented to the players, presented as heart rates (Vučetić et al., 2002).

Methods

Examinee sample

Examinee samples are 4 promising players of the NK Dinamo's B team. Average age of the players was 18±1, average height 175,8 ± 8,8 cm, average weight 65,9 ± 6,1 kg and the percentage of the body fat 8,2 ± 3,2 % measured by the method of bioelectric impendency (Omron BF302). The players have played in the 4:4:2 system, on the positions of midfield players, which were mostly under greatest energy strain, in the sense of sprinting during a match (Bangsbo, 1994).

Variables sample

Indicators of the match performance are shown as parameters of quantity of running at different intensities i.e. different speeds:

$L_{1,2}$ = running at low speeds (m)

$S_{1,2}$ = running at moderate speeds (m)

$B_{1,2}$ = fast and maximally fast running (m)

$UK_{1,2}$ = overall quantity of running (m)

Parameters of physiological strain, distances run during a match, have been estimated by heart rates. Based on obtained data, durations of each energy zone have been calculated, and the result in variables has been expressed as percentage of time spent in each energy zone in comparison to the overall time. The zones described by heart rates have been determined by a spiroergometric testing in the Sports diagnostic centre within the Faculty of Kinesiology, University of Zagreb.

$Z1_{1,2}$ = aerobe regeneration zone (%)

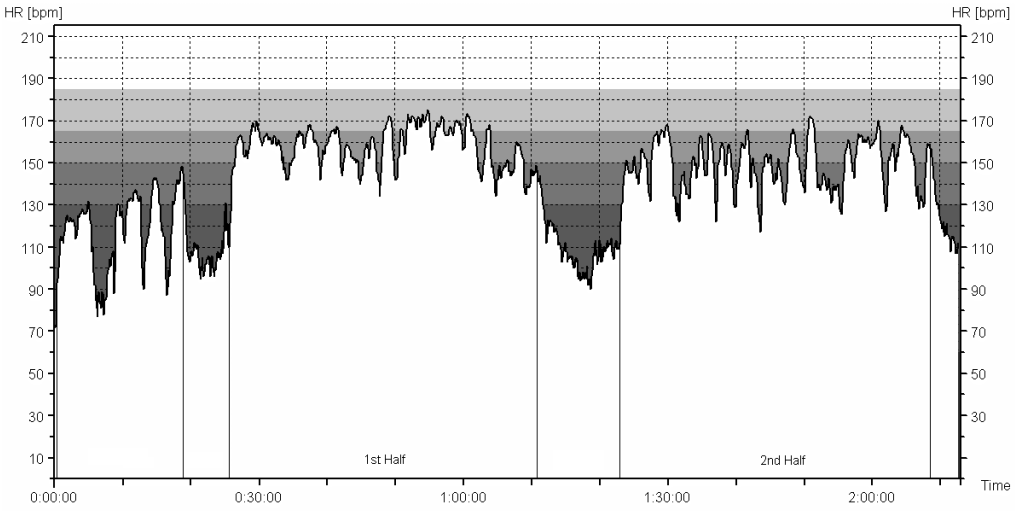
$Z2_{1,2}$ = aerobe extensive zone (%)

$Z3_{1,2}$ = aerobe intensive zone (%)

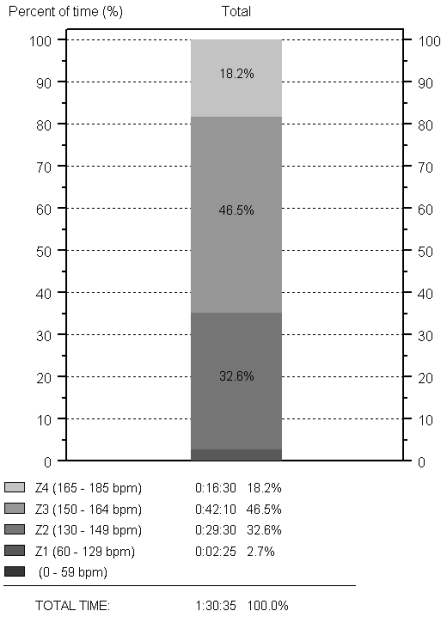
$Z4_{1,2}$ = anaerobe zone – maximal oxygen intake zone (%)

Experimental approach to problem

The same players were monitored and their performance measured during two matches. The first match was played at the beginning of the preparation period of the autumn season 2003/2004, and the other at the beginning of the competitive period of the season, i.e. after 2 months.



Graph 1. Graphic representation of the heart frequency movement of one player during the match



Legend in the text

Graph 2. Graphic representation of the heart frequency distribution according to zones of one of the examinees

Heart frequencies of the football players during the match were monitored by Polar Team System heart rate monitors (Graph 1.) and analyzed by the programme Polar PPP 4.0 (Graph 2.). The data on distances run by players were obtained through observations done by the students of the Faculty of Kinesiology, specially trained for this purpose. Each student monitored 1 player and entered the estimated length of section and the running speed into the list. After that, the values were added up for each of the three intensities and overall.

Methods of data analysis

Based on the obtained data, basic descriptive parameters (mean and standard deviation; SD) have been calculated, and the differences between the first and the second match in the monitored variables has been done by percentage. The data have been processed by the programme package Statistics for Windows 5.0 at the Faculty of Kinesiology of the University in Zagreb.

Results

The parameters used to evaluate match performance (quantity of running) have yielded differences (Table 3.) between the first and the second match.

Generally, the differences in indicators of strain (percentage of time spent in the zones) are smaller than changes in ran distances. The players on average ran more during the second than the first match, in all three intensities (L, S, B) and overall (UK). The greatest differences have been noted in the quantities of running at moderate intensity (56,4 %), fast (40,5 %) and overall (31,5 %). The players have, on average, spent more time in the maximal oxygen intake zone (Z4) during the second game (27,8 %). Correspondingly, they spent on average a smaller percentage of time in the zones Z3, Z2 and Z1 (Table 3.).

Table 3. Results of t-test analysis for dependant samples based on variables from two matches (index 1 and 2)

N=4	Mean	Std. Dv.	Dif.
L_1	2065	73	
L_2	2469	277	19,6
S_1	835	55	
S_2	1306	218	56,4
B_1	435	79	
B_2	611	156	40,5
UK_1	3335	121	
UK_2	4386	513	31,5
Z1_1	1,9	2,3	
Z1_2	1,0	1,6	-47,3
Z2_1	16,9	9,8	
Z2_2	12,1	7,3	-28,4
Z3_1	47,7	25,1	
Z3_2	43,8	23,6	-8,2
Z4_1	33,8	36,0	
Z4_2	43,2	30,8	27,8

Mean, Standard Deviation (SD), Difference xpressed by percentage (Diff.)

Discussion

Four midfield players of the young NK Dinamo team ran, on average, more at the three intensities (L, S and B) and overall (UK) during the second match in the autumn part of the season 2003/2004. Larger amount of running requires higher energy consumption, and therefore the data that the players have spent more time in the maximal oxygen intake zone (Z4), and less in the zones Z3, Z2 and Z1, is not surprising. As the differences in zone times are smaller than differences in ran distances, we can assume that the young players of the NK Dinamo team played more effectively in the second match in the autumn part of the season 2003/2004. In other words, the players ran considerably more during the second match (during the competitive part of the season) with not much higher energy consumption than in the first match (during preparatory part of the season). The conclusion points to an improvement of competitive fitness, which confirms that the aim of condition part of preparations has been achieved.

This model of evaluation of energy effects and demands during a match has proven to be very useful and relatively simple for practical use. By testing particular functional abilities of the players it is also possible to evaluate the effects of trainings conducted during preparatory part of the season. However, the presented model includes an integration of the ultimate energy and technical-tactical aim, with the prerequisite that they offer a bigger possibility of success during a football match. We believe that this or similar approach to monitoring player's match performance can considerably contribute to the raising of the football quality.

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THE ANALYSIS OF TWO GROUPS OF BASKETBALL TEAMS BASED ON THE SITUATIONAL PARAMETERS OF THE GAME

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Abstract

The research was conducted to establish the differences between first 4 and the rest teams on the basketball championship of Republic Croatia in 13 standard indicators of the situational efficiency in the game. The reason for this division was founded by authors in the fact that by the rules of the competition during the regular part of the season, only the 4 leading teams continue "the fight" for medals (play – off), while the rest of the teams compete for the order from 5-12 places.

By discriminatory analysis statistically important differences between two analyzed groups were established. Success in the game posted in work as binar criterional variable has "fixed" important statistic differences in case of five predectorial variables; REBOUND IN DEFENCE, THROWING THE BALL IN THE BASKET FOR THREE POINTS-SUCCESSFULY, WON BALLS, ASSISTANCE, REBOUND IN ATTACK.

Those variables were grouped on the positive pole which means that their better realization in the basketball game contributes more to victory while variable THROWING THE BALL IN THE BASKET FOR TWO POINTS-UNSUCCESSFULY and the variable PERSONAL FOULS are placed on the negative outcome of the game.

Key words: *Basketball, discriminatory analysis, situational parameters.*

Introduction

The activity in the basketball game today becomes measurable through the situational success by standard and unstandard indicators of the efficiency in the game. The question which tasks in the game influence and how much they contribute to the final result of the game is asked.

FIBA has standardized 13 indicators of situational efficiency which are officially followed on each basketball game of the championships in Croatia, which will be used by author in this research.

The goal of the research is to established whether there are statistically significant differences between two groups of basketball teams in the premier league on the base of 13 pedictorial and criterional variables.

The research should provide the insight in the possibilities of prediction of success in basketball game.

Methods and material

The sample of entity

The research was conducted on the sample of 120 basketball players in the Croatian premier league. The samples of entity represented 130 games of the basketball championships in Croatia during the season 1998/99. The competition was consisted of 22 rounds followed by the play-off. The following 12 basketball teams participated in championships: ZADAR, KVARNER-CROATIA LINE, CIBONA, ZAGREB, SPLIT, VAJDA, ŠIBENIK, SVJETLOST BROD, ZRINJEVAC, OSIJEK, BENSTON, and TELECOMP.

The sample of variables

The sample of predictorial variables is made by 13 standardly registrated indicators: FIELD GOALS MADE, FIELD GOALS ATTEMPED, THREE POINTS SHOTS MADE , THREE POINTS SHOTS ATTEMPTED, FREE THROWS MADE, FREE THROWS ATTEMPTED, REBOUNDS IN THE DEFENSE, REBOUNDS IN ATTACK, ASSIST, PERSONAL FOULS, LOST BALLS, WON BALLS, BLOCKED SHOTS.

The sample of criterional variable

The criterional variable is represented by the binary variable FIRST 4 team – REST 8 team.

Method of data processing

Basic statistic parameters of each of predictorial variables were estimated. The differences between two groups in the space of 13 standard indicators of efficiency in the basketball game are analyzed by canonical discriminatory analysis. Since it is the discrimination of two groups, this method is identical to Fisher's linear discriminatory function.

All analysis were done through the statistic programme STATISTICA FOR WINDOWS 5.0, on Faculty of Kinesiology, University of Zagreb.

Results and discussion

The gathered data represent official statistic of basketball championships of Croatia. Processing of gathered data through the descriptive statistics is shown in tabulated items 1, 2 and 3. From the 1 and 2 is prominent that FIRST 4 teams were more successful and that they had on an average 37.12 shots for two points (field goals)/ 22.06 successful (59%), and 15.06 unsuccessful (41%), while the REST 8 teams had on an average total of 39.54 field goals/ 22.06 successful (59%), and 15.06 unsuccessful 41%. The winning teams had on an average two attempts for two points less.

Table 1. Descriptiv statistics of first 4 teams

VARIABLES	AS	SD	Min.	Max.	Variance	%
FREE THROWS MADE	16.75	6.26	7	40	39.24	27
FREE THROWS ATTEMPTED	6.17	2.63	1	13	6.94	73
FIELD GOALS MADE	22.06	6.68	10	42	44.72	59
FIELD GOALS ATTEMPTED	15.06	5.27	5	33	27.85	41
THREE POINT SHOTS MADE	5.97	2.63	0	13	6.96	37
THREE POINT SHOTS ATTEMPTED	10.24	4.33	2	21	18.79	63
REBOUND IN ATTACK	7.90	3.79	1	18	14.43	
REBOUND IN DEFENCE	19.79	5.42	8	31	29.39	
ASSIST	9.38	4.23	2	21	17.90	
WON BALL	10.60	4.39	2	24	19.32	
LOST BALL	11.31	3.71	3	21	13.81	
BLOCK SHOT	1.66	1.63	0	7	2.67	
PERSONAL FAUL	20.05	3.45	9	28	11.96	

Table 2. Descriptive statistics of the rest 8 teams

VARIABLES	AS	SD	Min.	Max.	Variance	%
FREE THROWS MADE	15.57	6.06	2	35	36.80	72
FREE THROWS ATTEMPTED	6.02	3.39	0	16	11.50	28
FIELD GOALS MADE	21.55	5.30	8	38	28.15	55
FIELD GOALS ATTEMPTED	17.99	5.74	6	35	32.95	45
THREE POINT SHOTS MADE	5.08	2.39	0	12	5.73	35
THREE POINT SHOTS ATTEMPTED	9.48	3.83	1	22	14.68	65
REBOUNDS IN ATTACK	7.08	3.48	1	20	12.13	
REBOUNDS IN DEFENCE	15.19	5.01	3	28	25.16	
ASSIST	8.16	4.21	0	27	17.77	
WON BALL	8.10	3.93	0	22	15.46	
LOST BALL	10.47	3.54	2	21	12.58	
BLOCKED SHOTS	1.62	1.59	0	11	2.54	
PERSONAL FAUL	21.21	4.19	4	31	17.62	

By three points shots FIRST 4 teams had 37% throw-ins, and the REST 8 teams had 34.90 %. Both groups had approximately similar percentage of realization (FIRST 4 73%, the REST 8 72%), but still, FIRST 4 teams deducted larger number of free throws by game. We can conclude that FIRST 4 teams had on an average less shootings "from the game" (53.3%) than the REST 8 (54.1%), but the FIRST 4 (52.56%) were more effective than the REST 8 (49.22%).

The group of FIRST 4 teams had on an average larger number of rebounds in defense (19.79) then the group of the REST 8 teams (15.19) which is understandable concerning the larger number of unsuccessful throwings of the balls in the basket by the REST 8 teams and the bigger rebounding efficiency of the FIRST 4 teams.

There is no statistically important difference between two groups of teams of FIRST 4 and the group of the REST 8 teams in rebound in attack. FIRST 4 teams have on an average larger number of assistance (9.38) then the REST 8 teams (8.16). From the total number of balls thrown in the basket from the game, the FIRST 4 teams have achieved 33.46%, and the REST 8 achieved 30.64 % points by so called assist game, which means that they are better in ASSISTS.

Larger number of personal fouls on an average has been done by the REST 8 teams 21.21, then by the FIRST 4 teams 20.05. FIRST 4 teams have won on an average 10.60 balls, and the REST 8 have won 8.10 balls.

Differences between two groups of entity based on the index of situational efficiency in the basketball game

The results of the multivariant analysis of the variation in the proposed group of variables indicates that there is a statistically important difference between FIRST 4 teams which have secured a good position in the Croatian championship finals and the REST 8 teams ($p<0.00$).

The results of the series of univariant F- tests (tabulated items 3.) show that there is a statistic important difference in the next five variables: FIELD GOALS ATTEMPED (SHOT 2 UNS), REBOUND IN ATTACK (REB ATT), REBOUND IN DEFENCE (REB DEF), WON BALLS (WB), PERSONAL FOULS (PF). FIELD GOALS ATTEMPED (S. 2 UNS) implies that FIRST 4 teams were better prepared for shots, that they had individual players of the higher quality. FIRST 4 teams also had higher quality defense level (variables REBOUND IN DEFENCE AND WON BALLS). REBOUND IN ATTACK represents caught, rebounded balls from the ring or the penal in stage of transitive or set attack. It could be said that the FIRST 4 teams were more aggressive in rebound in attack, and that they were better tactically prepared for the rebound in attack and that they possessed individual players with higher level of quality of the rebound.

PERSONAL FOULS represent the number of player's mistakes. It is assumed that the better te-ta readiness of the FIRST 4 teams conditioned the larger number of personal fouls of the REST 8 teams.

REBOUND IN DEFENSE represents the number of caught balls and the balls rebounded from the ring or the panel in stage of transitive or set defense by obstructing the attack in order to achieve more than one shot during one attack.

Table 3. Multivariant f-test and series of univariant tests between first 4 and the rest 8 teams

VARIABLE	F	P - significant
FREE THROWS MADE	2,51	0,11
FREE THROWS ATTEMPTED	0,11	0,73
FIELD GOALS MADE	1,26	0,26
FIELD GOALS ATTEMPTED	20,10	0,00
THREE POINT SHOTS MADE	1,28	0,25
THREE POINT SHOTS ATTEMPTED	0,12	0,72
REBOUND IN ATTACK	5,46	0,02
REBOUND IN DEFENCE	46,92	0,00
ASSIST	0,73	0,39
WON BALL	29,51	0,00
LOST BALL	0,00	0,92
BLOCKED SHOTS	0,93	0,33
PERSONAL FOULS	8,83	0,00
Wilks' Lambda = 0,64; p< 0,00		

In the table 4. are described the results of peculiar value of canonical discriminatory function (λ), canonical correlation (Rcl) and x^2 – test of significance (x^2, df, p). It is visible that the obtained discriminatory function significantly distinguishes the group of the FIRST 4 teams from the group of the REST 8 teams on the level of significance 0.01 ($p<0.00$), with relatively high canonical correlation (0.59). It is possible to conclude that 13 standard indicators of situational efficiency properly distinguishes FIRST 4 from the REST 8 teams (namely to groups of basketball teams).

Table 4. Characteristic value (λ), canonic corelation (rc1), χ^2 - test, number of degrees of indepence (df) and the level of significance (p) discriminatory function

	λ	Rc1	χ^2	df	p
0	**0.54**	**0.59**	**109.88**	**13.00**	**0,00**

Tabulated list number 5. Describes the structure of discriminatory function and the results of center players at FIRST 4 and the REST 8 teams on the discriminatory function.

On the negative pole of discriminatory function are placed the REST 8 teams, and on the positive pole are FIRST 4 teams. The structure of discriminatory function is also bipolar.

Positive pole is best defined by variables REBOUND IN DEFENSE, WON BALLS, THREE POINTS SHOTS MADE, ASSISTS, REBOUND IN ATTACK, by small projections of variable FREE THROWS MADE, THREE POINTS SHOTS ATTEMPTED, and by insignificantly FREE THROWS ATTEMPTED, BLOCADES, FIELD GOALS MADE.

On the negative pole are placed variables FIELD GOALS ATTEMPTED and variable PERSONAL FOULS.

Largest positive contribution to efficiency (distinguishing FIRST 4 from the REST 8 teams) in basketball game has the variable REBOUND IN DEFENCE (0.56) considering that the rebound in defense is indicator of defense efficiency of the team. Because of that rebound in defense is the indicator of the entire defense and rebounding efficiency. FIRST 4 teams forced the REST 8 teams into the larger number of unsuccessful shots from the game (field goals made) and thereby, they created the supposition for larger number of rebounds in defense. Defense superiority of the FIRST 4 teams is also shown in correlation of variable WON BALL (0.39). Group of the FIRST 4 have had on an average 2.5 won balls more than the REST 8, and slightly better blockades of the shots.

Variable REBOUND IN ATTACK has statistically significantly positive correlation with discriminatory function (0.14). Rebound in attack from the functional aspect of the basketball game is interpreted as an extension of aggressiveness

Table 5. Correlation of variables with discriminatory function and the position of the central players groups on discriminatori function

Variables	R
FREE THROWS MADE	.12
FREE THROWS ATTEMPTED	.03
FIELD GOALS MADE	.05
FIELD GOALS ATTEMPTED	-.33
THREE POINT SHOTS MADE	.22
THREE POINT SHOTS ATTEMPTED	.11
REBOUND IN ATTACK	.14
REBOUND IN DEFENCE	.56
ASSIST	.18
WON BALL	.39
LOST BALL	.14
BLOCKED SHOTS	.01
PERSONAL FOULS	-.18
Group	DF 1
G_1:0 rest 8 teams	- 0.51
G_2:1 first 4 teams	+1.04

of the attack. Significant contribution to the determination of this discrimination function has the variable TWO POINTS SHOTS UNSUCCESSFUL (-0.33). Shot for two points represents the largest number of the attempts of one team for "scoring points", therefore, it is understandable that unsuccessful realization for two points from the game significantly negatively (even more than variable FIELD GOALS MADE) influence on the victory.

FIRST 4 teams had more attempts of three point's shots, that they were more efficient in execution, while it is presumed that the REST 8 teams had larger number insufficiently worked out actions and positions from the space for three points shots.

Significant correlation with discriminatory function has variable assists (0.18). Successful throwing stipulates high situational efficiency. FIRST 4 teams had on an average larger number of ASSISTS (9.38) than the REST 8 teams (8.16).

Conclusion

The idea of this work was to establish whether the 13 standard indicators of situational efficiency in the basketball game distinguish more successful four teams from less successful eight teams, and to establish their importance for the estimate of the outcome (victory – defeat) in basketball game.

Obtained canonical discriminatory function significantly distinguishes FIRST 4 from the REST 8 teams on the level of significance 0.01 ($p<0.00$) with relatively high canonical correlation (0.59), therefore it is possible to conclude that 13 standard indicators of situational efficiency statistically significantly distinguish group of the FIRST 4 from the REST 8 teams, and that it confirm high predictor value of 13 standard indicators of situational efficiency in the basketball game, on the final result of the game defined as victory – defeat.

On the negative pole, there is a group of the REST 8 teams, and on the positive pole, the group of the FIRST 4 teams. The structure of discriminatory function is bipolar. The positive pole is the best defined by variables REBOUND IN DEFENCE, WON BALLS, THREE POINTS SHOTS MADE, ASSIST, REBOUND IN ATTACK. On the negative pole, there are variables FIELD GOALS ATTEMPTED, and the variable PERSONAL FOULS, that is, variables which statistically significantly influence on the defeat in the game.

It could be concluded that the obtained results display the unevenness of Croatian basketball league. The difference in the quality was confirmed by almost all observed situational parameters.

It would be interesting to repeat such research on the representative level there were the teams are considerably more equalized, and it could be assumed that the lesser number of predictor variables would distinguish two groups of teams, which would suggest larger importance of particular situational parameters on the final outcome of the game.

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INFLUENCE OF THE GOALS SCORED ON FINAL OUTCOMES OF MATCHES OF THE 2003 WORLD HANDBALL CHAMPIONSHIPS FOR MEN IN PORTUGAL

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Abstract

The objective of the research was to define influence of the score progress across four quarters of a match on the final outcome expressed as the goal-difference. On the sample of 60 matches, played in the preliminary round of the 2003 World Championships, it was obtained that the goals scored in the second, BETA= -.62, and in the first quarter, BETA= .36, of a match have the greatest impact on the final match score or goal-difference. Nevertheless, the final match outcome is being built throughout a game by the scored goals. Higher-quality teams realized their previously defined tactical concepts, preconditioned by the characteristics of the opponents, in the first period of a match so they were able not to pursue the higher goal-difference in the second halftime, but to preserve functional integrity of a team. This phenomenon was enabled by the pre-arranged draw.

Key words: *scoring efficiency, round-robin system, preliminary group competition*

Introduction

The essence of handball game, that is efficiency of handball players in all phases of the game cannot be revealed without research studies aimed at determining relations between standard performance parameters and variously defined criteria of successfulness in a match (Vuleta et al., 2004). Successfulness of a particular team may be defined by standings, final outcomes of matches, goal-differences at the end of matches, the qualification to the higher competition stage (level) etc. Handball appertains to the group of very complex sport activities. A match is an event in which two opponent teams are contesting for victory, manifesting their states of preparedness, and where main measure of the outcome (success) is a number and ratio of the goals scored. Performance parameters vary across different time periods of a handball match which is officially divided into two 30-minute halves, but for the needs of the present research, the total 60-minute time was divided into quarters 15 minutes long.

Situation-related efficiency or partial performance of handball player is a part of total successfulness in the game that is objectively measurable with "statistical" observation of events in a match (Dežman et al., 2001). Parameters of performance may be collected *in situ* during a match (competition), or afterwards, from recordings. Each match is a specific manifestation of large number of abilities, attributes and the net of technical-tactical knowledge of players, but of coaches and of the entire logistic team as well. So, matching of two opponents produce similar, but never identical match courses or result progress.

The general linear model is, for its simplicity, most usually used in analyses of relations between variously structured predictor variables, among which the special position is given to partial performance parameters, and success in the analyzed sport (Dizdar et al., 1995). In the analysis of the goals scored in certain time periods of a match, special attention should be directed to the definition of critical spots of match progress (Rogulj, 2004). Previous research have demonstrated it is feasible to predict the final outcome of a match on the basis of standard parameters of performance in a game.

The objective of the research is to define influence of efficiency of shooting at the goal, that is, the goals scored in different time periods of a handball match on the final outcome, that is successfulness of teams defined as the final goal-difference. The analyses include only the performance parameters collected from the matches played in the round-robin system of the preliminary (group) round of the 2003 World Handball Championships for Men in Portugal.

Materials and methods

Sample of entities is comprised of 60 matches played by 24 national teams (120 opponents) of the 2003 World Handball Championships for Men in Portugal. The number of matches – 60, and the number of opponents – 120, observed ensure satisfactory statistical significance level for generalization of the obtained results.

Sample of variables. The sample of predictor variables (4) is represented by the number of scored goals in four time periods, that is, in four 15-minute long intervals of handball matches. The criterion variable is defined as the goal-difference at the end of the match, representing successfulness of a certain team in the observed match.

Data processing methods. The raw data were first processed by the elementary statistic procedures for determination of central and disperse parameters of the variables, and then by the regression analysis for computing the influence of four predictor variables on the final outcome of handball match expressed as the goal-difference.

Results and discussion

The central and disperse parameters of the predictor variables suggest that the number of scored goals in each of four 15-minute quarters of match is consistent and stabile (6-7 goals). Handball teams scored most of their goals in the second part of the first halftime (7.01) and the second part of the second halftime (7.0), that is, in the 2nd and 4th quarter of a match. The least goals were scored on average in the first quarter (6.36). It must be mentioned here that the highest value of standard deviation was obtained for the goals scored in the 2nd quarter (2.72). This suggests that the goals scored in the 2nd quarter could be an important regulator of the final outcome of a match, which is in concordance with the results obtained by Rogulj (2004).

Table 1. Central and disperse parameters of the predictor variables

	N	AS	Suma	Minimum	Maximum	Std.Dev.	Skewness	Kurtosis
VAR1	120	6.36	763	1	12	2.32	0.29	-0.22
VAR2	120	7.01	841	2	14	2.72	0.43	-0.19
VAR3	120	6.74	809	1	16	2.35	0.40	1.13
VAR4	120	7	840	2	16	2.31	0.54	1.03

However, observation of differences in the goals scored in particular periods of a handball match becomes sensible only in the context of successfulness of certain teams at a particular competition.

Table 2. Central and disperse parameters of the variables of the winners

	N	AS	Minimum	Maximum	Std.Dev.	Skewness	Kurtosis
VAR1	57	7.65	3	12	2.15	0.07	-0.51
VAR2	57	8.40	3	14	2.70	0.12	-0.42
VAR3	57	7.93	3	16	2.30	0.39	1.84
VAR4	57	7.82	4	16	2.40	0.67	1.26
GOALDIFF	57	9.09	1	40	2.15	0.07	-0.51

Table 3. Central and disperse parameters of the variables of the defeated teams

	N	AS	Minimum	Maximum	Std.Dev.	Skewness	Kurtosis
VAR1	57	5.16	1	10	1.87	0.20	0.12
VAR2	57	5.65	2	11	2.06	0.33	-0.02
VAR3	57	5.65	1	9	1.82	-0.05	-0.26
VAR4	57	6.25	2	10	2.00	-0.03	-0.88
GOALDIFF	57	-9.09	-40	-1	1.87	0.20	0.12

The victorious teams have higher average value of the goals scored in all quarters of the observed matches. The detected average partial progression of the goal-difference (2.49, 2.75, 2.28, and 1.57 goals) is a factor of the final successfulness (victory).

The winners scored most goals in the second period (8.40), whereas the defeated teams were most efficient in the fourth period (6.25), when the impact on the final outcome is not significant any more due to the already achieved higher goal-difference. The highest deviation of the average goal-difference obtained in the second period suggests the high importance of the result dynamism in the observed period.

All the correlation coefficients between the predictor variables and the criterion variable (Table 4) are statistically significant at the error level of 0.05, or they have significance of 95%.

The highest correlation values (-.92 i .85) were obtained between the variables *goals scored in the2nd (VAR2)* and *goals scored in the 1st (VAR1) time period* and the criterion variable *final goal-difference of a match*. Therefore, it could be stated with high certainty that there is an interdependence of result fluctuation in the first halftime, expressed as a number of scored goals, and the difference of the goals scored and received at the end of a match.

Table 4. Correlations between the predictor variables and the criterion variable

	VAR1	VAR2	VAR3	VAR4	GOLRAZ
VAR1	1	-.74	.59	-.76	.85
VAR2		1	-.53	.73	-.92
VAR3			1	-.43	.60
VAR4				1	-.75
GOALDIFF					1

Classic regression analysis was conducted in order to relate the observed predictor variables with final successfulness of particular teams.

Table 5. Multiple regression coefficients of relations between the predictor variables and the criterion variable

STATISTIC	VALUE
MULTIPLE R	0.95
MULTIPLE R^2	0.91
F (4,19)	48.43
p	0.00
STD. ERR. OF ESTIMATE	0.33

Table 5 contains multiple regression coefficients that suggest relations between the set of predictor variables and the criterion. Multiple correlation (0.95) and coefficient of determination (0.91) suggest significant quantity of common variance, respectively high power of prediction: F (4,19) = 48,43, p = 0,00 of the goals scored in particular quarters of a match on the final success of a team.

Table 6. Partial regression coefficients of the predictor variables

	BETA	St. Err. of BETA	B	St. Err. of B	t(19)	p-level
Intercpt			0.00	0.07	0.00	1.00
VAR1	0.36	0.12	0.36	0.12	2.93	0.01
VAR2	-0.62	0.11	-0.62	0.11	-5.52	0.00
VAR3	0.07	0.09	0.07	0.09	0.78	0.44
VAR4	0.00	0.11	0.00	0.11	0.04	0.97

It can be concluded from the results presented in Table 6 that the goals scored in the second (from the 16th minute till the end of the first halftime), BETA= -.62, and in the first quarter (from the 1st till the 15th minute of the first halftime), BETA= .36, have the greatest impact on the final score or goal-difference, that is, the final outcome of a match.

The question arises: What is the reason for such great predictability of the final outcome of a handball match on the basis of the dynamism of score in the first and, particularly, in the second quarter? The fact is that most handball trainers open matches with their best alignment, so it is very often that higher-quality teams differ considerably from the opposing lower-quality ones already after the first halftime. Quality tactical solutions in offence and defense as quality reactions of trainers of higher-quality teams to the positional play of their opponents are specially expressed in the 2nd quarter. Initial superiority of higher-quality teams is emphasized in the 2nd quarter and it produces the difference difficult to overtake afterwards in a match progress. This can be corroborated by the information that out of the total of 54 matches in which the teams scored more than 6 goals in the 2nd quarter of a match, in 41 matches it concerns the winners, and only in 13 the defeated teams. The defeated teams scored 6 or less goals in 44 out of 57 matches, whereas the winners only in 16.

The segment of physical fitness (preparedness) of national teams at great tournaments is also responsible for manifestation of the described parameters, especially due to greater density of competition calendar of powerful national leagues that most top-level players are playing in.

Variability of results of the predictor variables *goals scored* in the 3rd and 4th period of a match has no statistically significant impact on the criterion *total goal-difference in a match*.

The slowdown of the result progression of the winning teams in the second halftime is caused by the fact that matches in the preliminary round of the world championships generally have lower intensity due to quality discrepancy of teams caused mostly by the pre-arranged draw. Thus, these competition conditions made it possible for the nominated group carriers, i.e. higher-quality teams to profit from their advantage over their group opponents made in the first halftime in a way to spare their best players for further competition and to give opportunity to younger, less experienced members of teams to play as well.

Conclusions

The general conclusion, based on the conducted analyses, is that the final match outcome is being built throughout a game by the scored goals. A big range of goals scored in each quarter confirms the claimed. The 2003 World Handball Championships for Men is no exception - successfulness of particular teams is absolutely determined by the goals scored throughout a match, i.e. in different periods. However, it is not only the context of consistent, stabile and continuous offensive actions we are talking about; the final outcome is formed by optimal defensive activity as well, especially in the second halftime of a match.

Higher-quality teams realized their previously defined tactical concepts, preconditioned by the characteristics of the opponents, in the first period of a match. Higher-quality trainers emphasized these quality difference by timely recognition of the opponents' playing concepts and adequate solutions choices. Due to high competition rhythm, the second half of a match was not primary aimed at increasing the goal difference, but at preserving the functional integrity of a team, that is those individuals that carry the quality of play.

This phenomenon was particularly expressive because of the high bipolarization of quality in the sample of the teams observed. The higher-quality handball selections, mostly carriers in their groups, defined preservation of high competitive efficiency for the finals of the tournament as the priority objective of the preliminary competition round.

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INFLUENCE OF PERFORMANCE PARAMETERS OF BACKCOURT ATTACKERS ON FINAL OUTCOMES OF MATCHES OF THE 2003 WORLD HANDBALL CHAMPIONSHIPS FOR WOMEN IN CROATIA

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Abstract

The objective of the research was to explore influence of performance parameters on the final outcomes of handball matches. Sample of entities was comprised of 34 female backcourt attackers from 15 matches played by 6 national teams in the preliminary round of the 2003 World Handball Championships for Women. Significant impact (significance of 95%) of the efficient line (BETA=0.43) and side (BETA=0.41) shots of the backcourt attackers on the final result successfulness, defined as the goal-difference at the end of the match, was obtained. Beside the basic assignments and concrete tasks, backcourt attackers must perfect various techniques of shooting and moving on the pivot and wing player positions as well, because players' versatility, manifested in different tactical solutions, is a prerequisite of successfulness in high-quality competitions.

Key words: *backcourt attacker, situation-related efficiency, shooting efficiency, assists, shooting techniques, wings, pivot, line positions*

Introduction

Particular basic and specific anthropological characteristics and specific abilities as well as knowledge of players are responsible for efficient performance of technical-tactical elements, that is, efficient accomplishments of certain jobs and tasks in a handball match (Vuleta et al., 2003).

Due to the procedures of supervision and control of player's efficiency, consisting of analyses of relevant technical-tactical indicators, immediate application of the obtained results in the training process is in the function of distribution of training contents and loads, which should guarantee high quality work and progression of playing efficiency in phases of attack and defense (Vuleta et al., 1997.).

System of criteria for assessment of actual quality of players must ensure assessment of performance or playing efficiency parameters of individual players relative to playing positions and game phases (Vuleta et al., 2004.)

World Championships and other major competitions national selections are usually competing in, are held close in time with a high competition rhythm, therefore, interpreted the results of analyses of performance parameters can be acceptable only in the context of the observed type of competition. Successfulness or effectiveness of female backcourt attackers differs due to quality of a particular team, so their situation-related efficiency produces different manifestations and influences on the final efficiency of their teams.

Previous research studies on the influence of performance parameters on the final outcomes of matches, relative to game phases and playing positions, were mostly empirical and descriptive.

The objective of the research is to explore influence of performance or situation-related efficiency parameters on the final outcomes of handball matches.

Research hypotheses are:

H_1 – The influence of variables of performance indicators on the final outcomes of handball matches varies

H_2 – The variables *goals scored from the backcourt positions* and *goals not scored from the backcourt positions* have statistically significant influence on the final outcomes of handball matches.

Methods

Sample of entities is comprised of 34 female backcourt attackers from 15 matches (30 opponents) played by 6 national teams (Hungary, Slovenia, Germany, Denmark, China, The Ivory Coast) in the preliminary round (group D) of the 2003 World Handball Championships for Women held in Croatia.

Sample of variables. The set of predictor variables, representing situation-related effectiveness of backcourt attackers and the criterion variable representing successfulness of a certain team in a particular match, expressed as the match goal-difference, are presented in Table 1.

Table 1. Sample of the predictor variables (1-9) and the criterion variable (10)

1.	ŠUT6US	Goals scored - pivot position
2.	ŠUT6NE	Goals not scored - pivot position
3.	KRUS	Goals scored - wing position
4.	KRNE	Goals not scored - wing position
5.	ŠUT9US	Goals scored - backcourt attackers' positions
6.	ŠUT9NE	Goals not scored - backcourt attackers' positions
7.	ASIST	Assists
8.	IZB7M	Extorted penalties
9.	TEHPOG	Technical errors in attack
10.	GOLRAZL	Final goal-difference

Data processing methods. Central and dispersion parameters of the indicators of performance of backcourt attackers were determined in the scope of descriptive statistic of the observed variables, and regression analysis was used for computing the influence of predictor variables set on the criterion variable.

Results And Discussion

Central parameters suggest that the distribution of the backcourt attackers' shots, directed from different playing positions, is in concordance with their playing position-related shot-average of 20 shots from backcourt positions, about 5,5 from wing positions and about 4 from the pivot position. Sums of parameters of the observed variables reveal low shooting efficiency rate from the line positions.

Average shooting efficiency was 66% (a total of 82 goals scored out of 122 attempts) of side shots, and 46% (a total of 74 goals scored out of 161 attempts) of line shots. Low field shot efficiency of the backcourt attackers was obtained (about 35%) as well, so the "general" criterion of field shot efficiency for backcourt attackers (about 50%) was not complied to.

Table 2. Central and dispersion parameters of the predictor variables

	Valid N	Mean	Sum	Minimum	Maximum	Std.Dev.	Skewness	Kurtosis
ŠUT6US	30	2.73	82	0	8	1.91	0.82	0.41
ŠUT6NE	30	1.33	40	0	4	1.15	0.44	-0.68
KRUS	30	2.47	74	0	7	1.87	0.34	-0.49
KRNE	30	2.90	87	0	8	2.16	0.80	-0.04
ŠUT9US	30	7.07	212	2	13	2.86	0.46	-0.52
ŠUT9NE	30	12.80	384	4	27	5.39	0.72	0.49
ASIST	30	15.67	470	7	26	5.18	0.38	-0.18
IZB7M	30	1.73	52	0	4	1.31	0.34	-0.86
TEHPOG	30	9.50	285	4	19	3.76	0.71	0.07
GOLRAZL	30	0.00	0	-19	19	8.23	0.00	0.15

Table 3 presents central and dispersion parameters of the variables of the victorious and defeated teams.

Table 3. Central and disperse parameters of the variables of the winners and the defeated teams

	WINNERS					DEFEATED TEAMS				
	Mean	Sum	Minimum	Maximum	Std.Dev.	Mean	Sum	Minimum	Maximum	Std.Dev.
ŠUT6US	3.36	47	0	5	5	2.21	31	0	8	8
ŠUT6NE	1.43	20	0	3	3	1.21	17	0	4	4
KRUS	3.14	44	0	7	7	1.79	25	0	4	4
KRNE	2.79	39	0	7	7	3.14	44	0	8	8
ŠUT9US	7.5	105	5	12	7	7.07	99	2	13	11
ŠUT9NE	9.71	136	4	16	12	15.29	214	8	27	19
ASIST	18.43	258	12	26	14	13.36	187	7	21	14
IZB7M	1.79	25	0	4	4	1.57	22	0	3	3
TEHPOG	8.43	118	5	16	11	10.71	150	4	19	15
GOLRAZL	6.93	97	1	19	18	-6.93	-97	-19	-1	18

After every side shot scored by the defeated teams, with 64.58% of realization, the winners scored two, with 78.33% of realization, and after every two line shots scored by the defeated teams, with 36.23% of realization, the winners scored three goals, with 53.01% of realization average. The victorious teams scored almost identical number of goals from backcourt playing positions (43.57%) from 5 attempts less than the defeated teams (31.63%). In addition to the previous observations, an average of 5 assists more and 2 technical errors less suggests noticeable differences in the observed performance parameters of the backcourt attackers of the teams competing in group D. All that determined successfulness of their teams in the preliminary competition round.

Correlation coefficients between the observed predictors and the criterion suggest relatively weak relations in terms of performance of the female backcourt attackers (Table 4).

Table 4. Correlations between the predictor variables and the criterion variable

	ŠUT6US	ŠUT6NE	KRUS	KRNE	ŠUT9US	ŠUT9NE	ASIST	IZB7M	TEHPOG	GOLRAZL
ŠUT6US	1	0.42	-0.16	0.03	0.11	-0.38	0.34	0.00	0.24	0.39
ŠUT6NE		1	0.04	-0.22	-0.21	-0.25	0.18	-0.10	0.33	0.09
KRUS			1	0.01	0.09	-0.41	0.55	0.08	-0.16	0.53
KRNE				1	0.03	0.39	0.06	0.33	-0.01	-0.05
ŠUT9US					1	0.03	0.24	-0.08	-0.12	0.19
ŠUT9NE						1	-0.43	0.21	0.12	-0.59
ASIST							1	0.41	-0.09	0.62
IZB7M								1	-0.19	0.17
TEHPOG									1	-0.31
GOLRAZL										1

The biggest correlation between the variable *assist* and the criterion (0.62) suggests that in the more successful teams cooperation exists not only on the backcourt attacker - pivot relation, but on the backcourt attacker - backcourt attacker (after the intrusion onto the position of the second pivot) relation as well. In deep and shallow defensive zone formations, frontal stepping-outs and other movements of defenders towards a player in possession of the ball are prerequisites for the previously described actions of attackers.

Total and partial influence of the observed variables on successfulness of particular teams were determined by regression analysis.

Table 5. Multiple regression coefficients of relations between the predictor variables and the criterion variable

STATISTIC	VALUE
MULTIPLE R	0.82
MULTIPLE R^2	0.67
ADJUSTED R^2	0.52
F (9,20)	4.50
p	0.01
STD. ERR. OF ESTIMATE	5.70

Relation of the predictor variables set and the criterion is described by multiple correlation coefficient (0.82), significant at p=0.01 level, F (9, 20) = 4,5. Common variability of the predictor system and the criterion is about 67% (multiple R^2=0,67), or about 52% (adjusted R^2=0,52). Result is very logical, because 48% of the unexplained variability of final outcomes of matches can be explained by the influence of pivot and wing players' performance, other peformance indicators with direct or indirect impact on observed research domain and other factors induced by performance of either own or opponent team.

Partial regression coefficients of the predictor variables reveal statistically significant impact (significance of 95%) of the efficient line and side shots of the backcourt attackers on the final result successfulness, defined as the goal-difference at the end of the match.

Table 6. Partial regression coefficients of the predictor variables

	BETA	St. Err. of BETA	B	St. Err. of B	t(20)	p-level
Intercpt			-2.95	6.66	-0.44	0.66
ŠUT6US	0.43	0.20	1.85	0.86	2.15	0.04
ŠUT6NE	-0.07	0.16	-0.52	1.15	-0.46	0.65
KRUS	0.41	0.20	1.81	0.87	2.08	0.05
KRNE	-0.04	0.16	-0.17	0.61	-0.28	0.78
ŠUT9US	0.05	0.15	0.15	0.44	0.35	0.73
ŠUT9NE	-0.22	0.22	-0.33	0.33	-1.02	0.32
ASIST	0.08	0.23	0.13	0.37	0.36	0.73
IZB7M	0.11	0.18	0.69	1.13	0.61	0.55
TEHPOG	-0.26	0.15	-0.57	0.33	-1.75	0.10

Based on the results obtained by regression analysis, hypothesis H_1 is accepted with a statement that different performance parameters differ in their influence on the final outcome of a match. Hypothesis H_2 is rejected despite the expected statistically significant impact of field shots variables on the criterion variable

Although performance of the backcourt players is primarily determined by field shot efficiency, assists and technical errors, exclusive specialization for the classic playing position of a backcourt attacker is not permissible because not possible, mostly due to the differences in general morphological and, especially, motor characteristics of male and female

handball players. Therefore influence of line shots (shooting from the line playing positions) on the criterion variable is logical, but very concrete as well.

Namely, backcourt attackers of more successful better-quality teams more often found themselves in a position to perform line or side shots. It especially refers to intrusion of backcourt players into pivot position as the second one on the line, whereas the difference of assists is important and in favour of winners as well. Other situations such as individual breakthroughs and group tactic solutions (crossings and waving with screens), enable backcourt attackers to shoot from their and the other playing positions. Backcourt attackers perform side shots mostly after the previous intrusion of a wing attacker into the pivot position as the second one on the line, and after spreading the attacking composition, or simply after crossing with a wing with a simple screen etc.

Conclusion

On the basis of frequencies of the observed variables describing backcourt female attackers' performance, the following could be concluded – basic assignments and concrete tasks consist of high-quality shooting performance from the backcourt attacking playing positions, good cooperation with a pivot and wing players as well as fast and controlled ball transmission.

However, according to the results of the research, backcourt attackers must perfect various techniques of shooting and moving on the pivot and wing player positions as well, because players' versatility, manifested in different tactical solutions, is a prerequisite of successfulness in high-quality competitions.

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INDICATOR'S DIFFERENCES IN THE SITUATION EFFICIENCY AMONG SENIOR MALE AND FEMALE AT THE JUDO BALKAN'S CHAMPIONSHIP 2001 – 2002

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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 and female, participants of the Balkan's Judo Championships, held in Sarajevo, 2001 & 2002 years. Analysis has been done based on video scripts of 123 fights for senior's male and video scripts of 91 fights for senior's female in all seven categories. Matches have been monitored with 16 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 implicate to the statistically important differences among seniors – male and female in analyzed indicators of the situation's efficiency.

Key words: *judo, situation's efficiency, the most successful throwing techniques, the most successful grappling techniques, points, punishments.*

Introduction

Nowadays judo is very dynamic and demanding martial art where the fight is developing into two main areas: standing combat and floor combat. First: both areas of fight request different approaches in the process of training fighters for the championships; and second: necessity for the analysis of the situation's efficiency monitoring in judo can give quality information about acting manner of the fighters and their efficiency during the matches. Researches of the capabilities, distinctions and knowledge of fighters that are directed into analysis of the indicators of the situation's efficiency, which competitors realize during the competitions (Milanović, 1999) represent good base for the applying researching results of situation's efficiency in judo. The manner of leading the fight in judo requests from fighters extraordinary application of technical elements of judo into the right and left side at standing position and floor; same as possibility of combining of those techniques. Valuing importance of technical parameters of situation's efficiency is that they are collected in the conditions of real fights of two fighters in the most important competitions. Same importance have proper choice of application of the techniques in the competition and optimal approach to the application of those techniques through exercises in the situation's conditions of judo fight and through proper technology of training. In that context it is important to distinguish some researches that treat aspects of situation's efficiency. Weers (1996) confirmed that top-level judo fighters have capabilities to apply six throwing techniques in the standing position and two grappling techniques on the floor. Research of the Sterkowicz & Kasek (1983) confirmed that efficiency of the holding techniques Osae Komi Waza by senior female is higher comparing with male, but they are less efficient with hand throwing techniques; and both groups of subjects have same typical efficiency of throwing Seoi Nage technique. Main goal of this research represents confirmation of indicator's differences of situation's efficiency for senior male and female from Balkan's championships in judo. It serves also for defining those factors that mostly contribute to the success of the results, on this level of competitions for these two groups of examined.

Methods

Sample of the examined. Specimen of the examined is defined as a total of (n = 123) male combats for all seven categories (60, 66, 73, 81, 90, -100 and +100) and total of (n = 91) female combats for all seven categories (48, 52, 57, 63, 70, -78 and +78) from Balkan's Judo Championship, held in Sarajevo 2001 & 2002 years. At the Balkan's Championships further national judo teams participated: Bosnia and Herzegovina, Bulgaria, Rumania, FRY Macedonia, Albania, Greece, Turkey and Serbia & Montenegro.

Sample of variables. Analysis of the parameters of situation's efficiency is based on official classification of judo techniques by 16 indicators of situation's efficiency (IJF – Waza list, 1999) as it follows: a) Groups of judo techniques: 1) Nage – Waza (Throwing techniques), 2) Katame – Waza (grappling techniques); b) Subgroups of judo techniques: 3) Te – Waza (Hand throwing techniques), 4) Koshi – Waza (Hip throwing techniques), 5) Ashi – Waza (Leg throwing techniques), 6) Sutemi – Waza (Body drop throwing techniques), 7) Osae – Komi – Waza (Holding techniques), 8) Shime – Waza (Strangle techniques), 9) Kansetsu – Waza (Armlock techniques); c) Quantitative indicators of judo fights: - Technical points - 10) Ippon (10pts), 11) Waza – ari (7pts), 12) Yuko (5pts), 13) Koka (3 pts) - Penalties – 14) Shido (-3pts), 15) Hansokumake (-10pts); d) 16) Situation's efficiency of the separate throwing judo techniques and grappling techniques.

Data processing methods

The frequencies and percentage values were counted for all the observing variables. For the confirmation of the differences between the frequencies it was used χ^2 test (Chi Square test) at the level of statistical importance 5% ($p< 0,05$) assisting with contingent tables (Petz, 1997). Testing importance of the correlation among monitored variables it was used coefficient of the contingency (C). For the measuring of the situation's efficiency of every particular judo techniques it was used formula (Sterkowicz & Maslej, 1999):

$\mathbf{I_{eff}}$ = Number of the official scores / Total number of the attacks x 100.

Results and discussion

Based on the analysis of video scripts of 123 fights of male seniors and 91 video scripts of female seniors, it was presented 304 technical actions among which both groups presented 82,6% from the group Nage Waza, while a small number of the technical actions were presented from the group Katame Waza 17,4% (Table 1). Male seniors dominates with throwing techniques 87,9%, comparing to the female seniors 74,6%, that have more efficiency in floor techniques 25,4%, comparing to the male seniors 12,1%. The results of the χ^2 tests appoint to the existence of the statistics differences among monitored frequency of the throwing techniques, comparing to the grappling techniques ($p<,0027$) with coefficient of the contingency (C=,17).

Table 1. Frequencies and percentage values of situation's efficiency of the groups of the judo techniques

	Nage – Waza		Katame - Waza		Total	
MALE	160	(87,9 %)	22	(12,1%)	182	(59,9%)
FEMALE	91	(74,6 %)	31	(25,4%)	122	(40,1%)
Total	251	(82,6 %)	53	(17,4 %)	304	(100%)
χ^2 = 9,01; df= 1; p< ,0027; C=,17						

Comparing the situation's efficiency of the applied judo subgroups techniques among female and mail seniors (Table 2) from 304 presented techniques, to the group of Te Waza (hands) belongs 32,2% and Ashi Waza (legs) techniques 30%. Osae Komi Waza (holdings) is presented by 12,8%, Sutemi Waza (sacreficing) is presented by 10,9%, while Koshi Waza (hip) was presented by 9,5%, Kansetsu (arm lock) by 3,3% and Shime (strangling) by 1,3% of the applying efficiency in combats. Monitoring the structure of the situation's efficiency male seniors showed that they dominates with hand techniques by 38,5%, comparing to the female seniors by 23%, hip by 10,4% comparing to the female seniors by 8,2%. Female seniors had higher frequency of the leg throwing techniques of 33,6% comparing to the males of 27,5%, in holding techniques they had 18,9% comparing to the males that had efficiency of 8,8%. Females also had higher efficiency in applying arm locks by 4,9% comparing to the males by 2,2%. Results of χ^2 tests appointed to the existence of the differences ($p<,0070$) in the frequency of the situation's efficiency for the applied subgroups of judo techniques between male and female seniors. Coefficient of contingency (C= ,21) doesn't show big differences among monitored variables.

Table 2. Frequencies and percentage values of situation's efficiency of the subgroups judo techniques

	MALE		FEMALE		Total	
Te – Waza	70	(38,5 %)	28	(23 %)	98	(32,2 %)
Koshi – Waza	19	(10,4 %)	10	(8,2 %)	29	(9,5 %)
Ashi – Waza	50	(27,5 %)	41	(33,6 %)	91	(30 %)
Sutemi - Waza	21	(11,5 %)	12	(9,8 %)	33	(10,9 %)
Osae – Komi - Waza	16	(8,8 %)	23	(18,9 %)	39	(12,8 %)
Kansetsu –Waza	4	(2,2 %)	6	(4,9 %)	10	(3,3 %)
Shime – Waza	2	(1,1 %)	2	(1,6 %)	4	(1,3 %)
Total	182	(59,9 %)	122	(40,1 %)	304	(100 %)
χ^2= 14,52; df= 6; p< ,0070; C= 0,21;						

Table 3. Judo combat quantitative parameters male and female

	MALE		FEMALE		Total	
Ippon	86	(31,9 %)	76	(47,5 %)	162	(37,8 %)
Waza – ari	25	(9,3 %)	17	(10,6 %)	42	(9,8 %)
Yuko	62	(23,0 %)	22	(13,7 %)	84	(19,6 %)
Koka	9	(3,4 %)	7	(4,4 %)	16	(3,7 %)
Shido	30	(11,2 %)	35	(21,9 %)	65	(15,2 %)
Hansokumake	57	(21,2 %)	3	(1,9 %)	60	(13,9 %)
Total	269	(62,7 %)	160	(37,3 %)	429	(100 %)
χ^2 = 45,67 df= 5 p< ,00000 C= ,31						

Analyzing 429 realized quantity parameters of Judo points and penalties (Table 3), 37,8% was realized by Ippon, 19,6% by Yuko, 15,2% with penalty Shido and 13,9% with Hansokumake. Female showed better efficiency with 47,5 Ippons comparing to the male with 31,9% Ippons, while male presented 23% and female 13,7% of Yuko. During the fights male received less Shido penalties 11,2% then female 21,9%, so as with strongest Hansokumake (disqualification) 21,2%, while female had 1,9%. Results of χ^2 tests show that there are statistically important differences ($p< ,00000$) in frequency of the realized quantity parameters between female and male judo seniors, and coefficient of the contingency (C = ,31) appoints that correlation among monitored variables exists.

Analyzing first fifteen the most efficient separate judo techniques (Table 4), which seniors presented are: Kata Guruma, Sukui Nage, Ippon Seoi Nage, Seoi Nage that represent hand (Te) techniques; Ushi Mata,

O Soto Gari, Sasae Tsuri Komi Ashi and O Uchi Gari as techniques from leg (Ashi) throwing group; Sode Tsuri Komi Goshi, Harai Goshi as hip (Koshi) throwing techniques; Tani Otoshi and Sumi Gaeshi as sacrificing (Sutemi) techniques; Kesa Gatame and Yoko Shiho Gatame holdings (Osae); and finally, Ude Hishigi Juji Gatame, that represents armlock techniques (Kansetsu). Female seniors most efficiently applied Uchi Mata, O Uchi Gari, O Soto Gari, Ko Uchi Gari as most effective represents of leg (Ashi) throwing techniques; Seoi Nage, Ippon Seoi Nage and Sukui Nage as hand (Te) throwing techniques; Kesa Gatame, Yoko Shiho Gatame, Tate Shiho Gatame, Kami Shiho Gatame as holding techniques (Osae); Tani Otoshi, Soto Maki Komi as sacrificing (Sutemi) throwing techniques and Ude Hishigi Jugi Gatame as most efficient representers of arm lock techniques (Kansetsu).

Table 4. The most efficient judo techniques used by male and female seniors

MALE			RANK	FEMALE		
%	Frequency	Judo Techniques		Judo Techniques	Frequency	%
13,7	25	Kata Guruma	1	Uchi Mata	16	13,1
9,3	17	Uchi Mata	2	Kesa Gatame	12	9,8
8,8	16	Sukui Nage	3	Seoi Nage	11	9
8,2	15	Ippon Seoi Nage	4	Harai Goshi	10	8,2
6,6	12	O Soto Gari	5	O Uchi Gari	9	7,4
6,0	11	Sode Tsuri Komi Goshi	6	Ippon Seoi Nage	8	6,6
4,9	9	Tani Otoshi	7	O Soto Gari	7	5,7
3,8	7	Harai Goshi	8	Sukui Nage	6	4,9
3,8	7	Sumi Gaeshi	9	Yoko Shiho Gatame	5	4,1
3,8	7	Kesa Gatame	10	Tani Otoshi	5	4,1
3,3	6	Seoi Nage	11	Ude Hishigi Juji Gatame	4	3,3
3,3	6	Sasae Tsuri Komi Ashi	12	Ko Uchi Gari	4	3,3
3,3	6	O Uchi Gari	13	Tate Shiho Gatame	3	2,5
2,7	5	Yoko Shiho Gatame	14	Kami Shiho Gatame	3	2,5
2,2	4	Ude Hishigi Juji Gatame	15	Soto Maki Komi	3	2,5

Conclusion

In terms of targeting confirmation differences of situation's efficiency indicators between male and female seniors from Balkan's Championships 2001 & 2002, video analysis of 123 fights of male and 91 fights of female has been done. Parameter's difference of situation's efficiency has been tested by Chi-Square test, and results appoint to the existence of important differences between male and female seniors in groups of techniques, subgroup techniques, efficiency of the separate judo techniques and realized quantitative indicators of judo combats.

Main difference between male and female seniors is in using of more grappling techniques for female, while male using more hand throwing techniques and male have more frequency of the penalties Hansoku Make. Explanation of difference existence between male and female seniors' situation's efficiency indicators is, as first, probably in the level of the morphology, conditional and mental preparation. Second reason for these indicator's differences is that national judo federations sent competitors with less level of international experience to this level of competition. Obtained results could contribute to the better understanding of the monitoring and analyzing of parameters of situation's efficiency in judo for seniors in all level of competition.

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THE PHYSICAL AND GAME-SKILLS PROFILE OF THE ELITE SOUTH AFRICAN SCHOOLBOY RUGBY PLAYER

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Abstract

Rugby union is a popular sport played in more than hundred countries worldwide. Rugby consists of various activities that require certain anthropometrical, physical, motor- and game-specific components. These components are specific to the positional requirements in rugby (Craven 1974, Noakes and Du Plessis, 1996.) The aim of this study was to compile a status profile of the under 18 elite rugby player in South Africa with reference to physical and game-specific skills. The research group consisted of the top 97 elite South Africa rugby players as identified by the South African Rugby Football Union during 2003. A number of seven physical and motor abilities, eight anthropometrical variables and six game-specific skills were tested. The group was tested in 2003 and 2004 and the data was analyzed according to descriptive statistics and practical significant differences (d-values). A physical and game-skills profile was compiled for each position that can be used by coaches as a norm to identify potential talented players.

Introduction

For the last ten years research was done to identify and develop talented youth rugby players (Spamer, 2000). The aim of this project is to look at scientific methods through which young potential rugby players can be identified and placed in a development programme so that this group can be the core for national team selection at later ages. Aspects that were already researched, are: compiling of battery of tests, compiling of prediction functions for different ages, longitudinal studies on different age groupers, comparing of elite rugby players according to anthropometrical, physical and motor and game-specific variables between England, New Zealand and South Africa, compiling of norm scales to evaluate potential players for a rugby team as a group as well as each position and also the injury epidemiology of elite players at school and club level. This study is a further sub-project and concentrates on the top elite under 18 rugby player in South Africa. This group will be monitored for the next six years to see how many were successful in representing their country.

Methods

A number of 97 top elite under 18 players were used in this study, representing all rugby provinces in South Africa. The test protocol as compiled by SARFU was used and this battery of tests was executed during July 2003 and May 2004. The battery of tests consists of seven physical and motor ability tests (speed over 10m and 40 m, agility Illinois, speed endurance, bench presses, pull ups and push ups), eight anthropometrical measurements (length, mass, skinfolds, % body fat, endo, meso- and ectomorphy) and six game-specific tests (catching ability, ground skills, passing for accuracy, passing for distance and kicking for distance) (De La Port, 2004). Descriptive statistics were used to analyze the data as well as practical significance (d-values) (Cohan, 1988).

Results and discussion

Due to the short time and limited space available the profile of only one forward and one backline position will be reported. The complete profile for all the different positions is available in De la Port (2004). The results of these two positions will also refer to the average scores obtained in this study as well as other literature. The two positions that will be discussed are front row props and scrumhalves.

Props

This position illustrates that it is the third tallest player position (181.2 cm), the heaviest body mass (103.2 kg) and highest body fat percentage (22.7). Compared to other available literature it seems that props in this study are shorter, lighter and carry less body fat than results found in other studies (Table 1).

Table 1: Physical and game-skills profile of elite under 18 prop rugby players

POSITIONS	ANTHROPOMETRIC MEASUREMENTS	PHYSICAL-AND MOTOR ABILITIES	GAME SPECIFIC SKILLS
Prop	* Endo-mesomorphic physique ($\bar{x}$ = 6.09/7.74/0.41) (1) * Third tallest player ($\bar{x}$ = 181.22 cm) (1) ($\bar{x}$ = 186.67 cm) (2) ($\bar{x}$ = 180.60 cm) (2) * Heaviest body mass ($\bar{x}$ = 103.20 kg) (1) ($\bar{x}$ = 105.33 kg) (2) * Highest skinfold thickness ($\bar{x}$ = 147.07 mm) (1) ($\bar{x}$ = 117.90 mm) (2) * Highest body fat percentage ($\bar{x}$ = 22.72 %) (1) ($\bar{x}$ = 26.66 %) (2)	* Slowest over 10 m ($\bar{x}$ = 1.96 sec) (1) ($\bar{x}$ = 2.17 sec) (2) * Slowest over 40 m ($\bar{x}$ = 5.92 sec) (1) * Poorest speed endurance ($\bar{x}$ = 83.00 sec) (1) * Poorest result in pull ups ($\bar{x}$ = 7.50) (1) * Poorest result in push ups ($\bar{x}$ = 53.20) (1)	* Third best in catching and throwing over the crossbar ($\bar{x}$ = 13.50) (1) * Poorest result in passing for accuracy (4 m) ($\bar{x}$ = 3.00) (1) ($\bar{x}$ = 4.67 (2)

(1) = SARFU'S GREEN SQUAD (2003/2004)
(2) = OTHER LITERATURE

The results of the physical and motor abilities of props, represent a profile of the slowest speed over 10m and 40m (1.96 sec and 5.92 sec) and also the poorest results of all the player positions in speed endurance (83.0 sec), pull ups (7.5) and push ups (53.2). However, if the speed over 10m is compared with other research results, they showed a faster time (Table 1).

Referring to game-specific skills they were the third best in catching and throwing (13.5), but showed the poorest result in passing for accuracy (3.0) but that is still better than research that was done on other groups (4.6).

In conclusion, the data of the anthropometric measurements showed a better profile than other research that has been done, physically and motorically very few results of other studies of the same age group are available and as far as game-specific skills are concerned they certainly need more training in passing for accuracy.

Scrumhalves

With reference to anthropometric data, scrumhalves are the shortest (168.1 cm), lightest (69.6 kg) and have the smallest body fat percentage (12.6%) of all playing positions. Compared to other international results, the elite scrumhalves in this study are shorter, heavier and carry less body fat (Table 2).

Table 2: Physical and game-skills profile of elite under 18 scrumhalf rugby players

POSITIONS	ANTHROPOMETRIC MEASUREMENTS	PHYSICAL-AND MOTOR ABILITIES	GAME SPECIFIC SKILLS
Scrumhalf	* Mesomorphic physique ($\bar{x}$ = 7.50) (1) * Shortest player ($\bar{x}$ = 168.16 cm) (1) ($\bar{x}$ = 171.00 cm) (2) * Lightest body mass ($\bar{x}$ = 69.62 kg) (1) ($\bar{x}$ = 67.80 kg) (2) * Smallest measurement of skinfold thickness ($\bar{x}$ = 55.42 mm) (1) ($\bar{x}$ = 58.40 mm) (2) * Smallest body fat percentage ($\bar{x}$ =12.64 %) (1) ($\bar{x}$ =14.30 %) (2)	* Most pull ups ($\bar{x}$ = 18.40) (1) * Third most push ups ($\bar{x}$ = 66.60) (1) * Second fastest over 40 m ($\bar{x}$ = 5.23 sec) (1) * Second most agile ($\bar{x}$ = 14.74 sec) (1) ($\bar{x}$ = 16.39 sec) (2)	* Second best result in kicking for distance ($\bar{x}$ = 48.50 m) (1) ($\bar{x}$ = 39.20 m) (2) * Best in ground skills ($\bar{x}$ = 2.89 sec) (1) ($\bar{x}$ = 3.20 sec) (2) * Second best in passing for accuracy (4 m) ($\bar{x}$ = 5.50) (1) ($\bar{x}$ = 6.67) (2)

(1) = SARFU'S GREEN SQUAD (2003/2004)
(2) = OTHER LITERATURE

The profile of physical and motor abilities showed that they did the most pull ups (18.4), the third most push ups (66.6) and the second fastest in speed (5.2 sec) and agility (14.7 sec).

According to game-specific skills, scrumhalves were the best in ground skills (2.89 sec) and second best in kicking for distance (48.5 m) and passing for accuracy (5.5). Compared to international data the scrumhalves demonstrated better results in kicking for distance and ground skills, but in passing for accuracy the other research groups proved to perform better.

According to literature, the profile of scrumhalves requires specific anthropometric measurements: they must be fast, agile and possess strength and speed endurance, as well as good handling skills and kicking abilities. The results of the elite group in this study showed that they match nearly all of these requirements, but passing for accuracy needs improvement.

Conclusion

The aim of this study was to compile a profile of elite under 18 rugby playing according to physical and game-skills. The data was also compared to other similar research. For each player position a profile was developed that coaches of elite under 18 teams can use as a tool to compare potential talented players. The average scores of the elite players in this study was also added to the profile, as well as average scores of other similar studies. This can also be used effectively by coaches when testing elite players. This study on elite under 18 players will carry on for a further six years. Those players who gained national colours will then be used to do research on to compare profiles to see how they performed in the anthropometric, physical and motor and game-specific variables over this period. Only then we would be sure how talented players at the age of seventeen years should look like.

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OBJECTIVE EVALUATION OF THE KNEE VALGUS AS A RISK FACTOR FOR THE ANTERIOR CRUCIATE LIGAMENT INJURY IN TEAM HANDBALL

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Abstract

Investigations about injuries in team handball demonstrates a high frequency of lower extremity injuries with the greater number of knee trauma, especially ACL tears. Biomechanical studies have shown that significant knee valgus is the most common cause of a non contact ACL injury. Understanding and registration of the influence of injury risk factors, especially the changing of neuromuscular control is fundamental to develop preventive measures with the population at risk. The aim of this study is to present a functional diagnostic protocol which allows an objective evaluation of the knee valgus as a risk factor for the anterior cruciate ligament injury in team handball. The mentioned protocol has been developed in the polyclinic Peharec for 12 years and it is a product of experience and knowledge about the mechanism of sports injuries.

Key words: *ACL injury, team handball, knee valgus, neuromuscular control*

Introduction

The modern sport gives to athletes great demands which are insurmountable without a properly planned and programmed training process. The main important things for a rational guidance of the transformational process are on one hand the knowledge about biomechanics and functional characteristics of the sport discipline, and on the other hand, the information about individual characteristics of the athletes. For receiving indispensable information about the individual characteristics of an athlete we use well known measuring systems which gives us the information about the functional status of a sportsmen as well as the information about the possible existence of intrinsic risk factors responsible for sports injuries. Previous investigations have shown that bed posture, deranged movement biomechanics, musculo-skeletal deficiencies (Watson, 2001), a decrease of flexibility and coordination (Backx i sur., 1991), poor proprioception (Solomonow i Krogsgaard, 2001), fatigue and previous injuries (Arnason i sur. 2004) are significant predictors of sport injuries. The most commonly mentioned extrinsic risk factors for sport injuries are sports foot-wear, sports ground, sports equipment, the playing system and the referee criteria (Renstrom, 1994). The use of biomechanics measuring systems enables the evaluation of parameters such as neuromuscular control, muscle strength, endurance and flexibility. Biomechanical measurements pointed to the evaluation of an ACL (anterior cruciate ligament) injury risk gives the possibility to establish the functional stabilization of the knee during open and closed kinetic chain movement. Investigations about injuries in team handball demonstrate a high frequency of lower extremity injuries with the greater number of knee trauma, especially ACL tears (Seil i sur., 1998; Arendt i Dick, 1995). In team handball, backwards are more prone to ACL injuries than other players (Olsen i sur., 2004) and our subject is a backward player. Biomechanical studies have shown that significant knee valgus is the most common cause of a non contact ACL injury which can be present during the take-off phase of a jump, during the landing phase and during sudden changes of directions (Boden i sur., 2000; Gerberich i sur., 1987; Markolf i sur. 1995). Understanding and registration of the influence of injury risk factors, especially the changing of neuromuscular control is fundamental to develop preventive measures with the population at risk. Specially designed training process can improve the athletes' functional status by lowering the registered muscle deficiencies and consequently lower the risk of their injuries. Previous studies have confirmed a lower injury rate of ACL in athletes who practice a specific neuromuscular training (Hewwet i sur. 1996; Timothy i sur. 2005). After six weeks of neuromuscular training the muscle strength of the lower limb has improved for 44% Timothy i sur. 2005). Besides, the enhancement of neuromuscular control means optimization of functional ability and improvement of the athletes sport efficiency. The biomechanical organisation of a movement can be an indirect indicator of the neuromuscular control (Olsen i sur. 2004). For the need of this study we measured the mentioned dimension with three pliometric tasks: The maximal vertical jump, reactive jumps and the drop jump. *The maximal vertical jump* belongs to the class of explosive movements. These movements are characterized by a short execution time and are aimed at giving a high velocity to a part of the body. *Reactive jumps* occur in a much shorter time which also allows the measurement of the parameters of neuromuscular control. *The drop jump from a box 25cm high* requires the subjects to reverse the downward velocity into an upward one as soon as possible after landing. That allows the evaluation of the reactibility during eccentric-concentric tasks with a significant level of neuromuscular

control. For measuring the neuromuscular parameters special software and a measuring protocol with a specific marker positioning were designed. The aim of this study will be focused on the presentation of a functional diagnostic protocol through the example of an elite team handball player. The shown protocol has been developed in the polyclinic for 12 years as a product of experience and knowledge about the mechanism of sports injuries.

Materials and methods

For the needs of this paper we tested one elite team handball player, a member of the Croatian national team. He was 23 years old, 196cm tall and had 93kilos. The subject was tested at the end of his playing season, a week before the Athens Olympic Games. We used a protocol for functional testing that consists of three pliometric tasks: the maximal vertical jump (on both and on one leg), reactive jumps and the drop jump from a box 25cm high. For the *Maximal Vertical Jump* test subjects performed 3 consecutive maximal vertical jumps on both legs, and on one leg (right and left leg respectively). Between the three variants of the vertical jump test the subjects had enough time to rest in order to permit their maximal performance for every test protocol. They had to keep the jumping area as narrow as possible, and were free to select the jumping frequency. *The drop jump* test consisted of the subjects starting on the top of a box (25cm high). Subjects were instructed to drop directly down of the box and immediately perform a maximum vertical jump on one box that was placed right in front of them. The subject repeated the defined task 3 times. *The reactive jump* test consisted of five consecutive reactive jumps performed on both legs. A 3D optoelectronic Smart system with 9 IR (infra red) cameras on the frequency of 50 Hz was used. A very important part in the modelling of the body segments is the definition of the segment coordinate system since it gives the possibility to express the position of one segment in relation with all the other segments. To define the individual vectors of the segmental coordinative system we used the points on one segment and the individual axis of another (segmental or global) coordinative system (segmental vectors). Which one of the mentioned sources will be applied depends on what kind of information we want to receive. While defining the model we apply the possibility to use the *static* and *dynamic* models. On the static model we have the possibility to put a greater number of markers with a small distance in between which later will help us to gather anthropometric and postural parameters. We received the dynamic model by reducing the number of markers on the static model which were positioned to receive the anthropometric relations (figure1). The resulting model was gained with the vector calculation using the referent system of the laboratory and the anthropometric relations received from the static model.

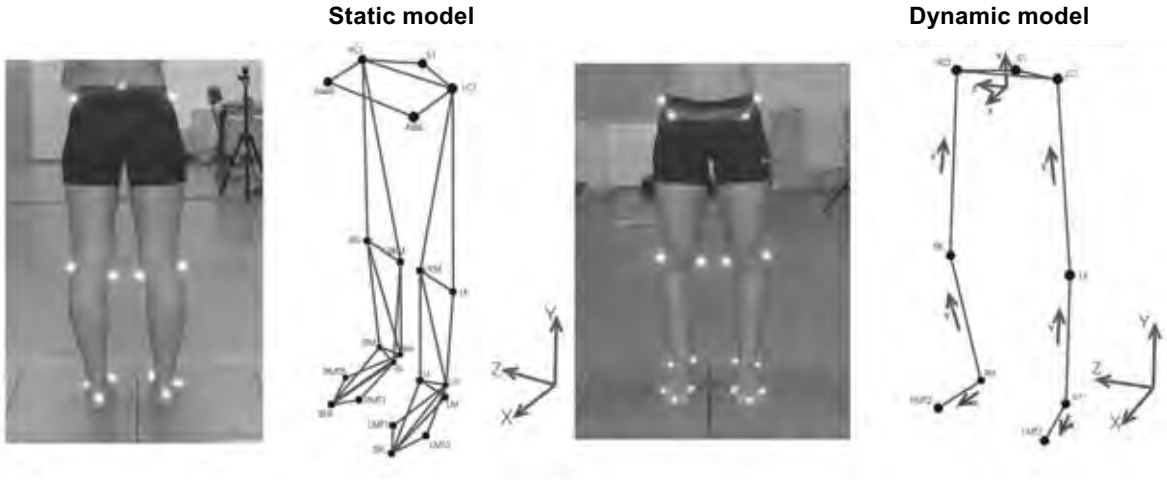

Figure 1. Static and dynamic model

In the end we applied the final calculations on the resulting model and received the wonted parameters. We can divide the received parameters in two groups, the motor and the biomechanical parameters. The second one is based on the received results of the angular motions. The basic parameters are jump high (cm), concentric work (J/kg), jump efficiency (cm/j) and Peak Power (W/kg). The second group of parameters is defined by the starting angles for the concentric action. They are ankle, knee, hip and pelvis angle of flexion and the knee valgus.

It is important to pint out that this is only one of the existing mathematical models for the calculation of the parameters such as knee valgus. It is especially difficult to define the axes in which a movement occur during the jump on one leg which is a part of our testing protocol. Our whish was to discern the parameters which indicate the deranged biomechanics of movement and to establish his relations with the injury risk of one athlete. During the testing procedure we gave to our subject the possibility to perform the task freely. The need of a free movement of our subject leads our testing procedure.

Results

The kinematical measurements show different values for all of the three kinds of jumps (figure 2, 3 and 4). The highest value is recorded after landing from a box 25 centimetre high which is the result of the stretch-shortening cycle. Maximal and reactive jumps on both legs did not show important differences. In one leg jumps we can notice a significantly higher jump with the left leg and lower value for the right leg in reactive jumps. The reason for this can be the fact that the left leg of our subject is the dominant one in the take off phase of the jump. The biggest difference in knee flexion can be notice between maximal and drop jump on both legs. When jumping on one leg the subject is accomplishing lower angle in knee flexion in relation to the jumps on both legs. We can also observe a lower difference in the flexion of left and right knee when performing maximal jumps. It is important to mention that the left knee was injured. The highest values of knee valgus are recorded during reactive jumps on both legs, and the lower one during both legs maximal jumps. Lower values of knee valgus are registered during maximal and reactive jumps performed on one leg. The flexion of the pelvis is significantly higher when performing the maximal jump on both legs in relation to the values registered in reactive jumps on both and one leg and drop jump.

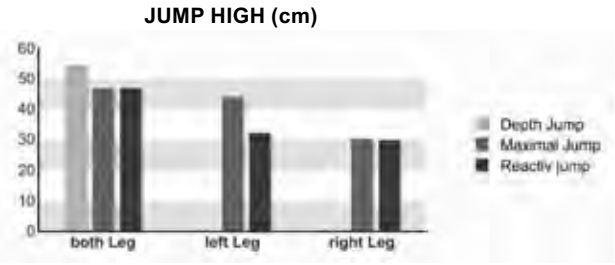

Figure 2. Jump high of the maximal vertical jump, the reactive jumps and the drop-jump

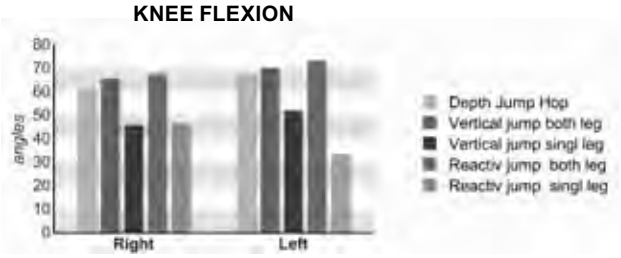

Figure 3. Knee flexion during the maximal vertical jump, the reactive jumps and the drop-jump

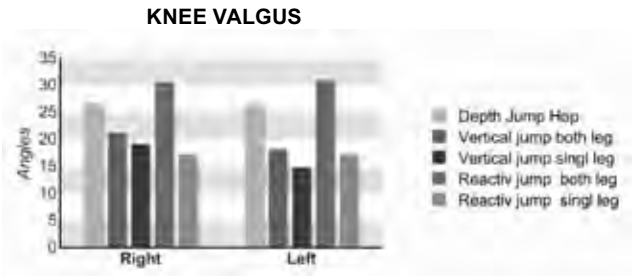

Figure 4. Knee valgus during the maximal vertical jump, the reactive jumps and the drop-jump

Discussion

The greater number of non contact ACL injury happens during sudden stops or changes of direction in the attempt to pass the opponent player or during lending on one leg (Olsen i sur., 2004; Myklebust i sur. 1998). Video analysis of the mechanism of an ACL injury during a handball game clearly shows that when an ACL injury happens during a sudden change of direction, than the feet is firmly fixed on the floor (abducted) with a significant knee valgus. The knee is in slight flexion (15^0), the tibia can be externally or internally rotated about 10^0, while the knee valgus is about 20^0 (Olsen i sur., 2004). The same authors has described the mechanism of an ACL injury during a lending action: the foot is firmly fixed to the floor in a slight abduction, The knee is in slight flexion (20^0) and the valgus is about 10^0 while the tibia is externally rotated for about 10^0. Right after the ACL tear the injured knee collapses in a valgus direction. If we understand the mechanism of an ACL injury, than it is easier for us to interpret the results. According to the mentioned investigation the risk value of the knee valgus is about 15^0 when the knee flexion is about 20^0. Therefore, the evaluated valgus of our examinee represents an etiologic risk factor for a knee injury and at the same time it gives the guiding lines for a preventive training process. We recorded a peak of a 30^0 valgus when the subject performed the reactive jumps on both legs. That value represents a high level risk for an ACL injury.

The function of the ACL is to stabilize the knee joint, prevent abnormal movements, and steer the movement of the knee (Nordin i Frankel, 2001). At 30^0 of knee flexion the ACL represents 85% of the total capsular and ligamentous resistance (Butler, Noyes i Grood, 1980). In addition, the ACL prevents hyperextension and stabilizes the knee against tibia rotation (Olsen i sur., 2004). Investigations also show significant knee instability when it is flexed about 20^0-40^0 (Takeda i sur. 1994). Those are the results of an investigation based on the video analysis of a team handball game. In the laboratory environment, we registered much greater values of knee flexion in relation to the values registered by analysing a handball game (Olsen i sur., 2004). In conclusion, it is important to point out that a deranged biomechanics of movement in the knee joint and a great knee valgus while performing a sudden change of direction or a landing action represents significant risk factors for an ACL injury. Biomechanical measurements of jumping performance are becoming very important because of the high frequency of ACL injuries during landing actions of the players. Such measurements enables on one hand, the quantification of the biomechanical parameters showing changes of neuromuscular control, and on the other hand, they represents the basis

for planning and programming an individual training process. Namely, like it has already been told, an individually planned and programmed preventive training can positively influence the amelioration of neuromuscular control and diminish the risk for an ACL injury.

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SPIROERGOMETRIC PARAMETERS OF ELITE FOOTBALL PLAYERS AND THEIR DIFFERENCES REGARDING PLAYING POSITIONS

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Abstract

The aim of this work was to determine central and descriptive parameters of tested spiroergometric values of the elite football players. This work also determined the differences of the elite football players in analyzed spiroergometric values with regards to the playing position. The research has been conducted in Sports diagnostic centre of the Faculty of Physical Education in Zagreb. The difference between attackers, defenders and midfielders in analyzed spiroergometric parameters was determined (Wilks' lamda=0.314, Raos'R=8,52, p<0.02). The determined differences between defenders, midfielders and attackers refer to the fact that it is necessary to address training of the football players with a more individualized approach.

Key words: *Football, spiroergometry, anaerobic threshold*

Introduction

Football training is a complex programmed process, directed towards the development and maintenance of numerous skills of the football players. For the purpose of optimizing training process, it is necessary to have an insight in current condition of all skills of the football players, and especially of the functional capabilities. Considering that a top football players runs 8 – 12 km during 90 minutes of a match (Rhodes, et al. 1986; Bangsbo, et al. 1999), it becomes clear that aerobic endurance is essential in football. The term "anaerobic threshold" (AT) is defined as the level of work or O_2 consumption just below that at which metabolic acidosis and the associated changes in gas exchange occur. The AT 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 all sports. Previous studies have determined a correlation between VO 2max and the distance ran during a match (Shepard, 1992).

The main purpose of this study was to determine central and dispersive values of the spiroergometric parameters of the elite football players on an incremental maximal exercise test. Secondary purpose of this study was to assess the differences in analyzed spiroergometric parameters between football players regarding their game playing positions.

Methods

The research has been conducted in the season 2001/02, during the second week of the competition period, at 17 elite Croatian football players, in the age group 23.79±3.8. One minute incremental maximal exercise tests were performed on a motor-driven trademill (Run race, Technogym, Italy), with 1.5% inclination. Quark b2 "breath-by-breath" gas analysis system (Cosmed, Italy) was used for respiratory gas exchange monitoring. Heart rate was monitored using a Polar Vantage NV (Polar ElectroOi, Finland) heart rate monitor. The maximal exercise test was interrupted when plateauing of oxygen consumption was noted or when subject perceived volitional fatigue. VT was assessed by a nonlinear increase in carbon dioxide to oxygen consumption ratio (V-slope method). For this purpose, 10 spiroergometric parameters were calculated and analyzed. Statistical data processing was made using the statistical software Statistica 6.0 for Windows. The MANOVA was used to determine the differences between the playing positions (defenders, midfielders and attackers).

Results

Average values for maximal oxygen consumption (SEVO2) and maximal relative oxygen consumption (SERVO2) were 4,61±0,42 L/min and 58.84±3.37 mL/kg/min, respectively. Average of maximal running speed (SEBRZMAX) achieved at incremental exercise test and the speed achieved at spiroergometric threshold (SEBRZAT) were 18,38±0,49 km/h and 13,97±0,62 km/h, respectively. (Table 1.) The attackers, midfielders and defenders differ in the tested spiroergometric values (Wilks' lamda=0.314, Raos'R=8.52, p<0.02)

Table 1. Central and descriptive spiroergometric parameters

	Mean	Minimum	Maximum	Range	Std.Dev.
AGE	23,79	19	31,5	12,5	3,80
ATT	78,01	68,4	89,6	21,2	5,73
ATV	179,73	165,9	188,5	22,6	5,81
SEVO2	4,61	3,86	5,49	1,63	0,42
SEVO2	58,84	54,4	65	10,6	3,37
SEHRMAX	191,18	179	211	32	9,21
SEVO2_HR	24,70	19,6	28,6	9	2,60
SEEVEMAX	158,96	126,8	177,6	50,8	12,51
SERFMAX	57,94	49	65	16	4,96
SEBRZMAX	18,38	17,5	19	1,5	0,49
SEBRZAT	13,97	13	15,5	2,5	0,62
SEHRAT	172,47	160	187	27	7,71
SERVO2AT	52,66	45,9	54,1	8,2	12,31

ATT – body weight, ATV – body height, SEOV2-oxygen consumption, SERVO2-relative oxygen consumption, SEHRMAX-maximal heart rate, SEVO2_HR-maximal oxygen pulse, SEVEMAX-maximal minute ventilation, SERFMAX-maximal breathing frequency, SEBRZMAX-maximal running speed, SEBRZAT-running speed at anaerobic threshold, SEHRAT-heart rate at anaerobic threshold, SERVO2AT-oxygen con-sumption at anaerobic threshold

Table 2. Central and descriptive spiroergometric parameters regarding playing positions

	DEFENCE			MIDFIELD			ATTACK		
	Valid N	Mean	Std.Dev.	Valid N	Mean	Std.Dev.	Valid N	Mean	Std.Dev.
GOD	5	24,96	4,10	6	24,40	4,03	6	22,22	3,41
ATT	5	81,24	4,90	6	76,35	7,03	6	76,97	4,63
ATV	5	183,86	3,99	6	178,73	8,09	6	177,28	2,12
SEVO2	5	4,78	0,26	6	4,44	0,62	6	4,64	0,26
SERVO2	5	58,86	3,54	6	57,82	3,14	6	59,83	3,74
SEHRMAX	5	184,00	3,24	6	193,67	9,05	6	194,67	10,37
SEVO2_HR	5	26,46	1,60	6	23,63	3,30	6	24,30	2,02
SEEVEMAX	5	167,84	7,67	6	152,37	14,41	6	158,15	10,67
SERFMAX	5	58,20	6,87	6	58,83	4,58	6	56,83	4,17
SEBRZMAX	5	18,50	0,50	6	18,50	0,45	6	18,17	0,52
SEBRZVENZ	5	14,00	0,35	6	14,17	0,41	6	13,75	0,94
SEHRVENT	5	167,60	2,30	6	173,83	7,99	6	175,17	9,35
SERVO2VEN	5	59,90	22,44	6	49,13	1,89	6	50,15	1,90

Discussion

According to the determined average values of VO2max/kg (58.84±3.37ml/min/kg), the elite Croatian football players have similar results as world top football players, whose values vary from 55 to 67mL/kg/min (Bangsbo, et al. 1999). The values of VO 2max indicate good conditioning fitness of the elite Croatian football players. It is known that defenders move averagely 8.4 km, attackers 9.8 km, while midfielders move the most number of kilometers during a match, 10.9 km (Verheijen, 1997). The elite Croatian midfielders have greater values VO 2max (59,83mL/kg/min) than the attackers (58,45 mL/kg/min), and the defenders (57,33mL/kg/min), which is a proof of correlation between VO 2max and the distance (km), which the players pass during a match (Shepard, 1992). The differences between the midfielders, defenders and attackers in the passed distances may be attributed to the different tasks of the players within the team. Midfielders move more than attackers and defenders. In the phase of attack, midfielders take a ball to the opponents' half, whereas defenders, in most cases, make a slight shift towards, while attackers wait for the ball from midfielders. In the phase of defense, attackers stand, the midfielders run back and defenders wait for players of the opponent team. It is known that defenders perform sprints from 1 – 5m more frequently (Verheijen, 1997), than the midfielders and attackers do. Defenders have to be quick and react quickly in order to be able to stop attackers, to which it is possible to attribute the differences of defenders in relation to attackers and midfielders.

Conclusion

The line specific quality is evident and needs to be recognized and integrated within planning and programming of a physical fitness training. The central and dispersive parameters of the tested functional status may serve to coaches as

the modal values, which should be aspired to and taken into account in the process of formation of a training of players, directed to development of functional capabilities.

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ATHLETIC PERFORMANCE CAPACITY IN MOUNTAINBIKE SPORTS UNDER EXTREMLY STRENUOUS MORE DAYS LASTING ENDURANCE IMPACT*

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Abstract

The aim of this study is to evaluate development and distribution of the following sports physiological parameters during the adidas bike Transalp Challenge 2004. They are the following: Borg`s RPE (1998), fluid intake (FI), energy intake (EI) - vegetarian and vegan nutrition pattern, fatigue of leg musculature and mood, heart rate (HR) and power output (PO), body water analysis, blood parameters haemoglobin (Hb) and haematocrit (Hct). Using a daily questionnaire (Q) FI, RPE, leg fatigue and mood was reported; three times both body water development by bioimpedance analysis and development of Hb and Hct by taking venous blood sample was estimated. Every individual itself recorded PO and HR. Two selected participants reported EI daily. FI, RPE, fatigue of legs and mood are reported of "bikeextreme" cyclists who succesful completed the TAC 2004 with complete data sets recorded (b-group, n = 10). Mean values for b-group: FI is 0.71 ± 0.21 L/h (male: 0.82 ± 0.16 and female: 0.58 ± 0.09), RPE is 15.48 ± 3.83 (male: 15.39 ± 1.0 and female: 15.57 ± 1.32), fatigue of legs is 2.52 ± 0.91 (male: 2.54 ± 0.92 and female: 2.50 ± 1.06) and mood is 2.14 ± 0.69 (male: 1.9 ± 0.70 and female: 2.38 ± 0.53). Values of FI are close to these of Tour de France (Brouns/Saris et. al. 1989, Saris et. al. 1989), Race Across America (Lindemann 1991) and other publications (Gabel. al. 1995, Galloway/Maughan 2000 and 1997, Grandejan/Ruud 1994, Peters 2003, Rehrer 2001, Rogers et. al. 1997). All other values are hardly comparable to established literature because not one study dealt with ultra-endurance MTB stage races, so that there is the necessity to do further research in this field.

Key words: *Mountain biking, multiple days cycling, ultra-endurance cycling.*

Introduction

In the field of extreme one day lasting mountainbike (MTB) impacts (Bührle/Stapelfeldt 1998, Impellizzeri et. al. 2002, Lee et. al. 2002, Stapelfeldt et. al. 2000) and of extreme one day lasting road cycle impacts (Johnson et. al. 1985, Neumayr/Pfister/Mitterbauer et. al. 2002 to 2004) just a few publications have been released. Two articles about one day lasting endurance strains in MTB-Sports (Impellizzeri et. al. 2002, Lee et. al. 2002) deal with the physiological profile of mountainbikers compared to road-cyclists, and the impact profile of a MTB race in terms of heart rate (HR). The findings show that the physiological-anthropometric characteristics of mountainbikers are very similar to those of road cycle uphill specialists (which confirms to the conclusions out of Wilber et. al. 1997). Thus mountainbikers show a higher power-development relative to their body mass at maximum load (measured in Watt per kilogram: W_{max} = W/kg). The individual single load at MTB races is shown through very high intensities and a very high impact-distribution during the whole competition. However, the HR on average (expressed in percent of the maximum heart rate, HR_{max}) lays at ≥ 90 % HR_{max} (impact at road cycle races about 70 – 80 % HR_{max}: Impellizzeri et. al. 2002, Palmer et. al. 1994).

For the publications of Neumayr/Pfister/Mitterbauer et. al. 2002 to 2004 on extreme one day lasting endurance impacts in road cycling sports it can be concluded that impact intensity dependent on incremental extent and intensity of a bike marathon is boosted under aerobic conditions, which means between 78 – 99,6 % of the total load. Furthermore, the examinations show an average decrease of HR during an extreme bike-marathon of about 10 %, at an ultra bike marathon even 10 % every ten hours. As a consequence of these long-lasting strain haematocrit (Hct) and haemoglobin (Hb) values decrease due to an increase of the plasma volume of the blood (PV).

In the field of extremely strenuous more days lasting endurance impacts in road cycling sports also just a few articles were released (Brouns/Saris et. al. 1989, Clark et. al. 1992, Gabel et. al. 1995, Garcia-Roves et. al. 1998, Lindemann 1991, Lucia et. al. 2003, Saris et. al. 1989), but there is no single publication about more days lasting endurance strains in MTB sports. Publications widely differ from 1989 to 2003, but offer similar conclusions in terms of their qualitative testimony. The recent publication estimates in the 2001 season of competition the total load of the stage races Giro d`Italia, Tour de France and Vuelta a Espana, based on HR and compares the determined values afterwards. The findings showed a comparable total load for all three stage races.

The older publication estimates, also by monitoring HR, the impact intensity of each competition-stage of a four days stage race. The impact intensity of both of the stages with a single time trail was compared to both stages with mass starting and bunch building. The output of this estimation shows that the impact intensity at individual single performance lays at 91- 93 % HR_{max} whereas the impact at bunch building of a road-cycle-race lays clearly lower at 79 – 82 % HR_{max} (compare: Impellizzeri et. al. 2002, Palmer et. al. 1994).

* *Young researcher award*

There have been two estimations about "Performance-determining factors in MTB-Sports" (Bührle/Stapelfeldt 1998, Stapelfeldt et. al. 2000), yielded a completely different profile of skills of the MTB athlete in comparison to the road cycle athlete. These specific characteristics for the MTB impact result from enormous peak power particularly at the beginning of a race, and during the course of the race, a permanent change of load and recovery. The importance of single skills for the complex performance capacity in MTB sports is completely different than road cycling. Regrettably no article about these probably interesting findings have been published until now.

After intensive and careful study of literature it can be concluded that sports science research in the field of MTB sports, especially in ultra-endurance and multiple days MTB sports, is an area in which there are few conclusive scientific findings.

Purpose

The Tour de France is the ultimately multiple day event for professional road cyclists (followed by Giro d`Italia/I and Vuelta a Espana/ESP). However, the adidas bike Transalp Challenge (TAC) is the hardest MTB race in the world (followed by Cape Epic/SA and Transrockies/USA), covering eight stages with total altitude of 22.500 m and milage of 662 km (daily average: 2.812,5 m in altitude and 82,75 km).

The aim of this examination in the context of my thesis-projekt "bikeextreme" is to evaluate development and distribution of the following sports physiological parameters. They are the following: Borg`s RPE (1998), fluid intake (FI), energy intake (EI) - vegetarian and vegan nutrition pattern, fatigue of leg-musculature and mood, heart rate (HR) and power output (PO), body water analysis, blood parameters haemoglobin (Hb) and haematocrit (Hct) during the whole duration of the TAC 2004.

The evaluation of the collection of raw data aids in my sports science examination of extreme MTB Sports and should aid the sports research in this field, so that the findings can be compared and contrasted to the existing literature.

The purpose of this paper presented is to evaluate the daily questionnaire with the main focus on daily FI (L/day) and the exercise induced FI per hour track time (L/h).

Method of this sportsscientific examination

The requirement of the "bikeextreme" participants for my examination of the TAC 2004 occurred through the Internet forum of the TAC Organiser.

a. Period before the TAC 2004

At about the end on June all test persons absolved a performance test with gradually load increase on a cycle ergometer under laboratory conditions at a sports medicine clinic in their hometown (load increase of power performance optionally 30 Watt every 5 minutes or 20 Watt every 3 minutes). This happened to get the following performance parameters to determine the individual initial situation for every single Transalp athlete for the purpose of the later results of my measurement: maximum heart rate HR_{max} (bpm), maximum power performance (W_{max}) and maximum power performance per kilogram body mass (W_{max}/kg).

b. Period during the TAC 2004

The field study in the scope of the world-wide only MTB stage race lasting over eight days included 33 well endurance trained amateur athletes (TAC: 16th until 24 th of July 2004).

July 16th and 17th: Basic measurement of every single participant based on BIA and venous blood sample (to determine Hb and Hct) before the start of the stage race on the 17th of July at 12 o'clock.

BIA and venous blood sample of each Transalp athlete:

…after each individual finished the 1st stage (July 17th), the 4th stage (July 20th) and the 6th stage (July 22th).

July 17th to 24th:

- daily during every stage of the eight daytime stages: individual and complete recording of HR course (bpm) and power performance course (Watt) during the race with the personal bike-computer (Polar or Ciclosport) of the participants
- daily after each individual finished each daytime stage: response to a questionnaire to evaluate the individual and subjective parameters body mass, fluid intake during the day (since breakfast), fatigue of leg-musculature and mood (each with three possible answers), rate of perceived exertion by Borg 1998 (RPE-Scale)
- daily after each individual finished each daytime stage: notation of the daily fluid- and energy-intake of two selected participants

c. Period immediately after the TAC 2004

During the TAC 2004 individual HR- and power performance data have been recorded from the "bikeextreme" participants. This collection of raw data concludes for the time being on the 30th of September 2004.

Only these data sets, which conclude with a complete recording of the individual performance parameters, determined in the performance test with gradually load increase at the laboratory**,** field study during the stage race and transfer of the HR- and power performance course of every single one of these eight stages, will be taken as the basis of my examination.

Table 1: Overview of methodical process during TAC 2004

date in July	Q (RPE, FI, legs, mood)	BIA	blood sample	HR	PO	EI
16th/17th		X	X			
daily: 17th – 24th	X			X	X	X
17th/20th/22th		X	X			

Results

The interim findings of the present study are presented and summarized in Tables 2 to 4. At the start: n = 37, at the finish only n = 10 concluded with complete data sets recorded (b-group)

Table 2: Values of maximum temperature T_{peak} and humidity H_{peak} for consecutive stages E 1 to E 8 of TAC 2004, daily at 2 p. m., are mean ± SD

	E 1	E 2	E 3	E 4	E 5	E 6	E 7	E 8	mean	SD
T_{peak} (°C)	28	24	24	29	32	33	28	22	27.5	± 3.93
H_{peak} (%)	45	45	44	50	45	60	50	94	69	± 16.95

Table 3: Evaluation of questionnaire parameters Borg`s RPE (1998), FI, fatigue of leg muscles and mood detailed for each single stage and overall for all daily "bikeextreme" finishers

stage	n	RPE		FI		legs	mood
		mean	range	mean	range		
E 1	30	15.13	11 - 19	4.37	2 - 7	2.87	1.93
E 2	29	15.41	12 - 19	4.2	2.5 - 8	2.59	1.86
E 3	24	14.75	12 - 19	4.4	3 – 7.5	2.33	1.75
E 4	25	16.52	11 - 19	4.6	3.5 - 7	2.76	2.4
E 5	23	13.65	9 - 18	3.54	2 – 5.5	2.57	2.04
E 6	21	15.1	12 - 17	4.5	2.5 - 10	2.62	2.19
E 7	13	16.62	13 - 20	6.35	4 - 8	3	2.08
E 8	11	14.55	9 - 18	3.32	2 – 6	2.27	2.18
overall		15.22		4.45		2.63	2.05

Table 4: Anthropometric data and values of RPE, FI, track time, FI per hour track time, fatigue of legs and mood are mean ± SD for b-group

variables	b-group		
	mean (n=10)	male (n=8)	female (n=2)
age	35.89 ± 27.66	37.5 ± 11.42	34 ± 5.66
body mass (kg)	66.97 ± 31.25	71 ± 9.17	61 ± 15.56
height (m)	1.76 ± 14.84	1.79 ± 0.04	1.73 ± 0.16
RPE	15.48 ± 3.83	15.39 ± 1.0	15.57 ± 1.32
FI (L/day)	4.05 ± 1.21	4.49 ± 0,85	3.6 ± 0.57
track time	5 h 44 min	5 h 27 min	6 h 11 min
FI/track time (L/h)	0.71 ± 0.21	0.82 ± 0.16	0.58 ± 0.09
fatigue of legs	2.52 ± 0.91	2.54 ± 0.92	2.50 ± 1.06
mood	2.14 ± 0.69	1.9 ± 0.70	2.38 ± 0.53

Discussion

Focusing the trend of T_{peak} (Armada-da-Silva et. al. 2004, Galloway/Maughan 2000) competitors had to fight high temperatures at almost two third of the whole race (28-33 °C). Six of eight stages were competed under dry conditions (44-50 %). Hottest stage E 6 did not go hand in hand with driest stage E 3. Borg`s overall RPE is highly dependent on kind of sports (Beneke 1998) and is accounted by two third of physiological (central and local factors) and one third of psychological parameters (Borg 2004, 1998, 1982). When observing cycling strains main muscle groups recruited are leg muscles. So it has to be kept in mind that local RPE (in particular of m. quadriceps) is of big importance in mountainbike sports (Garcin et. al. 1998, Jameson/Ring 2000, Koivula/ Hassem 1998, Robertson et. al. 2000).

The findings for exercise induced FI fit close to a large number of publications, Tour de France with 6.3 – 6.7 L/day and longer daily track times (Brouns/Saris et. al. 1989, Saris et. al. 1989), Race Across America with 0.72 L/h (Lindemann 1991), others with 0.5 – 1.2 L/h (Gabel et. al. 1995, Galloway/Maughan 2000 and 1997, Grandejan/Ruud 1994, Peters 2003, Rehrer 2001, Rogers et. al. 1997). The connection between RPE and FI show that the more strenuous an impact is perceived the less a cyclist is able to drink (caused by diminished emptying of stomach, Beckers et. al. 1992, Murray 1998 and 1992). Otherwise high impact is accompanied by high FI for the demand of blood flow cooling the exercising body (Galloway/Maughan 2000, Glace et. al. 2002, Kay/Marino 2000, Sparling et. al. 1993, further proved by the present study: maximum of RPE and FI at E 7, minimum values at E 8).

Fatigue of leg musculature is an important factor of performance in road cycling and mountainbike sports (see authors above).

But not only ideal physiological preparation leads to win a race. The physiological performance level for a determined competition, based on consequent training in both high impact and extent, is not enough to be winner. How a sportsman can push himself and his mental forces decides between victory or defeat, when two cyclists being at top of performance level (Häuser et. al. 1991, Handow 2003, Johnson et. al. 1985, Rauch et. al. 1988, Schlicht et. al. 1989 to 1990, Seiler 1995).

It can be concluded that TAC 2004 was overall perceived as „exertive" and local as „o.k.", means „exertive" at all, mood situation was „good" (fatigue of leg muscles and mood: best = 1, worst = 5) and FI was adequate to exercise induced demands.

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CORRELATION OF THE AEROBIC CAPACITY WITH SKILL OF WINDSURFER'S HIGH PERFORMANCE

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Abstract

The aim of the study was to analyze the relationship between the level of sports skill and aerobic capacity of high performance Polish windsurfers (men) during a cycle ergometer and windsurfing simulator exercise tests. The VE, VO_2, and the power at the HR of 170 bpm were measured by a metabolimeter "Cosmed" (K 4 B-2). The results showed close correlation of VE, VO_2 ml $\cdot min^{-1}$, power with a range of athletes sports skill during a simulator exercise test. During a cycle ergometer exercise test the close correlation of rank estimation was showed with power only.

Key words: *windsurfing, sport skill, aerobic capacity, correlation*

Introduction

Windsurfing was recently regarded as the sport of moderate physical effort. For that reason, technique of sailing was more important than windsurfing efficiency. But because inclusion of windsurfing into the Olympic sports and cancellation at the pumping prohibition, the ISAF proposed the Medical Commission of IOC to analyze the physiological requirements of windsurfers during the Olympic class contest "Mistral One Design" (Bornhoft, 2001).

It is known that the windsurfer's physical loads predominate over aerobic energy. Thus the discussion of the windsurfer's aerobic capacity deserves special attention (De Vito et al., 1997). The estimation of windsurfer's aerobic capacity, particularly of high performance athletes, is a necessary condition for effective realization of their training and competitive practice (Vogiatzis et al., 2002). Regarding this some questions need further specifications, in particular:

- how much does the range of windsurfer's skill correlate with aerobic capacity of athletes?
- what ergometric tests provide most information to study the windsurfer's aerobic capacity?

The aim of this study was to examine the correlation of aerobic capacity with high performance windsurfer's skill during cycle ergometer and windsurfing simulator test exercises.

Methods

The study was carried out in the Academy of Physical Education and Sport in Gdansk. Nine high performance Polish windsurfers (male, Olympic and National Representation, aged 20 – 27 years) took part in this study. They performed exercise tests on the cycle ergometer and especially designed (Jaszczur-Nowicki, Tomiak, 2004) windsurfing simulator.

The physical effort tests progressively increased power by 25 W during a cycle ergometer starting from 100 W, and by 10 W during a windsurfing exercise test starting from 60 W, every two minutes. Heart rate (HR) registration was made up by Polar Sport Tester every 2 minutes. During the tests the power of work at HR of 170 bpm (W_{170}) as the conditional level of the anaerobic threshold was recorded.

To determine a minute ventilation of lungs (VE) and oxygen consumption (VO_2) a portable metabolimeter "Cosmed" (K 4 B-2) was applied.

Statistical analysis included determination of Means ± SD), statistically reliable difference between indices by t-criterion (p) and correlation coefficient (r) by use of the standard computer program "Statistics 6.0".

Results

The data presented in Table 1 gives evidence about differences between the VO_2 indices under work power at HR of 170 bpm during the cycle ergometer and windsurfing simulator exercise tests. During the cycle ergometer exercise test the means of VE, VO_2 ml $\cdot min^{-1}$ and VO_2 ml $\cdot min^{-1} \cdot kg^{-1}$ were 85.9±19.9 l $\cdot min^{-1}$, 2914±701 ml $\cdot min^{-1}$ and 42.9±6.7 ml $\cdot min^{-1} \cdot kg^{-1}$, whereas during a simulator exercise test those means equaled 78.7±15.0 l $\cdot min^{-1}$, 2404±573 ml $\cdot min^{-1}$ and 35.0±5.2 ml $\cdot min^{-1} \cdot kg^{-1}$ correspondingly. The difference between VO_2 ml $\cdot min^{-1}$ and VO_2 ml $\cdot min^{-1} \cdot kg^{-1}$ indices during those tests was statistically reliable ($p < 0.005$). The index of work power (W_{170}) during a windsurfing simulator exercise test was significantly (~ at 2,5 time) lower as compared to those observed during the cycle ergometer exercise ($p < 0.0001$).

Table 1. Rank estimation of sports skill and parameters of aerobic capacity of high performance windsurfers during cycle ergometer and windsurfing simulator exercise tests at HR of 170 bpm. (statistic reliable at $p < 0.05$)*

Athletes	Rank	Cycle ergometer test				Windsurfing simulator test			
		VE $l \cdot min^{-1}$	VO_2 $ml \cdot min^{-1}$	VO_2 $ml \cdot min^{-1} \cdot kg^{-1}$	W_{170}	VE $l \cdot min^{-1}$	VO_2 $ml \cdot min^{-1}$	VO_2 $ml \cdot min^{-1} \cdot kg^{-1}$	W_{170}
Mar.	1	112.0	4236	54.5	325	109.0	3581	39.4	130
Mys.	2	94.0	3010	42.5	275	88.1	2579	36.4	90
W. Mir.	3	103.7	3410	46.7	300	85.4	2739	37.5	90
W. Mar.	4	101.4	3075	45.2	225	82.3	2633	38.7	110
Lew.	5	57.1	2075	33.6	175	69.5	1996	32.4	80
Gr.	6	69.7	2417	46.4	200	76.7	2163	41.5	70
Zw.	7	83.2	2479	40.2	175	60.7	1940	31.5	70
R.	8	59.3	2167	33.0	175	61.0	1626	24.8	70
Gr.	9	92.6	3362	44.1	250	76.0	2377	32.5	60
Statistics: M ±SD		85.9 19.9	2914 701	42.9 6.7	233 58	78.7 15.0	2404* 573	35.0* 5.2	85.6* 22.4

The data in Table 2 proves close correlation between VE, VO_2 ml min^{-1}, W_{170} and a range of the windsurfer's sports skill during a simulator exercise test (the means of correlation coefficient are equal at –0.82, -0.78 and –0.85, correspondingly, $p < 0.05$). I.e. the means of those indices are higher in windsurfers of higher sports skills. During a cycle ergometer exercise test close correlation was showed with power only.

Table 2. The correlation between rank estimation of sports skill and parameters of aerobic capacity of high performance windsurfers during cycle ergometer and windsurfing simulator exercise tests at HR of 170 bpm. (r is statistic reliable at $p < 0.05$)*

	Cycle ergometer test				Windsurfing simulator test			
	VE $l \cdot min^{-1}$	VO_2 $ml \cdot min^{-1}$	VO_2 $ml \cdot min^{-1} \cdot kg^{-1}$	W_{170}	VE $l \cdot min^{-1}$	VO_2 $ml \cdot min^{-1}$	VO_2 $ml \cdot min^{-1} \cdot kg^{-1}$	W_{170}
Rank	-0.58	-0.56	-0.56	-0.70*	-0.82*	-0.78*	-0.65	-0.85*

Discussion

Comparative analysis of our laboratory results indicates that a windsurfing simulator test may be applied for the objective control of the windsurfer's performance in laboratory conditions.

In comparison with a cycle ergometer exercise test the aerobic indices during a windsurfing simulator test are of smaller quantities. That fact may be explained by larger mass of muscle groups participating at the cycle ergometer test. But the simulator exercise test is more specific for estimation of aerobic capacity of high performance windsurfers. For that reason it is more preferable in comparison with the cycle ergometer exercise test.

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THE EFFECT OF SEASON OF BIRTH AND SPORTING SUCCESS*

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Abstract

The conducted research aims to establish the difference in birth distribution between various categories of members of Croatian national teams (seniors, juniors) and general population from which they come. Birth dates of sports national teams were taken from Croatian sports yearbook 2004/5 and were adjusted to the data from every single Sport federation. General population birth dates distribution data were taken from National Statistics Institute of the Republic of Croatia. Chi – square goodness of fit technique was applied to establish the difference between distributions of birth seasonality of various samples. The results have shown that there is no significant statistical difference in birth distribution between members of various sports categories i.e. seniors and juniors. Also, there is no significant statistical difference between general populations born the same year as they were. On the other hand, there is a significant statistical difference between the birth distributions of each category of sports and general population they come from. The majority of sports population was born in winter months of the year (52.4%), whereas in general population more people were born in summer (31.7%) and autumn months (31.8%).

Key words: *effect of birth date, sporting success, talent identification, systematic discrimination*

Introduction

Many psychological, psychiatric and sociological researches have shown relation between human behavior and time of birth (month of birth). It has been found out that intelligent and extravert people were born in winter time in greater number than expected (Smithers et al.,1978) while mentally retarded and similar were mostly born in spring time (DiPasquale et al., 1980). Moreover, it has been shown that birth seasonality exists within job selection (Cooper, 1973). For example, army officers, lawyers and medical doctors tended to be born predominantly in the summer and autumn, artists in the spring, and musicians in the winter. In social means (Smithers et al.,1984), the persons tending to be on physical jobs were born more than expected in autumn and winter, whereas persons favorable to bureaucratic jobs were born more frequently in summer time. The interest in these issues has reflected also to sport, but so far there have been few researches, so the cognitions are partial. Former researches were mostly focused on baseball (Thompson et al.,1991), ice hockey (Boucher et al., 1994), football (Šerović et al.,2005;Verhulist,1992) and tennis (Dudink, 1994). The results in mentioned sports have shown that the most of senior category athletes were born in winter and early spring ~ ⅔. So far the researches have been conducted on older athletes – seniors and seldom the national teams members. Considering that, the question is whether the same pattern can be found in younger age groups, i.e. juniors. Furthermore, only few earlier researches compared the sample of athletes with the sample of general population the athletes come from. Taking in consideration all the drawbacks of previous researches, the author set a goal to research the differences between distribution of birth seasonality of senior and junior members of the Croatian national teams and general population they come from.

Methodology

The sample (table1) consists of subjects who belong to 31 'A' senior(n=1083) and 'A' junior(n=686) male national teams of Croatia (athletic, baseball, cycling, boxing, weightlifting, gymnastics, hockey, wrestling, sailing, judo, canoe, karate, kick-boxing, basketball, savate, fencing, diving, football, archery, volleyball, shooting, swimming, rugby, handball, ice hockey, ski, table tennis, taekwondo, tennis, water-polo, rowing) and the sample of general population from which the above mentioned athletes come from. For seniors, years from 1971-1987 and juniors 1988-1990. Each sample has been divided into 12 calendar months according to the month of birth of the subjects. Dates of birth of the national teams' members have been taken from Croatian sports yearbook 2004/5 and have been adjusted to the data from the Sports federation of every single sport. The data about distribution of birth of general population have been taken from the National Statistics Institute. To establish the differences between birth seasonality of different samples, chi-square goodness of fit technique has been used (Nam,1995;Reijneveld,1990).

* *Young researcher award*

Results

Table 1. Monthly birth distribution of Croatia national team members (seniors, juniors) and corresponding total population pattern .

Month	National team members senior	Nat. team mem. junior	Total (Nat. team mem.)	General population for senior (X)	Gen. pop. for junior (X)	Total (general population) (X)
Sep.	68	42	110(6.2%)	3702.1	3703	7405.1(13.4%)
Oct.	74	46	120(6.7%)	2709.3	2706.5	5415.8(9.8%)
Nov.	76	49	125(7%)	2371.1	2371.9	4743(8.6%)
Dec.	192	116	308(17.4%)	1486.3	1488.1	2974.4(5.3%)
Jan.	154	98	252(14.2%)	1682.1	1679.9	3362(6%)
Feb.	128	81	209(11.8%)	1501.1	1503	3004.1(5.4%)
Mar.	94	59	153(8.6%)	1753	1749.2	3502.2(6.3%)
Apr.	79	52	131(7.4%)	1721.1	1720	3441.1(6.2%)
May.	48	32	80(4.5%)	1873.1	1871.3	3744.4(6.7%)
Jun.	61	39	100(5.6%)	2099.3	2101	4200.3(7.6%)
Jul.	45	31	76(4.2%)	3669.1	3670	7339.1(13.3%)
Aug.	64	41	105(5.9%)	3006.1	3004.3	6010.4(10.8%)
Total	**1083**	**686**	**1769(100%)**	**27573.7**	**27568.2**	**55141.9(100%)**

X – mean

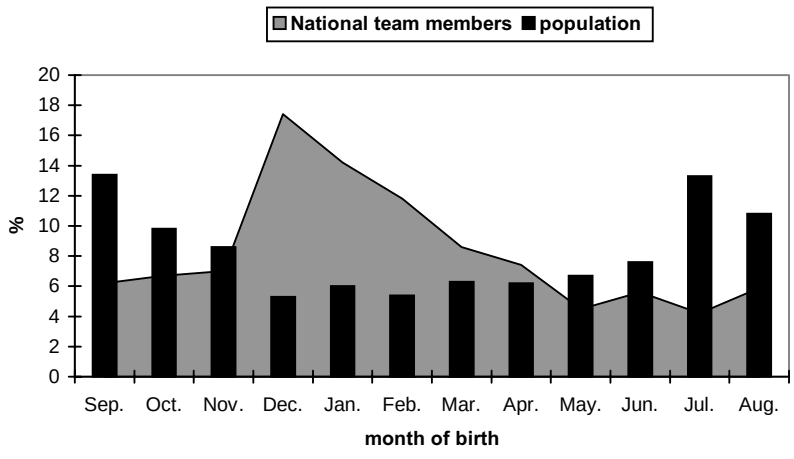
According to the obtained results (table2), there is no significant statistical difference in birth distribution between subjects of different sports categories i.e. seniors and juniors. Also, there is no significant difference between general population the athletes belong to according to the year of birth. However, there is a significant statistical difference between birth distributions of each category of athletes and general population they come from. Consequently, birth distribution among athletes of different age equals the birth distribution among the general population from which the athletes come. In conclusion (table1,2), we could say that in general population people are born mostly in autumn (31.8%) and summer months (31.7%), while members of national teams are born predominantly in winter (52.4%).

Table 2. Values and significance levels of the Chi – square technique (X^2).

Sample	Compared season of birth distribution	X^2	df	p
Nat. team mem.	Senior-junior	5.90	11	n.s. (0.581)
Pop.	Population senior-population junior	6.01	11	n.s. (0.536)
Pop.-Nat.team.mem	Population senior-senior	91.3	11	s. (< 0.001)
	Population junior-junior	94.5	11	s. (< 0.001)

n.s. – non significant sesonal variation, s.- significant sesonal variation, pop. – general population, Nat. team mem.- national team members.

Figure 1. Summarize month of birth distribution for national team members population and general population they belong.



Considering the dynamics of birth (Figure1), the curve of general population has the 'M' shape (like in works Congill,1966) with two peaks, in July and September in which population persons are predominantly born. In the case of sport population (Figure1), the curve takes 'unipolar' shape, which means it has only one peak, where most of athletes are born in December and some of them in January (similar in researches made within only one sport, Šerović et al.,2005;Jacques et al.,1994;Verhulist,1992). Although these differences can be attributed to climate and biological factors, it is the author's opinion that they are caused mainly by human behaviour. So, the cause of obtained differences can be clarified by 'domino effect' of organized selection in club work system which has been carried out traditionally for many years. In other words, the selection date or inscription date of the youngest generation potential athletes into professional clubs always takes place at the end of the current year (October to December). If the potential athletes are recruited from 1990/1991 generation, those born closer to the selection date (ex. November 1st,1990) have bigger chances for entering and surviving in the clubs than those born later (ex. October 30th,1991). That happens because persons born closer to date of selection (ex. November 1st,1990) are more likely to be perceived as physically more mature than the persons born later (ex. October 30th,1991), which is quite normal since they had more time for physical development and training. The bigger the difference between months of birth is, the more chances those born closer to the selection date will get. Consequently, due to the constant selection at the end of the year, there has been a significant increase of athletes born predominantly in the first months of the selection year. This concept has caused a systematic discrimination of younger children of the same generation, who have been showing tendency (Musch et al.,1999) to 'escape' from organized sport into recreative and less demanding ones. Not only is the birth date effect present in sports, it can also be found in the schools (Hauck et al.,1993;Russell et al.,1986), where children born closer to the inscription date are achieving better results than the younger ones of the same generation. So far there has been no strategy referring to this issue neither in sport nor in schooling.

Conclusion

There is a significant statistical difference between birth distributions of every single category of athletes and the general population they come from. On the other hand, there is no significant statistical difference in birth distribution between each category of athletes and there is no difference between birth distribution in general population from which athletes come from. Also, most of the sport population is born in winter months of the year while in general population more persons are born in summer and autumn months.

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DIFFERENCES AMONG THE ORIGINAL AND OBTAINED CLUSTERS OF ATHLETES FROM DIFFERENT SPORTS BACKGROUND

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Abstract

The aim of the study was to determine whether all elite athletes coming from the same energetic group of sports showed similar response of the functional parameters to the physical load. The sample comprised 102 elite athletes divided into three groups: aerobic, mixed and anaerobic (original clusters). The testing encompassed morphological, motor and functional parameters (VO2max exhaustion treadmill test). Discriminant analysis of the original clusters, k-means clustering, and discriminant analysis of the obtained clusters were performed. Original clusters did differ from each other (significant morphology and aerobic capacity functions) but cluster analysis showed mixing of the subjects between obtained clusters and pointed to the entities that differed from others in their group but still performed well in competitions. It meant that the years of specific training did not alter in a large extent, some of their cardio-respiratory characteristic, which could be explained by heritage. The evaluation of the athletes made strictly according to the results of functional testing should be avoided because in some athletes who developed compensatory mechanisms it could underestimate their potential.

Key words: *energy pathways, heritage, physiological adaptations, aerobic capacity*

Introduction

The specific training, that stimulates specific energy pathways, should develop functional and motor abilities of the athletes coming from the same sport in a similar way. The body of knowledge about genetic predetermination of physiological adaptations to training stimuli is growing (Bouchardet al., 1994, 1998, 1999; Gayagay et al., 1998; Klissouras 1997). There are more and more evidence that functional response to physical load is influenced by heritage in a large amount. The aim of the study was to determine whether all elite athletes coming from the same energetic group of sports show similar response of the functional parameters to the physical load. Also, the aim was to explore if some elite athletes show different response from other athletes in the similar sport and still perform well on competitions. The questions raised were: Is the traditional classification of the sports according to the energetic demands applicable to every athlete? Should we evaluate someone's potential according to the traditional way of understanding the required abilities for a certain sport?

Subjects and methods

The sample consisted of 102 elite athletes (male, age. 24..84 ± 3.99) and it was divided according to the traditional categorization of sports meaning according to the energy pathways used for that sport (Matthews and Fox, 1971). Group 1 (aerobic sports) consisted of 34 subjects, athletes from triathlon, long distance running, rowing and cycling. Group 2 enrolled 38 athletes from aerobic-anaerobic sports, while in Group 3 there were 30 athletes from strictly anaerobic events (sprint, hurdles, long and high jump…). The testing protocol encompassed following variables:

a) Morphological: Height, Weight, Fat tissue percentage, BMI, Vital capacity
b) Explosive strength (as an anaerobic abilities indirect estimate) tested on Kistler platform by squat jump (jumping height in cm)
c) Cardio-respiratory parameters tested by incremental protocol (1 km/1min) on treadmill with COSMED Quark b2 gas analyser. Parameters included were:
   - HR*max*- maximal heart rate (bpm)
   - HR*vt*- heart rate at ventilatory threshold (bpm)
   - VO_2max- maximal oxygen uptake (ml/kg/min)
   - VO_2vt- oxygen uptake at threshold (ml/kg/min)
   - VE*max*- maximal ventilation (L/min)
   - VE*vt*- ventilation at threshold (L/min)

- CO_2max- expired Co2 at maximum (%)
- CO_2vt – expired CO2 at threshold (%)
- RER*max*- the value of respiratory exchange ratio at max

After the protocol the percentages of maximal VO2, HR, CO2 and VE at the ventilatory threshold were calculated, as well as the changes in CO2 expired between threshold and maximum. The data were analyzed by methods of descriptive statistics, discriminant analysis and the k-means clustering was used to classify the subjects into predetermined number of clusters.

Results

The results of discriminant analysis of traditional groups confirmed that the traditional way of looking at the sports according to their energetic demands is reasonable because, in general, three groups of athletes really differed according to their ventilatory response and functional abilities during incremental exercise. The results showed that the groups differed significantly (Wilks Lambda=0.350, $p<0.001$). The variables that contributed the most to the discrimination of the groups were maximal oxygen uptake, oxygen uptake at ventilatory threshold, the percentage of maximal oxygen uptake at ventilatory threshold that were larger in aerobic athletes. RER*max* that was also a significant variable and it was lower in aerobic athletes as expected, as well as explosive strength. Basically, the discriminant analysis of the traditional clusters resulted in two significant discriminative functions that could be named *Aerobic capacity* and *Morphology function*, in regard to their correlation with variables representing those dimensions.

Even though the differences between groups existed when we compared the whole groups, the further cluster analysis, *k-means clustering*, that was performed by means of computer program confronted the previous findings in a way that it extracted the entities that were really different from other members of their group. The cluster analysis formed three new groups with 44, 24, and 34 subjects. The results showed that the number of the subjects in newly obtained groups was different from the number in our groups, which clearly pointed to the mixing of the subjects among the groups. The newly obtained clusters comprised athletes from all three traditional groups, meaning that there existed a significant number of athletes that showed different functional and motor abilities from other members of their traditional group (Figures 1-3).

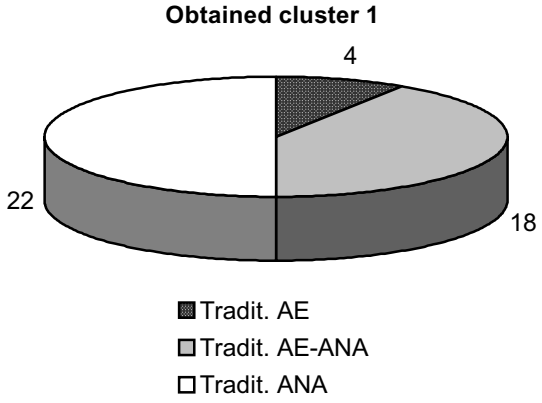

Figure 1: Obtained cluster 1 shows predominantly anaerobic character but encompasses also 4 athletes that were in traditional aerobic cluster, as well as 18 athletes coming from traditional aerobic-anaerobic cluster

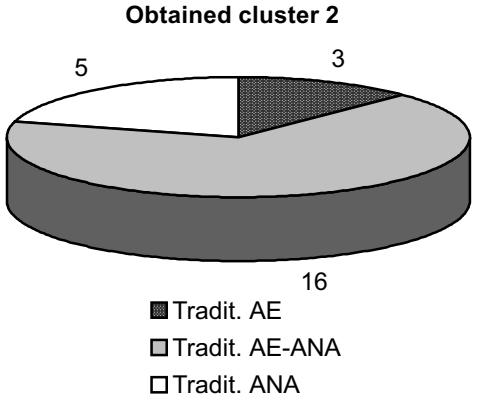

Figure 2: Obtained cluster 2 shows predominantly mixed character but encompasses 3 athletes that were in traditional aerobic cluster, as well as 5 athletes coming from traditional anaerobic cluster

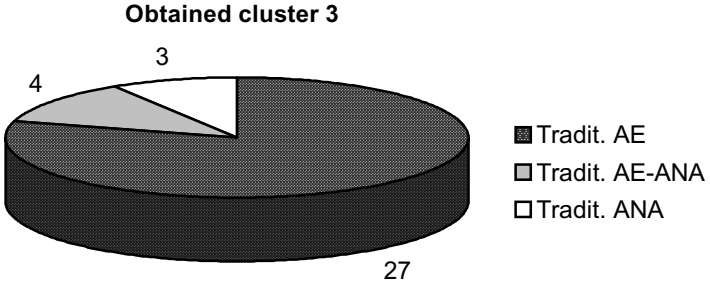

Figure 3: Obtained cluster 3 shows predominantly aerobic character but encompasses 4 athletes that were in traditional mixed cluster, as well as 3 athletes coming from traditional-anaerobic cluster

Discriminant analysis of the obtained cluster showed even grater differences among the groups (Wilks lambda=0.62, p=0.00 and Wilks lambda= 0.352, p=0.00) and the two discriminative functions that explained the variance was again *Aerobic capacity*, but the second function was in high correlation with variables representing heart rate response at anaerobic threshold and at maximum so it was named *Sympaticotonic heart rate response*, meaning that the newly obtained clusters differed better according to the heart rate response than according to the morphology as in traditional clusters.

Discussion

It is known that the success in sport is not only the result of cardiovascular and motor fitness and it is obvious that some genetic and psychomotor factors had a very important role in reaching the sports elite in some subjects. The results of discriminative analysis of the original clusters confirmed that the traditional way of looking at the sports according to their energetic demands is reasonable because, in general, three groups of athletes really differed according to their ventilatory response and functional abilities during incremental exercise. Even though this was true for the whole group, the further cluster analysis confronted the previous findings in a way that it extracted the entities that were really different from other members of their group. Their ventilatory response, explosive strength and aerobic capacity were not as it was expected for that type of sport but they were still achieving very good results. The most interesting findings were the results of a few aerobic athletes whose functional response was similar to the athletes in anaerobic group and whole aerobic capacity was much lower that expected even though they shortly after wan several international competitions. It was interesting that the years of aerobic training did not alter, in large extent, some of their cardio respiratory characteristic, which could be explained by heritage. Several studies (Bouchard et al., 1998; Rico Sanza et al. 2003; Bouchard et Perusse, 1994) suggested that ventilatory threshold might be influenced by genetics as well as maximal aerobic capacity.

In conclusion, the individual approach to each athlete should be applied whenever possible during planning and programming training process. The conclusions made strictly according to the results of cardio respiratory and motor testing should be avoided and considered potentially dangerous, because in some athletes they could underestimate their real potential. Individual differences originating from genetic and psychosocial factors should be considered before evaluating someone's testing results.

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POSITION-RELATED DIFFERENCES IN MORPHOLOGICAL CHARACTERISTICS OF CROATIAN TOP-LEVEL FEMALE HANDBALL PLAYERS

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Abstract

On the sample of 42 Croatian top-level female handball players, position-related morphological characteristics were determined by the analysis of variance. Twenty morphological measures were used for evaluating the morphological characteristics. Statistically significant differences, highly stressed in the longitudinal dimensionality of the skeleton and subcutaneous fat tissue, were determined. Present differences in morphological constitution suggest the differentiation and selecting of the players in terms of position-related specific kinesiological demands.

Key words: *handball, morphologic, characteristics, playing position, anthropometrics, differences*

Introduction

Morphologic anthropometrics is a method that comprises human body measuring along with processing and analyzing the obtained measurements. Successful athletes of particular sport have similar body dimensions and constitution. Similarities become more evident in higher levels of the competition, i.e. in top-level sport. The "sport type" is therefore easiest to be found in homogenous group of professional athletes of particular sport. While evaluating the anthropological dimensions, it should be borne in mind that they are the result of heritage and adapting to the influences of different factors, especially the factors of training and nutrition. It can be expected for the specifics of kinesiological structure and motor, biomechanical and energy demands required from athlete in particular sport to be reflected in specifics of athletes' body build in different sports.

Team players significantly differ in their anthropological characteristics due to the different tasks and demands of the game. With regard to this assumption, the aim of this research is to determine the differences in position-related anthropometrical characteristics of Croatian top-level female handball players. Information obtained may be of use to coaches while selecting young players according to their position-related morphological characteristics.

Research methods

The sample of entities was defined as a group of players who have played handball in The first Croatian handball league for at least two years. Research has been performed on the sample of 42 entities who could be characterized as Croatian top-level female players, according to the training level of handball techniques and playing experience. All entities are clinically healthy and without marked motor aberrations.

The sample of variables was comprised of 20 morphological measures, under the assumption that there are four latent dimensions: longitudinal dimension of the skeleton, transversal dimensionality of the skeleton, body weight and voluminosity, and subcutaneous fat tissue. Dimensions were measured following the procedures given by Mišigoj-Duraković, 1995.

Five measures were chosen for evaluating longitudinal dimensionality of the skeleton: body height, arm span, leg length, arm length, hand length. Fore measures were chosen for evaluating the transversal dimensionality of the skeleton: knee diameter, elbow diameter, wrist diameter, fist diameter. Five measures were chosen for evaluating the body weight and voluminosity: body weight, upper arm girth during relaxation, upper arm girth during contraction, rib cage breadth, lower leg girth. Fore measures were chosen for evaluating the subcutaneous fat tissue: upper arm skinfold, abdominal skinfold, back skinfold, lower leg skinfold.

Data processing methods

Basic descriptive parameters were calculated: arithmetic means (AS), standard deviations (SD), minimum (Min) and maximum (Max) value of the results registered. The normality of distribution was verified following the Kolmogor-Smirnov test; maximum differences between realistic and theoretical cumulative frequencies were calculated (MaxD).

Differences in anthropometrical characteristics of the players were computed by the multivariate and univariate analyses of variance. The data was processed by "Statistica 5.0" program.

Results and discussion

Basic descriptive parameters (table 1) show the normal distribution of all the variables and no extreme distribution of data, which is of great importance to the following statistical processing. It can be noticed that variables for the analysis of subcutaneous fat tissue are at the borderline of normal distribution, which is not unusual considering the fact that, in practice, the fat tissue is very hard to isolate from the muscle tissue.

Table 1. Basic statistic parameters

Variables	AS	SD	Min	Max	MaxD
VISTIJ	178,41	5,36	166,90	193,60	0,12
RASRUK	180,87	5,81	170,47	192,17	0,07
DUZSAK	18,02	1,09	16,33	20,70	0,11
DUZRUK	77,60	3,04	70,83	82,33	0,12
DUZNOG	100,32	4,35	90,37	109,43	0,06
TJETEZ	70,98	7,67	59,00	87,00	0,09
SIRRAM	38,53	2,48	29,60	42,67	0,10
SIRZDJ	29,46	2,38	25,20	38,47	0,12
DIJSAK	7,92	0,43	6,50	8,60	0,09
DIJRUZ	5,46	0,22	5,07	6,07	0,17
DIJLAK	6,68	0,45	5,67	7,50	0,05
DIJKOL	9,86	0,60	8,93	11,37	0,12
OPSNAD	27,96	1,97	23,97	33,03	0,08
OPNAFL	29,47	2,26	25,73	35,27	0,07
OPSGRK	89,10	3,53	82,50	96,33	0,08
OPSPOT	38,49	2,01	34,53	42,83	0,12
NABNAD	6,98	2,85	3,50	16,27	0,21
NABTRB	12,34	4,83	5,87	23,00	0,12
NABLED	10,67	2,90	6,53	18,53	0,20
NABPOT	5,39	2,68	3,00	14,20	0,22

Table 3. Univariate analyses of variance (ANOVA)

Variables	AS				F	p
	goalkeepers (n=12)	wings (n=10)	pivots (n=8)	backs (n=12)		
VISTIJ	178,86	174,12	178,90	181,21	4,00	**0,01**
RASRUK	181,54	176,64	179,24	184,81	5,02	**0,01**
DUZSAK	17,63	17,82	17,96	18,63	2,05	0,12
DUZRUK	77,77	75,44	78,07	78,92	2,86	**0,05**
DUZNOG	99,96	96,88	102,17	102,32	4,27	**0,01**
TJETEZ	72,86	69,47	71,25	70,17	0,40	0,75
SIRRAM	37,98	38,95	38,50	38,74	0,31	0,82
SIRZDJ	29,71	28,97	28,76	30,10	0,69	0,56
DIJSAK	7,68	7,88	7,99	8,13	2,67	0,06
DIJRUZ	5,36	5,40	5,48	5,59	2,74	0,06
DIJLAK	6,82	6,73	6,54	6,59	0,79	0,51
DIJKOL	9,91	9,92	9,84	9,78	0,13	0,94
OPSNAD	27,69	28,46	28,49	27,45	0,74	0,54
OPNAFL	29,22	30,28	29,81	28,83	0,85	0,47
OPSGRK	88,78	89,56	90,69	87,98	1,04	0,39
OPSPOT	38,28	38,07	39,93	38,07	1,84	0,16
NABNAD	7,67	6,38	8,20	5,99	1,39	0,26
NABTRB	15,41	12,10	11,42	10,08	2,98	**0,04**
NABLED	12,06	11,23	9,02	9,92	2,39	0,08
NABPOT	5,00	4,51	7,43	5,15	2,20	0,10

While observing the table 3, it can be globally concluded that position-related differences exist, which was expected considering the game-position task specifics.

Table 2. Multivariate analyses of variance (MANOVA)

Wilks' Lambda	Rao's R	df 1	df 2	p-level
0,01	2,77	60	57	0,00

While recapitulating the ANOVE (table 3) results, it is possible to determine the variables with position-related differences that can be the best explained by observing the arithmetical means. Statistically significant differences were determined in the most of the variables for evaluating the longitudinal dimensionality of the skeleton (VISTIJ, DUZRUK, DUZNOG, RASRUK) and in one of the variables of subcutaneous fat tissue (NABTRB).

The results of the arithmetical means make it obvious that backs, goalkeepers and pivots have the emphasized longitudinal dimensionality of the skeleton. It stands to reason that backs are, as a rule, the tallest, since their playing function is connected to efficient shooting at the goal over and trough the defensive wall. Their body height is also desirable for better visual control over the court. It is also desirable for a goalkeeper to have emphasized longitudinal dimension in order to cover larger goal area. Pivots also have greater voluminosity and strength because they must sustain constant contact with the defenders and fight for the favorable position. Wings differ from pivots in reduced voluminosity, i.e. they fall in the group of players with weaker body constitution. Reasons for this are game tasks demanding the wings to act on an attack within limited space and under favorable shooting and passing angle. Also, the basic characteristic of their play is dynamism and agility of moving with or without the ball that demands the lower level of general body gravity center along with the lower measures of longitudinal dimensionality of the skeleton.

Coaches regularly expect from the players to attain athletic body build with reduced fat tissue, since it causes negative effect in the success of the game regardless of the playing position. Fat tissue makes players move slowly, and it is known that explosive movements and fast reactions dominate in handball, such are the defense movements of the goalkeeper, rapid and explosive jumps of the backs or dynamism and agility of the wings. However, table 4 shows that that the difference between particular playing positions is also manifested in variables for subcutaneous fat tissue. This dimension is especially emphasized with the goalkeepers since, logically, their training process alone is profoundly individualized and different from that

of other players. While other players perform their tasks trough various forms of running and moving, the goalkeeper's trainings are not so demanding in terms of energy supply. The total straining of the players in the defense area is less than the straining of the players in the court, so this can be assumed to be one of the main reasons for the goalkeepers to have the stressed dimension of abdominal subcutaneous fat tissue. The fact that the wings come the second in this variable is a bit surprising, whereas there is an explanation for this condition when it comes to pivots. Namely, playing position requires pivots to be strong and robust, and therefore allows greater amount of fat tissue. Finally, wings have the least problems with the amount of fat tissue, probably due to the necessity of being as lighter as possible when jumping and performing other movement in demand for their playing position.

Therefore, it can be concluded that present differences in morphological constitution suggest the differentiation and selecting of the players in terms of position-related specific kinesiological demands.

Conclusion

This research was performed on the sample of 42 top-level Croatian female handball players. Twenty morphological measures were applied for the analysis of the morphological characteristics. Position-related differences in anthropometrical characteristics of the players were defined by the multivariate and univariate analyses of variance. Among players, the analysis of variance has shown the existence of position-related differences that are considerably manifested in the longitudinal dimensions of the skeleton and subcutaneous fat tissue. Such results were expected with regard to the variety of tasks the players have to execute. Finally, it can be concluded, under the condition that one is familiar with the range of evaluation by this method, that the anthropometrics of functional-diagnostic procedure of the athletes plays a part in the selection process and especially in the evaluation of the training process. Correspondence between genetic and non-genetic part of the variance of human characteristics and abilities is different for dissimilar abilities and characteristics. Thus, it follows the general rule: during lifetime, the influence on particular dimension will be smaller if the genotype part of the variance for the same dimension is bigger; and vice-versa. Therefore, this research also showed, as the majority of recent studies did, the importance of anthropological characteristics in handball and in other sports.

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RELATIONS BETWEEN SPEED OF ALTERNATIVE AND EXPLOSIVE MOVEMENTS, MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES WITH BOYS AGED 11-12

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Abstract

The system of 27 variables were applied on the sample of 109 pupils of elementary school 5th- form, of which 6 alternative and explosive movements (as criterion variables system), 9 morphological characteristics and 12 motor abilities (specific system of predictor variables). The purpose was to determine the relations between the systems of variables of alternative and explosive movements, morphological characteristics and motor abilities in order to establish rational procedures for the most possible optimal sports orientation and selection, planning and programming the training contents, as well as an efficient development of anthropological characteristics relevant to enhanced development of the speed of alternative and explosive movements with boys aged 11-12. The data were processed by canonic correlation analysis.

The results based on the calculated matrices of the structure of canonic factors pointed that there were statistically significant relations between integral canonic factors of the speed of alternative and explosive movements, integral canonic factor of growth and development and integral canonic factor of motor abilities. This means that the tested boys at this age possess the desirable integrity in the range of the tested anthropological characteristics, as well as that successful development of speed of alternative and explosive movements may be accounted for by 54% morphological characteristics and 75% motor abilities.

Key words: *relations, alternative and explosive movements, morphological characteristics, motor abilities, boys aged 11-12.*

Introduction

One of the problems of integral anthropological status of 11-12 years old children is the one implying the relation between speed of alternative and explosive movements, morphological characteristics, and other relevant motor abilities, not only because they have been poorly researched so far, but also owing to the fact that the man's speed and explosive strength are treated as one of the most important motor abilities without which any motion structure in sport is impossible (Malacko, 2002, Tokić & Prskalo, 1999).

Actually, we can hardly speak of a man's motion structure consisting of a single movement without being influenced by a powerful complex control mechanism of excitation intensity governing the variability of speed and explosive strength in motor zones of the central nervous system.

The scientific and professional literature point to the existence of several speed factors, which are most often defined in terms of the man's ability to perform high-frequency movements in shortest possible time, or to perform a single movement as fast as possible under the given conditions, as well as the explosive strength most often defined as the ability to develop maximum energy in a single movement in the shortest possible time (Kurelić, Momirović, Stojanović, Šturm, Radojević & Viskić-Štalec, 1975).

While in one motion situation, certain type of body composition obstructs directly the realization of a kinetic program, this same body composition may be highly favorable for another motor situation. Consequently, the resulting problem is to discover the most optimum relations between speed of alternative and explosive movements, morphological characteristics and other relevant motor abilities so as to maintain the optimum anthropological integrity as a final goal of physical education in elementary school (Findak, 1999, Pejčić, 2002).

In accordance with the above, the purpose of this research was to determine the relations between the speed variables of alternative and explosive movements, morphological variables and motor variables, in order to establish rational procedures for the most optimum sports orientation and selection, planning and programming training contents, as well as the efficient development of anthropological abilities relevant to the development of alternative and explosive movements of 11-12 years old boys.

Methods

The sample of 109 elementary-school pupils was subjected to testing of 27 variables, of which 6 belonged to alternative and explosive movements (system of criterion variables), 9 variables accounted for morphological characteristics and 12 were motor abilities (separate system of predictor variables).

For evaluation of alternative and explosive movements (system of criterion variables), the following system of criterion variables was applied: 1. plate tapping, 2. one foot tapping, 3. two feet tapping, 4. standing broad jump, 5. medicine ball put - lying, 6. 20 m dash from high start.

Within the scope of morphological variables, the following system of predictor variables was applied: 1. body height, 2. shoulder width, 3. iliocristal width, 4. body weight, 5. upper arm circumference, 6. thigh circumference, 7. triceps skinfold, 8. subscapular skinfold, 9. abdominal skinfold.

Within the scope of motor variables, the following system of predictor variables was applied: 1. dragging and jumping over, 2. agility in the air, 3. obstacle course backwards, 4. sit-ups, 5. reverse sit-ups, 6. pull-ups with undergrip on horizontal bars, 7. toe touching standing, 8. toe touching - sitting straddle, 9. dislocation backwards with bat, 10. slalom with three balls, 11. slalom with legs kicking two balls, 12. hand dribble.

Canonic correlation analysis was applied to determine relations between two different multidimensional anthropological systems of manifest variables, where the system of speed variables of alternative and explosive movements represented the system of criterion variables and the systems of morphological and motor variables served the purpose of predictor variables.

Assuming the two applied multidimensional anthropological systems of variables were linearly connected, the first step was calculation of the relation between criterion and predictor variables using a cross-correlation matrix, followed by solving the characteristic equations which resulted in roots (λ). Bartlett's χ^2test, was applied for testing statistic significance of the coefficient of canonic correlation (Rc), which explained linear combinations between arrays of variables, and for calculation of squares of canonic correlation (Rc^2) which explained the mutual variance of variables from two different arrays.

Results

The analysis of the matrix of cross-correlation between the system of criterion speed variables of alternative and explosive movements and predictor system of morphological variables (Table 1) points to a relatively high and statistically significant correlations of pairs of variables (marked with *) with the 20 m dash variables from high start, standing broad jump and one foot tapping.

Table 1: Cross correlations between criterion system of speed variables of alternative and explosive movements and predictor system of morphological variables

Variables	1	2	3	4	5	6
1	.01	-.10	-.14	-.16	.15	.36*
2	-.02	-.11	-.06	-.15	.18	.41*
3	-.09	-.23*	-.16	-.36*	.10	.52*
4	-.10	-.26*	-.23*	-.43*	.03	.63*
5	-.05	-.19*	-.15	-.37*	.04	.56*
6	.02	-.19*	-.16	-.37*	.04	.61*
7	-.15	-.32*	-.16	-.46*	.01	.61*
8	-.14	-.29*	-.17	-.45*	.04	.55*
9	-.16	-.33*	-.23*	-.49*	-.02	.58*

Table 2: Structure of canonic factor of alternative and explosive movements

1	.17
2	.45*
3	.30*
4	.72*
5	.04
6	-.91*

Table 3: Structure of canonic factor of speed of morphological characteristics

1	-.48*
2	-.55*
3	-.77*
4	-.89*
5	-.80*
6	-.86*
7	-.91*
8	-.83*
9	-.86*

The highest and the only characteristic squares was that of the first canonic factor (λ = .25). Bartlett's Hi-square test (χ^2=135.53) at the level of p=.00 was also applied for testing statistic significance of the coefficient of the canonic correlation (Rc = .73), as well as their mutual variance (Rc^2 = .54).

The results in the matrix of factor structure of speed of alternative and explosive movements (Table 2) and the predictor system of morphological characteristics (Table 3) indicate statistically significant correlation between the applied manifest variables and the canonic factors (except for the variables of plate tapping and medicine ball put - lying).

Canonic factor in the field of criterion variables (Table 2) may be interpreted as integral canonic factor of speed of alternative and explosive movements, whereas in the morphological field (Table 3) it may be interpreted as integral canonic factor of growth and development.

The analysis of cross-correlation between criterion system of speed variables of alternative and explosive movements and the predictor system of motor variables (Table 4) also points to the statistically significant correlation of pairs of the most applied variables of the two anthropological fields, except for the medicine ball put - lying, showing the statistically significant correlations with variables of strength.

Table 4: Cross-correlation between criterion system of speed variables of alternative and explosive movements and the predictor system of motor variables

Variables	1	2	3	4	5	6
1	-.31*	-.39*	-.44*	-.58*	-.05	.64*
2	-.05	-.09	-.19*	-.29*	.26*	.24*
3	-.32*	-.42*	-.46*	-.62*	-.14	.60*
4	.31*	.40*	.48*	.66*	.35*	-.53*
5	.41*	.43*	.49*	.63*	37*	-.62*
6	.31*	.41*	.42*	.64*	.49*	-.56*
7	.17	.28*	.34*	.34*	.14	-.37*
8	.17	.18	.32*	.25*	.05	-.30*
9	-.28*	-.23*	-.21*	-.28*	-.00	.32*
10	-.43*	-.45*	-.38*	-.46*	-.16	.39*
11	-.28*	-.25*	-.32*	-.40*	-.08	.55*
12	-.15	-.27*	-.38*	-.47*	-.15	.53*

Determination of statistically significant relations by means of Bartlett's Hi-square test (χ^2=232.79) between criterion system of speed variables of alternative and explosive movements and the predictor system of motor variables resulted in canonic correlation of .86 (Rc=.86) which is statistically significant at the level of .00 (p=.00), while the mutual variance was .75. The highest eigenvalue was that of the first canonic factor (λ=0.9).

Within the field of criterion variables, the isolated canonic factor can be interpreted as the factor of speed of alternative and explosive movements in the field of criterion variables (Table 5), or the integral canonic factor of motor abilities in the motor field (Table 6).

Table 5: Structure of canonic factors of speed alternative and explosive movement

1	.17
2	.45*
3	.30*
4	.72*
5	.04
6	-.91*

Table 6: Structure of canonic factor of motor abilities

1	-.77*
2	-.39*
3	-.79*
4	.82*
5	.86*
6	.84*
7	.48*
8	.38*
9	-.38*
10	-.56*
11	-.61*
12	-.66*

Discussion

While interpreting the canonic correlation analysis, the common rule was applied, i.e. linear increase of the resulting vector of canonic factor variable in the first anthropological field corresponds to the proportional linear increase of the resulting vector of variables from the second anthropological field and conversely, provided there is a statistically significant correlation between the two tested systems of variables in different fields.

This particularly means that based on the pairs of canonic factors and on the determined relations with morphological characteristics, the boys achieve good results in speed of alternative and explosive movements if they have lower body sizes, weight and voluminosity. On the basis of the determined relations with motor abilities, the boys achieve good results in speed of alternative and explosive movements if they have higher values in coordination of body, arms and legs, repetitive strength of the trunk, as well as the flexibility of shoulder girth and back thigh.

When dealing with sports and sports events in which the speed of alternative and explosive movements is predominant, the research finds that the development of these characteristics and skills should be simultaneous with the development of other anthropological abilities being in correlation with the speed of alternative and explosive movements. Conversely, when dealing with sports and sports events in which other motor abilities are predominant, developing speed of alternative and explosive movements should come first, owing to the reason that the speed of alternative and explosive movements is one of the most important motor abilities without which performing any other motion structure is almost impossible.

The obtained results indicated rather high and statistically significant relations between speed factors of alternative and explosive movements (system of criterion variables), the integral canonic factor of motor abilities and integral canonic factor of growth and development (as individual systems of predictor variables).

In the present research this means that, on the basis of the determined relations with morphological characteristics, the boys achieve good results in the speed and explosive movements if they have lower body sizes, weight and voluminosity. Based on the determined relations with the motor abilities, the boys achieve good results in the speed of alternative and explosive movements if they have higher values of the coordination of the body, arms, legs, repetitive strength of the trunk, arms and shoulder girth, as well as the flexibility of the shoulder girth and the back of the thigh.

The results of this research can satisfactorily be applied in the particular sports practice, especially when dealing with the establishing rational procedures for sports orientation and selection, planning and programming the training contents, development of the relevant motor abilities, as well as their monitoring and control, especially in sports in which the speed of alternative and explosive movements is predominant.

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MINERAL STATUS DURING A COMPETITION MATCHES IN TOP LEVEL JUNIOR MALE BASKETBALL PLAYERS

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Abstract

Minerals are categorized as macrominerals or microminerals (trace minerals) based upon the extent of their occurrence in the body (Hunt and Groff, 1990). During exercise, the sweat can be lost water and electrolytes (Terrados and Maughan, 1995), moreover depending on the climatic conditions and the intensity of the match, sweat losses among individual players can range from less than 1 L (~1 qt) to as much as 4 L (4.2 qt), and various studies have reported that on average, players replace anywhere from 0% to 87% of that sweat loss during the match (Burke, 1997; Maughan et al. 2004). Therefore the aim of this investigation was to examine the mineral status (CL+ (Chloride); NA+ (Sodium), K+ (Potassium)) during the official competition in international basketball players.

The statistical analysis used to compare the results obtained during the three blood sample was a repeated-measures analysis of variance and the Pearson Coefficient Correlation (r) to study the relationship between the minerals and the playing time. The level of significance was set at 0.05.

Our results demostrated a decreased significantly ($p<0.05$), between (K+) PRE values and (K+) POST values during the matches. Even then potassium replacement alone should be considered post exercise in basketball.

Key words: *Minerals; Basketball; Performance, Competition.*

Introduction

Minerals are categorized as macrominerals or microminerals (trace minerals) based upon the extent of their occurrence in the body (Hunt and Groff, 1990). A synthesis of NA+, K+, ATPase is necessary for maintaining an adequate function of the NA+, K+ -pump (Viru, 1995). On the other hand, the CA+ is required for hard bones, transmission of nerve impulses, activities certain enzymes and necessary for maintenance of membrane potential and muscle contraction (Hunt and Groff, 1990., Marieb, 1989). In certain cases exercise, during the basketball matches could contribute to the deficiency (Gibson y Edwards, 1992).

During exercise, the sweat can be lost water and electrolytes (Terrados and Maughan, 1995), moreover depending on the climatic conditions and the intensity of the match, sweat losses among individual players can range from less than 1 L (~1 qt) to as much as 4 L (4.2 qt), and various studies have reported that on average, players replace anywhere from 0% to 87% of that sweat loss during the match (Burke, 1997; Maughan et al. 2004). Therefore the aim of this investigation was to examine the mineral status (CL+(Chloride); NA+ (Sodium), K+ (Potassium)) during the official competition with the playing time in a selective group of international junior players.

Methods

Subjects. Nine international junior players were selected to participate in this investigation. Before giving their written consent to participate, subjects received verbal information about this study, procedures and potential risks. All experimental procedures were approved by the ethics Committee of the University of Basque Country. Their mean (±SD) age, height and weight were 16.0 ± 0 years, 197.59 ± 5 cm and 91 ± 67 kg, respectively (Table 1).

Blood sampling. During two competition official matches on winter season, blood sampling in the mid-season before (PRE), after (POST) and 48 hours after finishing the matches (48 POST) took under the same experimental conditions. Blood samples were drawn from the ear after the subjects had rested for 10 minutes in a seated position. Tubes were taken to the laboratory in the Centro de Perfeccionamiento Técnico (Fadura-Getxo) for hematological analysis immediately after completion of blood sampling.

Table 1. Mean (±SD): Age, height and weight.

N=9	Mean	SD
Age (Years)	16.0	0
Height (cm)	197.59	5
Weight (Kg)	91	67

Hematological Analysis. Blood samples were collected in EDTA tubes for analysis. The serum (NA+; K+; CA+) concentration was measured by potenciometry method (Sportchem- SE-1510 ®. Sevilla, España)

Statistical Analysis. All the values are expressed as mean± Standard Deviation (SD). The statistical analysis used to compare the results obtained during the three blood sample was a repeated-measures analysis of variance. The level of significance was set at 0.05.

Results

General Results. The (K+) decreased significantly ($p< 0.05$), between PRE values (5.69 ±0.67) and POST values (5.66 ±0.90) (Figure 1). In contrast, there was not significant difference between the PRE values and the POST 48 values. There were no significant differences in (CL+) and (NA+) between PRE values and POST values.

Table 2. The mean (±SD). NA (Meq/l); K (Meq/l) CL (Meq/l). Significant difference compared PRE and POST (k+). P <0.05.

				P	P	P
	PRE	POST	48 POST	PRE vs POST	PRE vs 48 POST	POST vs 48 POST
NA (Meq/l)	141.50±3.9	140.83±3.06	144.83±5.4	NS	NS	NS
K (Meq/l)	5.69±0.67	5.66±0.90	5.69±1.1	P<0.05	NS	NS
CL (Meq/l)	102.83±3.4	103.50±1.9	101.83±3.37	NS	NS	NS

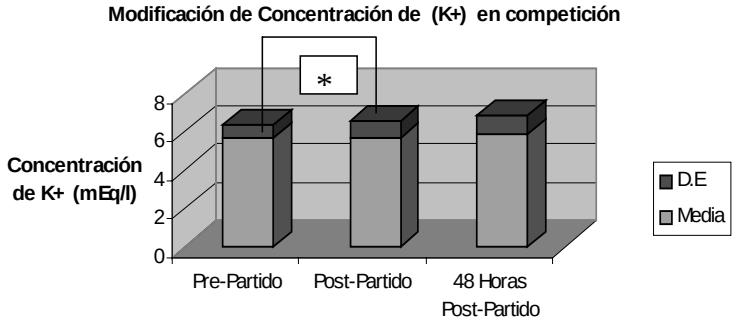

Figure 1. (K+) PRE vs (K+) POST ($p< 0.05$) , values during a basketball matches.*

Discussion

From the results of our study, we observed a decreased significantly ($p< 0.05$), between (K+) PRE values and (K+) POST values. These data, in contrast with other investigations (Cuzzolin and col. 1992), that did not find significant differences between the PRE test values vs POST values in basketball players. Also, Gibson and Edwards (1992), asseverate that one of the limiting factor of the performance during competition is the (K+) accumulation in extracellular area. On the other hand, the (K+) diminution can be decrease the muscle activity (Maughan and col. 1994). Then, the potassium could be a specific mineral in the rehydration process during a season in basketball

In our research group opinion, we think that it`s necessary to evaluate more investigations about this phenomenon in basketball with other trace minerals.

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DIFFERENCES IN BLOOD LACTATE CONCENTRATION AFTER SIMULATING ALPINE SKIING SLALOM AND GIANT SLALOM RACES

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Abstract

The objective of this study is to establish whether there are any differences in concentration of lactate in blood after simulated slalom and giant slalom races in top athletes of the Croatian B alpine skiing national team. The sample comprised five top alpine skiers from the Croatian "B" alpine skiing national team, aged 16 to 17. The measurement covered the following variables: concentration of lactate in blood after the first and the second legs of slalom and giant slalom races (mmol/l), heart frequency (HF) and rate of perceived exertion (RPE). The obtained results lead to the conclusion that there were statistically significant differences in lactate concentration between the slalom and giant slalom simulated races in first as well as in second leg. In addition, according to the measured lactate values and the rating of perceived exertion, slalom represented a greater physical load for an athlete's organism than giant slalom. We concluded that the heart rate was not a reliable indicator of physical load in skiers due to great individual differences, which most likely arise from differently stimulated vegetative systems. In the future, such research should be conducted on a larger sample of examinees, which requires more funding and organization due to execution of field measurements

Key words: *alpine skiing, physical load, blood lactate*

Introduction

Alpine skiing as a sport implies great physical and mental efforts for the athlete, requiring of them extreme agility, coordination, strength and stamina, because the winner in top competitive skiing today is decided by a mere hundredth of a second. Alpine skiing is an aerobic/anaerobic sport, and the energetic mechanisms participating in energetic processes during training and competitions have not been subjects of research frequently. In daily training, good understanding of energy mechanisms is assuming an increasingly important role, and the data about differences in concentration of lactate in blood after simulated slalom and giant slalom races on the same course do not exist in literature. Within the research conducted so far on alpine skiers, values of lactate concentration of 9 to 13 mmol/L in blood were measured after alpine skiing slalom and/or giant slalom races (Andersen, R.E., Montgomery, D.L., 1988).

The objective of this study is to establish whether there are any differences in concentration of lactate in blood after simulated slalom and giant slalom races in top athletes of the Croatian B alpine skiing national team.

Methods

The measurement was carried out by experienced measurers from the Sports Diagnostics Center with the Faculty of Kinesiology Zagreb.

Subjects: The sample comprised five top alpine skiers from the Croatian "B" alpine skiing national team, aged 16 to 17. The measurement covered the following variables: concentration of lactate in blood after the first and the second legs of slalom and giant slalom races (mmol/l), heart frequency (HF) and rate of perceived exertion (RPE). All examinees had been acquainted with the work and measurement program in detail.

Measuring procedure: Simulated slalom and giant slalom alpine skiing races were carried out in the identical manner as real races. The athletes were not allowed to undertake and any training activities with maximum intensity at least 24 hours prior to the testing. The examinees analyzed the course in order to avoid the effect of the informative component on the final result. The races had to be taken properly in terms of technique and in accordance with the skiing rules in order to fully simulate the conditions of real racing. In this research, the blood sample was taken in a closed room where the athletes arrived after finishing the simulated race. The blood lactate concentration was determined after the first and the third minute. The maximum obtained value of the two measurements was taken as the result. If we established that concentration of lactate in blood was growing in athletes after the third minute as well, the measurement was repeated after the fifth minute upon the race.

Heart rate monitors were mounted on the athletes' chests before the beginning of the races, recording the heart rate value during the races.

The rating of perceived exertion was assessed by means of Borg's scale for assessment of perceived exertion in athletes, which pertains to a test where increase or decrease of activities simultaneously causes changes on the scale that the athletes express as perception of higher or lower exertion. The modified scale includes values 1 through 10, where number 1 represents very, very light and number 10 very, very heavy exertion for the athlete.

Measuring equipment: Lactate in blood was measured by a blood lactate test meter *Lactate pro*, made by the Japanese manufacturer Arkray. Heart frequency was measured by a Polar type heart frequency monitor, batch S710i, made by the Finnish manufacturer Polar Elektro.

Statistical data processing: Since the testing included an examinee sample comprising only five top skiers from the Croatian B alpine skiing national team, the t-method (test for dependent samples) was applied for analysis of the results obtained. The smaller the sample, which is the case here, the higher the t – ratio should be in order to be able to consider the difference between simulated slalom and giant slalom races statistically significant; *t* should be at least 2.78 if we want to prove that the difference is statistically significant at the level of 5 % ($p<0.05$), (Petz, 1997).

Results

Each table contains the results obtained by measuring lactate after slalom and giant slalom (LAsl i LAgs in mmol/L), the difference between them (Δ LAgs-LAsl), heart frequency (HF), rating of perceived exertion (RPE) and the result achieved in the simulated slalom and giant slalom races TimeSL (s) i Time GS (s).

Table 1. The values of blood lactate concentration after the first legs of slalom and giant slalom races.

Subject	LAsl-1	LAgs-1	Δ LAgs - LAsl	HF sl-1	HF gs-1	RPE sl-1	RPE gs-1	Time SL(s)	Time GS(s)
T.Š.	8.1	7.6	-0.5	164	154	9	8	61.01	50.92
D.M.	7.6	7.0	-0.6	175	168	7	8	60.10	49.53
N.Z.D.	9.9	6.4	-3.5	179	153	9	8	57.50	48.71
I.O	8.7	5.9	-2.8	190	180	9	8	59.71	51.30
I.R.	10.7	6.4	-4.3	180	159	9	8	59.48	48.50

The measurement results obtained show that the measured lactate values after the first leg of the slalom race are significantly higher than those measured after the first leg of the giant slalom race. The difference between the arithmetic means is 2,34 mmol/L, which indicates a very stable difference in lactate concentration between the simulated first legs of slalom and giant slalom.

By calculating Student's *t-test* for dependent samples, we obtained a value of t = *3,05.* The number of degrees of freedom is (N – 1). The student's t-test produced the borderline value of $t = 2.78$ for 4 degrees of freedom, with a significance level of 5%. As the *t* obtained is higher, we can see that the difference is statistically significant, and thus the results obtained lead to the conclusion that there are statistically significant differences in lactate concentration between the first legs of slalom and giant slalom simulated races.

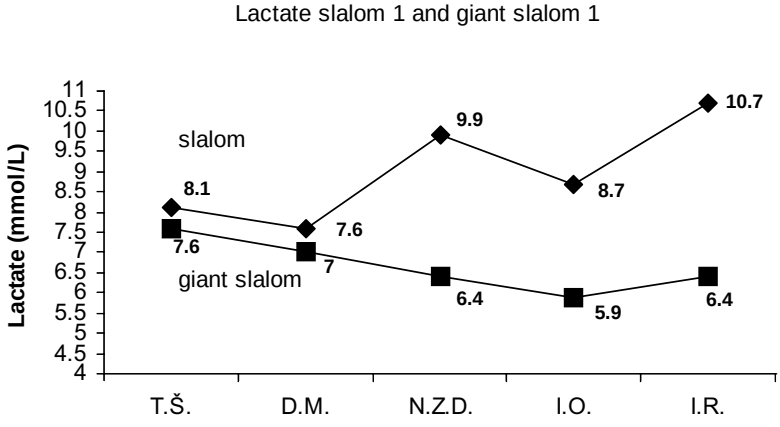

Figure 1. Blood lactate (mmol/L) values for the first legs of slalom and giant slalom races

The measurement results obtained show that the measured lactate values after the second leg of the slalom race are significantly higher than those measured after the second leg of the giant slalom race. The difference between the arithmetic means is 2,30 mmol/L, which indicates a stable difference in lactate concentration between the simulated second legs of

slalom and giant slalom. By calculating student's *t-test* for dependent samples, we obtained a value of t = *2,98.* The number of degrees of freedom is (N – 1). The student's t-test produced the borderline value of *t* = 2.78 for 4 degrees of freedom, with a significance level of 5%. As the *t* obtained is higher, we can see that the difference is statistically significant, and thus the results obtained lead to the conclusion that there are statistically significant differences in lactate concentration between the second legs of slalom and giant slalom simulated races.

Table 2. The values of blood lactate concentration values measured after the second legs of slalom and giant slalom races

Subject	LAsl-2	LAgs-2	ΔLAgs – LAsl	HF sl-2	HF gs-2	SLP sl-2	SLP gs-2	Time SL(s)	Time GSv(s)
T.Š.	6.6	5.9	-0.7	168	157	9	9	61.14	48.50
D.M.	8.0	6.2	-1.8	173	164	9	8	62.24	49.08
N.Z.D.	10.9	5.7	-5.2	177	155	9	8	58.31	49.04
I.O	7.7	6.2	-1.5	190	171	9	8	60.44	46.67
I.R.	8.4	6.1	-2.3	171	162	9	8	62.40	50.17

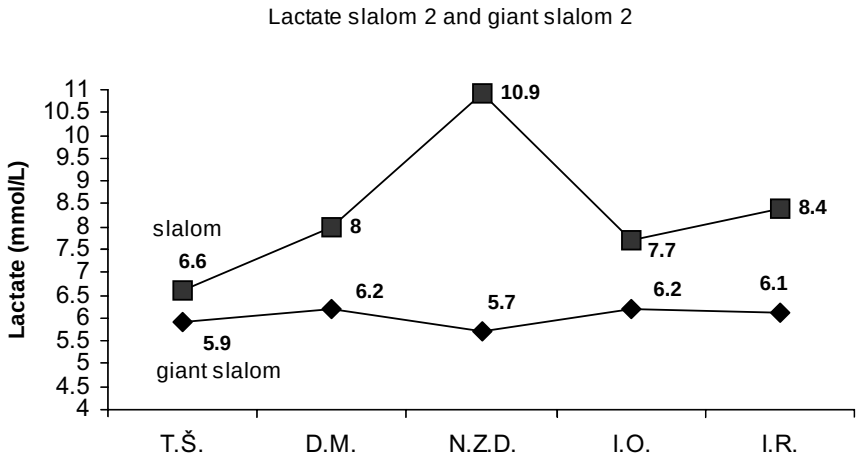

Figure 2. Blood lactate (mmol/L) values for the second legs of slalom and giant slalom races

Discussion

Considering the small number of examinees in this research, it is not possible to make any conclusions that would apply to the entire alpine skier population. However, some occurrences have been noted that could be explained by the technical and physiological requirements of the sport.

1. According to the measured lactate values and the rating of perceived exertion, slalom represents a greater physical load for an athlete's organism than giant slalom.
2. Heart rate is not a reliable indicator of physical load in skiers due to great individual differences, which most likely arise from differently stimulated vegetative systems.

Biologically immature athletes rarely exceed 10 mmol/L concentration in blood, and the reason for this is a relatively low level of phosphofrucotkinase, which acts as an agent in anaerobic degradation of glucose, and creation of pyruvic acid is lower due to the weaker link in the chemical reaction chain. This parameter should also be taken into account when measuring concentration of lactate in younger athletes.

In the future, such research should be conducted on a larger sample of examinees, which requires more funding and organization due to execution of field measurements. Only then, could the proposed conclusions be confirmed.

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THE INFLUENCE OF THE EXPLOSIVE AND ABSOLUTE POWER OF LEGS AS WELL AS AEROBIC POWER ON THE WINGATE TEST RESULTS IN BASKETBALL PLAYERS AT THE AGE OF 15-18 YEARS

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Abstract

The sample of 29 basketball players at the age 15-18 years (15,83±1,14 years; 188,07±7.81 cm; 74,52±11,22 kg) have performed: Wingate test, motoric test baterry (high jump, long jump, 20 metres sprint and leg press on isokinetics dinamometre) and maximal oxygen consumption have been established using direct method (K4b^2 COSMED S.r.l.Italy). With factor analysis of three motoric tests there have been isolated the first latent dimension – leg power. The aim of the study is to estimate the leg power, absolute power and aerobic power influence on Wingate test results. The study results show that predictors significantly forsees both relative peak power and relative mean power (the determination coefficient is .31 and .28 respectively). In the predictors system leg strength has the greatest individual influence.

Key words: *Wingate, anaerobic power, VO $_{2max}$, basketball*

Introduction

From the aspect of the functional status basketball requires well developed aerobic and anaerobic capacities. Aerobic capacities are mostly related to the recovery in short intervals of rest or low- intensity activity and influence the maintenance of the high intensity of play throughout the game (McInnes et all 1995). However, anaerobic capacities represent dominant energy source in all activities that influence the results, such as jump, shoot, counter-attack, pressing, passing (Stone, and Steingard 1993). The estimation of functional capacities level is a significant segment of training technology, both from the aspect of selection and the aspect of training groups homogenizing and training load determining. However, unlike the tests for aerobic status evaluation, the tests for anaerobic capacity evaluation are not well defined.

First, there is an agreement that most anaerobic tests correlate in the results of motivated subjets but not in what is measured by the tests (Inbar, 1996).Second, there is no criteria of what ought to be measured and how. Third, it is hard to determine participation of aerobic mechanisms for the ATP resynthesis in the tests that last longer than a few seconds. Nowadays most frequently used test for anaerobic capacity evaluation is Wingate test, designed in 1974 at the Wingate Institute in Israel.

As the test results two parametres are most frequently used: the peak power (maximum reached power) and the mean power (expressed in absolute or relative values) meant to represent anaerobic power and anaerobic capacity. In order to define the Wingate test parametres better, a large number of researches has been carried out and they included estimating connection with "anaerobic" motoric tests (strength, explosive power, movement frequency tests). Recent researches have shown the fact that the correlation coefficient is mostly above 0.70. The strongest correlation is found to be with the speed of running 20, 40 and 50 meters (Bar-On, and Inbar, 1978, Tarp et all., 1985, Kaczkowski et all., 1982). Therefore, the connection of Wingate test parametres and motoric »anaerobic« tests is very high but insufficient for the results of the Wingate test to forsee the result in specific motoric tests. In adittion, under conditions of heavy muscular work aerobic metabolism may account for substantial portion of the energetic requirements in test of as little as 30 second duration (as much as 40% Hill, and Smith, 1989). The aim of the study is to estimate the influence of the explosive and absolute power of legs as well as aerobic power on the Wingate test results.

Methods

The study has been carried out on the sample of 29 basketball players at the age 15-18 years (15,83±1,14 years; 188,07±7.81 cm; 74,52±11,22 kg). All athletes or their parents signed an informed consent form. The testing of maximal oxygen uptake and motor abilities (SLJ, VJ, 20m) was conducted in "Lukovski" basketball center in Novi Sad. VO_{2max} testing was performed using direct method with K4b^2 (COSMED S.r.l.Italy). Each motoric test has been carried out three times,after the proper warm-up, and as a result the highest value has been taken. . Not less than 1 and no more than 7 days passed between the testing of motoric ability and aerobic power. For assesment of the maximal oxygen consumption the Shuttle-run test was used, satisfying test criteria for VO $_{2max}$ assessment (it lasts 8-12 minutes) and gives the highest values of oxygen consumption in three performed tests for estimating maximal aerobic power (Stojanovic, and Ilic, unpublished

data).All subjects performed test at the same time of day. Before testing each subject, calibration of apparatures has been performed by the instruction of the manufacturer.

The anaerobic capacity testing (air-braked bicycle ergometre) and maximal leg strength (isokintetics dinamometre Weba Sport Dyno 2000) have been carried out in the Laboratory for functional diagnostics at the Medical Faculty of the University of Novi Sad. Warm-up before Wingate test was performed folowing instruction of author(Inbar 1996).The day before testing the subjects were not doing any intensive bout.

Variables

- Wingate relative peak power WPPREL
- Wingate mean power WMPREL
- Maximal O_2 uptake $V0_2REL$
- Standing long jump SLJ
- Vertical jump VJ
- 20m peed s 20m
- Leg Strength ASL

Results

Table 1 shows eigenvalues and explains variance of latent structure of three motoric tests(vj,slj and 20m). As we can see, only the first latent dimension is significant, that is, has eigenvalue higher than 1 and explains 75% of the total variability. On the basis of used motoric test analysis, we can define the first main component as the explosive strength of legs. The component matrix (Table 2) shows that standing long jump best represents the latent dimension.

Table 1. Eigenvalues and variance of latent structure explanation of three motoric tests

Total Variance Explained Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**2,253**	**75,091**	**75,091**	**2,253**	**75,091**	**75,091**
2	,496	16,519	91,610			
3	,252	8,390	100,000			

Extraction Method: Principal Component Analysis.

Table 2. The component matrix of factor analysis structure in three motoric tests

	Component
	1
SLJ	**,908**
VJ	,880
20 m	-,809

Table 3 includes regression analysis results of predictive variables system and their influence on relative maximal power given in the Wingate test. The predictive variable system consisted of absolute leg strength, explosive power of legs (the first main component of factor analysis in three motoric tests) and relative maximal oxygen consumption measured directly in the shuttle-run test. The multiple correlation coefficient shows that the system of predictors correlates with the criteria .55. The determination coefficient is .31 and is significant at the significance level .05. While analyzing Table 4 one can conclude that in the system of predictors the absolute leg strength has individually greatest influence on the criteria (statistically significant on the level .05). Next strong variable is maximal oxygen consumption variable, and the explosive power is a step behind, with the notion that none of them is statistically important. The fact that latent ability of explosive power has no greater influence on the relative maximal power in the Wingate test is surprising. We ought to look for the explanation in duration of the motoric tests which estimate the explosive power. Namely, the tests estimate the ability to perform power in the least possible time, while in the Wingate test it takes between 5 and 10 seconds for reaching maximal power. On the other hand, the test for estimating absolute leg power is performed on isokinetics dinamometre, on which each attempt lasts much longer than 1 second.

Table 3. Multipla correlation, determination coefficient and predictor significance level on the relative peak power of the Wingate test

R	R Square	Adjusted R Square	Std. Error of the Estimat	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Chang
,557[a]	**,310**	,227	1.2256	,310	3,744	3	25	**,024**

Predictors: (Constant), relative VO_2max, leg power, leg strength.

Table 4. Individual influence of predictors on a criterion in the predictive variables system and the significance level

	Unstandardized Coefficients		Stand. Coeff.	t	Sig.
	B	Std. Error	Beta		
(Constant)	2,886	2,722		1,061	,299
Leg strength	1,845	,008	,448	2,188	**,038**
Leg power	,130	,285	,093	,456	,652
VO_2max	6,427	,042	,254	1,524	,140

Dependent Variable: Wingate - RELATIVE PEAK POWER (peak/kg)

Table 5 consists of the regressive analysis of the predictive variables system and its influence on relative medium power obtained in the Wingate test. In the table we can see that predictor system forsees criterion with 28% (statistically significant on the significance level). The fact that none of the predictors do not statistically significantly influence the criterion (Table 6) is very interesting. However this criterion is mostly influenced by absolute leg power, the maximal oxygen consumption, and at last by explosive leg power! We can also notice that maximal oxygen consumption influence the medium power more than maximal power, although the difference is small. The medium power, according to the very author of the test, (Bar-Or, & Inbar, 1996) reflects local endurance of leg muscles (their ability to sustain extremely high-power). It seems that maximal oxygen consumption has no significant influence on the results in the conditions of maximum engaged muscles in duration of 30 seconds.

Table 5. Multiple correlation, the determination coefficient and the significance predictor level and their influence on relative mean power obtained in the Wingate test

R	R Square	Adjusted R Square	Std. Error of the Estimat	Change Statistics				
				R Square Change	F Change	df1	df2	Sig. F Chang
,532[a]	**,283**	,197	.8198	,283	3,284	3	25	**,037**

Predictors: (Constant), relative VO_2max, leg power, leg strength.

Table 6. Individual predictor influence on the criterion in the predictive variables system and the significance level

	Unstandardized Coefficients		Stand. Coeff.	t	Sig.
	B	Std. Error	Beta		
(Constant)	2,540	1,820		1,395	,175
Leg strength	9,119	,006	,338	1,617	,118
Leg power	,171	,191	,187	,898	,378
VO_2max	4,379	,028	,264	1,553	,133

Dependent Variable: Wingate - RELATIVE MEAN POWER (mean power/kg)

The results of the study showed that the predictive variables system statistically significantly influences both parametres of the Wingate test. The predictive system has greater influence on relative peak power than on relative mean power. In the predictive variables system, the gratest influence has absolute leg power, then maximal oxygen consumption and explosive leg power with the fact that only the influence of the absolute leg power on relative peak power is statistically significant at the .05 of the significance level.Only a small portion of the Wingate test results are explained with motoric tests for the anaerobic power evaluation and the test for aerobic power evaluation.

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POSITIONAL AND AGE-RELATED DIFFERENCES IN MOTORIC TESTS AMONG CROATIAN NATIONAL FOOTBALL TEAM MEMBERS

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Abstract

The objective of this paper was to establish positional and age-related differences in motoric tests among Croatian national football team members (U-15, U-17 and U-19). The central and descriptive parameters of variables for assessment of the sprint-type explosive force, agility and movement frequency speed based on age, represent the modal values of Croatian football players. This paper establishes the differences among strikers, central defenders, wingers and midfielders among the U-15 national team members (Wilks' lambda=0.23, Raos' R=2.77 p<0.00). Positional differences among the U-17 and U-19 national team members were not established, however, some age-related differences were (Wilks' lambda=0.47, Chi-Sqr=60.17, p<0.00).

Key words: *football players, national team members, positional differences*

Introduction

Positional differences have been the subject of interest of sport scientists for years now (Reilly and Thomas, 1976; Bangsbo, 1994; Verheijen, 1997). These differences were examined through football matches being recorded by camera and subsequently analyzed. The researchers wanted to know what activities players engaged in during a match. They realized that there were differences between distances run by strikers, defenders and midfielders during a match. A football player runs a total of 8 - 12 km during a match (Bangsbo, Norregaard, Thorsco and colleagues, 1991; Samaros, 1980; Bangsbo, 1994). However, for coaches and scientists, the distance a player sprints is more relevant than the total distance he runs. This is due to the fact that sprinting distances are what separates professional from amateur football. Sprints of 1-5m and 5-10m account for the most of all sprinting plays (Verheijen, 1997). Few researchers have dealt with examining positional differences within age groups, which makes for the objective of this paper - to establish positional differences among Croatian national team members U-15, U-17 and U-19. The differences were examined based on tests for assessing the sprint-type explosive force (*Sprint10m*, *Sprint20m* and *Sprint30m*), agility test (AG93639) and test for assessing movement frequency speed (CAT). In addition to the positional differences, this work also examines the differences among Croatian national team members (U-15, U-17 and U-19) in the tested mobility space.

Methods

The research was conducted during the season of 2004/2005 and included Croatian national team players U-15 (n=33), U-17 (n=19) and U-19 (n=33). For this purpose, the athletes were subjected to three tests for assessing the sprint-type explosive force (these tests were conducted using a telemetric photo-cell system, RS Sport, Zagreb), an agility assessment test (AG93639) and a movement frequency speed test (CAT). The data was statistically processed using the statistical application SPSS ver. 11.5 for Windows. The central and dispersive parameters were calculated by age. The normality of the distribution was checked using the Kolmogorov-Smirnov test. The positional differences within the ages (U-15, U-17 and U-19) were determined by using MANOVA. The canonical discrimination analysis for independent samples was used to determine differences among the national team members (U-15, U-17 and U-19). The T-test for independent samples was used to determine partial differences among the groups.

Results

The central and dispersive parameters represent the modal values for Croatian footballers (U-15, U-17 and U-19) (Table 1).

Table 1. Central and descriptive parameters of croatian national football team members in motoric tests (U-15, U-17, U-19)

	Mean	Minimum	Maximum	Std.Dev.
	U-15			
SPRINT10	2,23	1,98	2,53	0,14
SPRINT20	3,50	3,14	3,88	0,16
SPRINT30	4,74	4,30	5,25	0,21
AG93639	7,52	6,90	8,45	0,34
CAT	31,12	23,67	37,33	2,91
	U-17			
SPRINT10	2,15	1,95	2,30	0,10
SPRINT20	3,38	3,10	3,69	0,15
SPRINT30	4,55	4,26	4,87	0,16
AG93639	7,85	6,62	8,32	0,39
CAT	30,32	22,33	35,67	3,96
	U-19			
SPRINT10	2,09	1,89	2,46	0,14
SPRINT20	3,27	2,98	3,79	0,14
SPRINT30	4,41	4,06	4,81	0,15
AG93639	7,49	6,74	9,80	0,62
CAT	31,85	24,00	38,33	3,46

SPRINT10 – sprint 10 meters, SPRINT20 – sprint 20 meters, SPRINT30 – sprint 30 meters, AG93639 – agility, CAT - cating

The AG93639 variable and the CAT variable had no part in creating differences among the players (U-15, U-17 and U-19). A statistically significant difference was seen in regard to the U-15 player positions (strikers, midfielders, central defenders and wingers) in the mobility space tested (Wilks' lambda=0.327, Raos' R=2.77, p<0.00). No positional differences among the U-17 and U-19 players were established.

By using the discriminative analysis, statistically significant differences were established among the national team members (U-15, U-17 and U-19), at the level of significance p<0.00 (Table 2).

Table 2. Discriminative analysis - differences between the national team members (U-15, U-17, U-19) in motoric tests

	λ	Canonical R	Wilk's Lamda	χ^2 test	df	p
0	0,95	0,70	0,47	60,17	10	**0,00**

The differences between age groups were mainly caused by the 30m sprint-type explosive force variable (Table 3).

Table 3. Structure of discriminative function – correlations between motoric test and discriminative function

	DF 1
SPRINT10	**-0,51**
SPRINT20	**-0,68**
SPRINT30	**-0,84**
AG93639	0,04
CAT	0,06

SPRINT10 – sprint 10 meters, SPRINT20 – sprint 20 meters, SPRINT30 – sprint 30 meters, AG93639 – agility, CAT - cating

Table 4. Manova - differences regarding players position among national team players U-15, U-17 and U-19

	Wilk's Lamda	Rao's R	df 1	df 2	p
U-15	0,27	2,77	15	69	**0,00**
U-17	0,35	0,92	15	30	0,55
U-19	0,45	1,47	15	66	0,13

The T-test produced partial differences among the U-15 and U-17 players in all the mobility tests conducted, except for the movement frequency speed test. The sprint-type explosive force variables produced differences among the U-15 and U-19 players. No differences among the U-17 and U-19 players were established only in the 10m sprint test and the movement frequency speed test (Table 5).

Table 5. T-test for independet grups, defferences between U-15, U-17 and U-19 croatian national football team members in motoric

	Mean	Mean			
	U-15	U-17	t-value	df	p
SPRINT10	2,23	2,15	2,36	50,00	**0,02**
SPRINT20	3,50	3,38	2,68	50,00	**0,01**
SPRINT30	4,74	4,55	3,35	50,00	**0,00**
AG93639	7,52	7,85	-3,12	50,00	**0,00**
CAT	31,12	30,32	0,84	50,00	0,40
	Mean	Mean			
	U-15	U-19	t-value	df	p
SPRINT10	2,23	2,09	4,22	63,00	**0,00**
SPRINT20	3,50	3,27	6,08	63,00	**0,00**
SPRINT30	4,74	4,41	7,31	63,00	**0,00**
AG93639	7,52	7,49	0,26	63,00	0,80
CAT	31,12	31,85	-0,93	63,00	0,36
	Mean	Mean			
	U-17	U-19	t-value	df	p
SPRINT10	2,15	2,09	1,66	49,00	0,10
SPRINT20	3,38	3,27	2,50	49,00	**0,02**
SPRINT30	4,55	4,41	3,20	49,00	**0,00**

Discussion

The central parameters (Table 1) may serve as modal values, as they relate to the Croatian national football team members. These types of data are important for coaches because they represent the goals to be achieved, but they may also be used as values based on which coaches can make team selection decisions. The age-related differences among the U-15, U-17 and U-19 national team members were expected and may clearly be seen within the central and descriptive parameters (Table 1). Positional differences among the strikers, midfielders, wingers and defenders were established only among the U-15 national team members (Table 4). One of the possible reasons for this is that U-15 players are under a more intensive influence of physical growth

and development (puberty) than the U-17 players, and especially the U-19 players. From this we can draw a conclusion that the U-17 and U-19 players are more homogenous groups than the U-15 players, at least as regards the tested mobility space with the sprint-type explosive force variable, the agility test and the movement frequency speed test. In establishing differences among the ages, it was evident that players differed based on their age, regardless to whether we compare the U-15 and U-17, the U-17 and U-19, or the U-15 and U-19 players (Table 5). The results improve from the U-15 to the U-19 players, so we can assume that such trend will continue during their transition toward the adult-player age. The differences established among the national team players may be attributed to growth processes, but also to the fact that the U-19 players had more years of training than the U-17 or U-15 players. The sprint-type explosive force assessment variables contributed to the differences among the players the most, which was expected because explosive force actions (10m sprint, 20m sprint, 30m sprint) take a certain level of absolute force, which is developed only after the puberty.

Conclusion

The results in the central parameters of the Croatian national team members may serve as modal values. These types of information, along with the positional and age-related differences among players, are greatly important for football coaches, as well as for personal coaches. Football coaches will use this information to make team selections, while personal coaches will use it as goals to strive for during development of players' explosive capacities.

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DIFFERENCES IN PLAYING EFFICIENCY STRUCTURE OF THREE TYPES OF BASKETBALL PLAYERS IN DEFENCE

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Abstract

The aim of this study was to establish whether playing characteristics of three player types are seen in the structure of selected variables of their playing efficiency in defence. The sample consisted of 144 players from twelve national teams who competed at the 2004 European Basketball Championships for U20 Men. The data of accumulated statistics in defence for three player types were processed. Guards were playing for the majority of time (43.8%), followed by forwards (29.2%) and centres (27.0%). When the playing times of all player types were equalised, it was established that the centres were predominant in offensive and defensive rebounds and blocked shots. Guards recorded the greatest number of steals; but the differences among the player types in other variables were not significant. In most of the variables the results of forward were somewhere in between the other two player types.

Key words: *guards, centres, forwards, player types, performance, standard FIBA indicators*

Introduction

There are three basic types of players in basketball - guards, forwards and centres. Some of them are further divided into subtypes, e.g. point guards, shooting guards, power forwards, small forwards, etc. Individual types and subtypes of players have similar prevalent qualities and characteristics enabling them to successfully perform one, two or more playing roles and – within these roles – various jobs in the game.

Jobs in defence are *general* and *special. General* jobs are typical for all players (e.g. closing out, marking offenders while they are dribbling the ball, guarding offenders on the ball side and on the help side, playing various defences against screens, blocking out and rebounding. *Special* jobs are assigned to individual players according to their specific capacities and features.

Guards most often guard the opposing guards and sometimes even forwards. After the shot, they try to hinder the outlet pass to fast break, the side line throw-in or quick transfer of the ball. After the ball has been lost, they return quickly to the back court, guard aggressively the offender in possession of the ball and hinder the opponent's organization of offence. They help their teammates in defence (guard denial) (e.g. in various screens, double teaming) and in defence rotations. In press defences they play in the first line of defence and often perform the role of a trapper.

Forwards most often guard the opposing forwards and even centres. If necessary, they may also guard guards. After the shot, they rebound and hinder the outlet pass of the ball to fast break. They may also return quickly to the back court and assume defending positions so as to hinder the passing and circulation of the ball around the restricted area. They help guards and centres in defence (wing denial) (e.g. in various screens and double teaming). They try to block or hinder the opponent's shots. After the shot has been made, they block the opponents out and rebound. In press defence they usually play in the second line of defence – they play the role of an interceptor or even a trapper.

Centres guard the opposing centres and also forwards, if necessary. After the shot they rebound and hinder the outlet pass to fast break. Failing that, they return to the back court, taking the shortest path possible. In the set defence a defending centre hinders passing of the ball to the offending centre. If the latter receives the ball, the former hinders hi/her actions and tries to block the shot. After the shot, they block the opponent out and rebound. Centres must be in good control of the central part of the restricted area. They have to help their teammates in defence (centre denial) (for example in penetrations, cuts, or various screens of perimeter players). In press defence, they play the role of the goal tender in the last line (Wooten, 1992; Trninić, Dizdar, & Dežman, 2000; Dežman, Trninić, & Dizdar, 2001).

The aim of this study was to establish whether some of the described characteristics of playing jobs of three basic player types in defence are also seen in the structure of selected playing efficiency or performance variables in defence.

Methods

The sample consisted of 144 players from twelve national teams playing at the 2004 European Basketball Championships for U20 Men in Lithuania. The classification of players into three main types – guards, forwards and centres – was based on the players' positions as stated in the official rooster of national team players.

Table 1. Number of individual player types and their body height (BH)

Playing type	N	BH - mean	Min	Max
Guards	60	190.0	186.0	195.0
Forwards	43	200.8	197.0	204.0
Centres	41	208.3	204.0	214.0
Total	144	199.7	186.0	214.0

The variables included:

a) TIME – average playing time per game for the three player types, and

b) 5 variables of playing efficiency in defence: DR – defensive rebounds, OR – offensive rebounds, ST – steals, BL – blocked shots, PF – personal fouls.

The official game statistics data were obtained from the website: www.fibaeurope.com. The calculations were based on the data of accumulated statistics for all players of the twelve national teams. Based on these data the authors calculated the sum total of frequencies of individual variables in defence and their percentage per game for all guards, forwards and centres of the national teams. The differences between the three player types of the twelve national teams during the play and the frequency of executing selected playing efficiency variables in defence were established by one-way analysis of variance (ANOVA). The SPSS for Windows statistical package was used.

Results

Table 2. Percentage of playing time of three player types per game

	Playing	Mean	%	Std.	Std.	Min	Max	Sig. B	F	Sig. F
Variable	type			De	Err					
	guards	87.7	43.8	22.13	6.39	58.3	122.8			
TIME	forwards	58.4	29.2	19.85	5.73	30.4	102.1			
	centres	54.0	27.0	18.43	5.32	24.0	81.9	0.812	9.881	**0.000**

Legend: Mean – arithmetic mean (average values per match), % of playing time, Std. De - standard deviation, Std. Err – standard error, min, max – theminimal and maximal result, Sig. B – test of homogeneity of variances, F – F values, Sig. F – statistical significance of F

There were statistically significant differences between guards, forwards and centres in terms of average playing time in a match. Guards were playing for the majority of time, followed by forwards and centres.

Table 3. Differences between guards, forwards and centres in variables of performance in defence

	Playing	Mean	%	Mean	Std.	Std.	Min	Max	Sig. B	F	Sig. F
Variable	type			et	De	Err					
	guards	7.3	33.1	5.5	2.58	0.74	3.7	11.9			
DR	forwards	6.8	31.1	7.8	3.58	1.03	2.1	16.3			
	centres	7.9	35.9	9.7	2.83	0.82	3.8	13.3	0.897	0.4	0.693
	guards	2.1	21.5	1.6	1.14	0.33	0.6	4.5			
OR	forwards	3.2	31.9	3.6	1.98	0.57	0.6	7.6			
	centres	4.7	46.7	5.7	1.80	0.52	2.0	8.8	0.310	6.8	**0.003**
	guards	6.2	47.7	4.7	2.69	0.78	2.3	11.6			
ST	forwards	3.3	25.9	3.8	1.24	0.36	1.8	5.1			
	centres	3.4	26.5	4.2	1.40	0.40	0.9	5.4	0.162	8.6	**0.001**
	guards	0.4	12.7	0.3	0.37	0.11	0.0	1.0			
BS	forwards	0.8	26.1	0.9	0.41	0.12	0.3	1.4			
	centres	1.8	61.2	2.2	0.61	0.18	1.0	2.9	0.251	28	**0.000**
	guards	8.7	39.2	6.6	2.83	0.82	5.1	13.3			
PF	forwards	6.8	30.9	7.8	2.72	0.79	2.4	11.9			
	centres	6.6	29.9	8.1	1.77	0.51	3.4	9.8	0.215	2.5	0.099

Legend: Mean et – average values per game, if the playing times were equalised

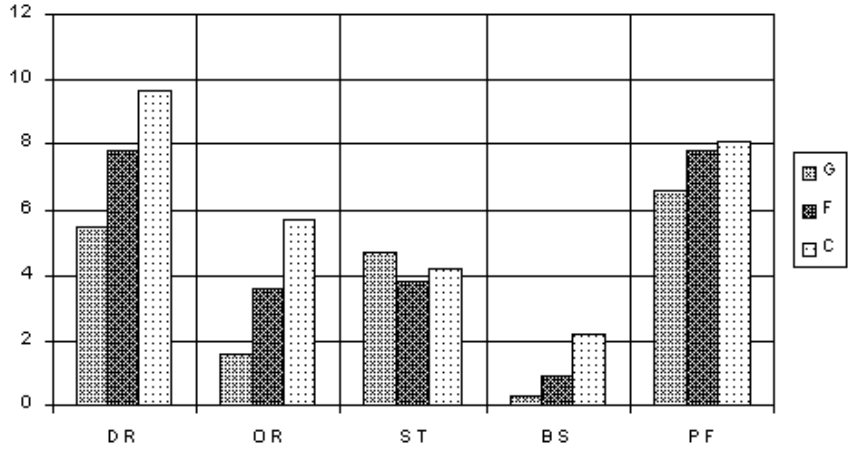
The results in Table 2 show the differences between the three player types in selected variables in real-time playing.

Statistically significant differences between guards, forwards and centres were obtained for the following variables: OR – offensive rebounds, ST – steals and BS – blocked shots.

Centres made the most offensive rebounds (OR) and blocked shots (BS). They were followed by forwards and guards. There were no statistically significant differences between player types in terms of defensive rebounds (DR).

The biggest number of steals (ST) and personal fouls (PF) was recorded for the guards, followed by forwards and centres. The differences were statistically significant.

Owing to unequal playing times, these results distort the true characteristics of player types' play, which is why we transformed the data by equalising the playing times of all players. This was achieved by dividing the results of individual types of players by percentage of their playing time and multiplying the result by 33.3%. The transformed results are shown in the column *Mean et* in Table 3.



Graph 1. Profile of playing efficiency of the three player types in defence when their playing times were equalised

The third column in Table 3 (Mean et) and Graph 1 show that the relations between the three player types changed to some extent. The centres were predominant in defensive rebounds (DR), offensive rebounds (OR) and blocked shots (BS). They were followed by forwards and guards. Centres made the most personal fouls (PF). Nevertheless, the differences between them and forwards and guards were not large. After the data transformation, the differences between various player types in terms of steals (ST) decreased.

Discussion and conclusion

At the 2004 European Basketball Championships for U20 Men, two or three guards and one or two forwards or centres were on the court for the majority of time in all national teams. Consequently, the guards were playing for the majority of time (43.8%), followed by forwards (29.2%) and centres (27.0%).

Information on the percentage of playing time of individual player type is very important, if correct interpretation of the results is to be obtained. Excessive differences in the playing time of player types may blur their particularities in a play. In our study, this was the case with the variables defensive rebounds (DR), steals (ST) and personal fouls (PF).

When the playing times were equalised, the transformed results (Mean et in Table 3, Graph 1) corresponded better to the peculiarities of the play of the three basic player types in defence. The centres were predominant in the variables defensive and offensive rebounds (DR, OR) as well as in blocked shots (BS); they also made the most personal fouls (PF). They were followed by the forwards. The guards achieved the least of the above-mentioned variables. The results are corresponded to practical experience. Tall players are privileged when it comes to rebounds and blocked shots (they reach higher) and they also have advantage over shorter players when making rebounds or shot blocking because they are positioned in the vicinity of the basket.

As regards steals (ST), the best were the guards; nevertheless, the differences between the centres and the forwards were not large (Mean et in Table 3, Graph 1), which does not correspond completely to practical experience. Guards are usually the fastest players in a team. They also have a good overview of the play. Their strong pressure on the ball and high level of anticipation enables them to intercept the ball many times. In our study such practical experience was not completely confirmed. We were unable to provide an explanation for this, due to insufficient data. Perhaps the reason lies in the different scope of playing tasks of individual player types (owing to their versatility), thus blurring some of the peculiarities in the play of the basic player types.

The results principally confirm some of the features of playing roles and jobs of the three basic player types in defence that were described in the basic premises. At the same time they point to the fact that interpretation of such results has to be done with outmost prudence, as it is obvious that many factors influence the structure of these variables. The most important are the following: playing time of selected player types, scope of playing roles and jobs of individual player types and particularities of team tactics.

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DIFFERENCES IN STANDARD PERFORMANCE INDICATORS BETWEEN MALE AND FEMALE BASKETBALL SENIOR TEAMS PARTICIPATING IN THE 2003 EUROPEAN CHAMPIONSHIPS

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Abstract

The scientific researches of the basketball game dealt mainly with the man's basketball. The aim of this paper is to determine the basic differences between male and female performance by comparing the official statistics parameters of male and female teams that participated at 2003 European Championships. Discriminant analysis showed that the greatest difference between male and female performance is in three point shots which for the most of the players are the basis of their game. Larger number of unsuccessful two point shots, turnovers and defensive and offensive rebounds made by the female players are explained by their inferior motor abilities, impatience, more rapid drop in concentration, as well as the more frequent use of the less aggressive defense.

Key words: *team game, competition, success, national team, discriminant analysis.*

Introduction

Previous scientific researches investigated the game situations, relations between the indicators of situational efficiency and competition performance, latent structure of the situational space, anthropological characteristics and the indicators of situational efficiency of individual player types, criterion systems for the players quality evaluation, the effects of training programs, etc. (Swalgin 1998, Maršić 1999, Trninić & Dizdar, 2000, Trninić, Dizdar & Lukšić 2002, Dizdar 2002), and referred mainly to the male teams. This research is an attempt to determine the differences in standard parameters of situational efficiency between male and female basketball senior teams that participated at the 2003 European Championships. In other words it is an attempt to determine the manifestation of the differences between males and females in the actual basketball game.

Methods

The sample consisted of 16 male and 12 female senior national teams that participated at 2003 European Championships. Each game for both male and female teams was analyzed resulting with the statistic parameter of 86 games, or more exactly total of 172 official basketball statistics.

Variable sample consisted of 13 standard indicators of situational efficiency. The descriptive statistics parameters were calculated for the investigated groups of players. Kolmogorov – Smirnov test was performed to determine the normality of the distribution. Canonical discriminant analysis was used to determine the possible existence of statistically significant differences between male and female teams in total space of standard as well as individually in space of derived parameters of situational efficiency. Besides that we determined the amount of influence of single variables at the differences between male and female teams – based on matrix of orthogonal variable projections with the discriminant function.

Results

Tables 1 and 2 show the basic statistic parameters (Mean, Standard Deviation, Minimum, Maximum) for both male and female teams in standard parameters.

Table 1. Mean, Standard Deviation, Minimum, Maximum, Skewness i Kurtosis and Max D - test for male teams in 13 standard parameters.

MALE	XP2	XN2	XP3	XN3	XP1	XN1	XA	XSN	XSO	XOL	XB	XOP	XIL
MEAN	19,14	19,15	7,15	13,54	17,33	7,18	11,66	8,96	21,88	6,10	2,56	24,24	14,09
SD	4,18	5,72	2,54	3,96	5,36	3,52	4,05	3,42	5,23	2,96	1,98	4,10	4,23
MIN	8,00	8,00	2,00	3,00	5,00	0,00	2,00	3,00	9,00	2,00	0,00	14,00	7,00
MAX	31,00	34,00	13,00	25,00	29,00	17,00	23,00	20,00	33,00	15,00	8,00	34,00	25,00
Max D	0,11	0,10	0,14	0,12	0,10	0,12	0,09	0,11	0,08	0,11	**0,22**	0,11	0,08
TEST													0,15

Table 2. Mean, Standard Deviation, Minimum, Maximum, Skewness i Kurtosis and Max D - test for female teams in 13 standard parameters.

FEMALE	XP2	XN2	XP3	XN3	XP1	XN1	XA	XSN	XSO	XOL	XB	XOP	XIL
MEAN	20,12	24,33	5,11	10,52	16,18	5,84	12,54	11,00	23,38	8,28	2,53	21,10	15,27
SD	5,16	5,65	2,57	3,84	6,14	3,50	4,33	4,39	5,31	3,25	1,92	4,12	4,31
MIN	7,00	10,00	0,00	2,00	6,00	0,00	2,00	3,00	9,00	2,00	0,00	11,00	7,00
MAX	32,00	39,00	12,00	21,00	34,00	18,00	26,00	24,00	36,00	18,00	7,00	32,00	28,00
Max D	0,07	0,09	**0,16**	0,10	0,10	**0,15**	0,08	0,13	0,08	0,12	**0,17**	0,10	0,14
TEST													0,14

Mean, Standard deviation (SD), minimum value (MIN), maximum value (MAX), maximum distance between relative cumulative theoretical frequency and relative cumulative empirical frequency (*max D*), and limit value (TEST), (XP2) two-point field goal scored, (XN2) two-point field goal attempts, (XP3) three-point field goals scored, (XN3) three-point field goal attempts, (XP1) free throws made, (XN1) free throws attempts, (XA) assists, (XSN) defensive rebounds, (XSO) offensive rebounds, (XOL) steals, (XB) blocked shots, (XOP) personal fouls, (XIL) turnovers.

The results of Bartlett Chi-Square Test (Table 3) show that analyzed discriminant function significantly differs male from female teams at the 0,01 level of statistical significance with the canonical correlation of 0,65 so it can be concluded that 13 standard parameters of situational efficiency show the differences between male and female teams.

Table 3. Chi-Square Tests/successive roots – for discriminant function between male and female teams in 13 standard parameters.

	Eigen-value	Canonicl R	Wilks' Lambda	Chi-Sqr.	df	p-level
0	0,741297	0,652469	0,574285	90,68202	13	0,000

Eigen-value – the discriminant function value, Canonical R – canonical correlation coefficient (discriminant), Wilks' Lambda – Wilks' Lambda value for each discriminant function, Chi-Sqr – value of Chi – Sqr test for the testing of discriminant function significance, Df – degrees of freedom on basis which the testing was performed, P – level – proportion of error made by accepting the hypothesis that the difference is statistically significant.

Male teams are at the negative side of the discriminant function (Table 4), and female teams are at the positive side.

Table 4. Position of group centroids at discriminant function of 13 standard parameters of male and female team situational efficiency.

M	-0,9179
W	0,7982

Table 5. Classified correlations of individual standard variables of male and female team situational efficiency with discriminant function

FEMALE TEAMS	XN2	0,531
	XOL	0,408
	XSN	0,299
	XSO	0,166
	XIL	0,161
	XA	0,122
	XP2	0,121
MALE TEAMS	XB	-0,009
	XP1	-0,115
	XN1	-0,222
	XOP	-0,445
	XN3	-0,451
	XP3	-0,465

After it show that the discriminant function statistically significant differs the groups in standard parameters of situational efficiency, correlation coefficients of each variable with discriminant variable were determined (Table 5).

The positive side of 13 standard parameters (Table 5) is best defined by unsuccessful two point shots (0,531), followed by won balls (0,408), offensive rebounds (0,299) and defensive rebounds (0,166), lost balls (0,161), assists (0,122) and number of two point successful shots (0,121). That means that the female teams have higher numerical value in these mentioned variables. The negative side of 13 standard parameters is best defined by successful three point shots (-0,465), unsuccessful three point shots (-0,451), personal faults (-0,445), followed by unsuccessful free shots (-0,222), successful free shots (-0,115) and blocks (-0,009). In other words, these variables are the ones in which the male teams have higher numerical values.

Discussion

According to the previously stated results the highest contribution to the differences between male and female teams has the number of unsuccessful two point shots (0,531). Female players have average of 24, 33, and male 19, 15 unsuccessful two point shots. It is presumed that the reason to the higher number of unsuccessful two point shots of females, compared to males, is in bad shot selection, poorly timed passes, faults in technique, as well as in inferior motor abilities which are the reason for the lower precision during the quick reaction situations. Also, based on experience, we can say that the females show certain level of impatience which leads them in to the situations of taking the shot from a bad position (shot selection). After the unsuccessful two or three shot the transition of tem in to defense stage is not enough organized, which in turn leads to situations in which

the points are easily scored, (defense in own field is not strong enough, i.e. it is not well set in a space (rotation) which makes it possible for the opponent to take higher number of shots from a half distance.

In relation to this kind of defense in female teams, compared to the male, female teams have a higher number of offensive rebounds (11: 8, 96). Offensive rebounds significantly contribute to the structure of the discriminant function (0,299) so they can be analyzed from a defense and offense view point. Analyzing the defense point, the offensive rebounds are the result of drop in motivation and disorganized defense, i.e. lack of balance between defense lines (guards, forwards and centers). From the offense view point, i.e. the team on shot, offensive rebounds mainly have several reasons: rebound balance of the offensive lines, physical dominance or emphasized motivational factor (for example, if the team has bad shot percentage, their rebound motivation is on higher level in both defense and offense).

Significant correlation with discriminant function has variable ball gained (0,408).Tables 1 and 2 show that the females have higher average number of ball gained per game (8,28:6,10). Steals can be achived by individual and collective defense (e.g. different types of pressing, aggressive defense, rotation, traps, high rhythm of the game – physically better prepared team has more chance to win a ball). However, the key word might be a concentration. As with the two point shots, female players, compared to males, have higher number of ball gained probably because of their faults in offense technique, problems with offense organization (tactical training, drop in concentration and, in general, because of the offensive lines disbalance. Because of mentioned reasons female players find themselves more frequently in non defined situations in which nobody has the ball possession and in which the key factor is rapid reaction which in the end results with ball gained or lost ball.

Higher number of lost balls compared to the male players could be explained similarly to the ball gained balls. Female players probably have higher number of lost balls because of their modest motor and functional abilities, more rapid drop in a concentration, bad situation assessments, lack of offensive balance and poorer individual technique in relations to male players.

Female teams have the average of 12,54, and male 11,66 of assists per game. Assists variable correlation with discriminant function is 0,122. Assists can be analyzed from a shot point of view. For the teams with higher percentage of successful shots, in this case for the male teams, it is normal to expect fewer number of assists, i.e. of passes leading to the points scored from a close distance. Same can be applied to the break through which often leads to excess players, and at the end to assist. Similarly, higher number of offensive rebounds and turnovers (caused mainly by poor defense) leads to higher number of assists.

Personal fouls variable correlation with discriminant function is very high (-0,451). Female teams, more frequently use zone defense in which the emphasis is more on collective and less on individual defense. That leads to less aggressive game, fewer personal fouls and in the end fewer free throws. In male teams the emphasis is on individual defensive responsibility (aggressiveness). High intensity man- to- man defense is mainly used with a lot of physical contact bordering personal fouls. That leads to higher number of personal fouls and naturally higher number of free throws compared to female teams.

Male teams have the average of 2,56, and female 2,53 blocks per game .Variable blocks has insignificant correlation to the discriminant function (-0,009). Blocks, as a statistical indicator is almost of insignificant importance. Mostly they are the result of individual players reaction which can be significant only in extremely tied games when this individual reaction solves the question of the winner (last seconds of the game).

Higher number of three point shots in male teams compared to the female teams is caused by their physical superiority, technical preparation, shot selection (male teams almost have no limits in shot selection), tactics and naturally motivation.

Male teams have average of 59, and female teams average of 60 field shots per game, which show that both male and female teams have similar number of offensive elements per game. Female players inferiority in regards to their anthropometric characteristics, motor and functional abilities and numerous other differences in gender lead to differences in performance related to basketball game. With the change related to the field dimensions, basket height, ball diameter (there was a change of ball diameter in a 2004/05 season) etc. it is more similar to the male game, in other words it would become more attractive.

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THE EVOLUTION OF AN HOLISTIC PROCESS IN SPORT TRAINING

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Abstract

The modern sports movement is going through a process of differentiation. New activities are developed and developing. New values and new organizational forms and methods of sports training can replace older ones. Sport is part of a modern lifestyle and various subcultures show the diversity of modern sport. In this paper I try to say something about the new philosophy of changing values in modern society and try to give a description of process of value differentiation in sport. We used the methods, methodological principles and means of experienced learning through the pedagogical experiment (special training camps) that was the part of long time preparation of 20 members of Czech junior wild water slalom junior team. The used programmes (icebreakers, contact games, trust games, initiative and team games, strategic games, sociodrama games, communication and cooperation games, environmental games, overcoming obstacles, rope courses…..) were firstly opportunities for self-development as well as for learning a great deal about teamwork. There are not exact quantitative results but our experiences show the great qualitative development in cohesion of the whole team (also positive communication among team and coaches) and the great fruitfulness of Czech team on Junior World Championships probably reflects the personal development (self-confidence, self-respect, self-fulfilment, high spirit..) of competitors

Key words: *experiential learning, long time sport preparation, personal development, pedagogical experiment, game as a training mean, comfort and learning zones, wild water slalom training*

Introduction

The normal and natural position for man is not to be at rest but to be "on the move". It is not activity and movement that need explanation but immobility and rest. The Norwegian climber and philosopher A. Naes was asked by a journalist why he was still climbing 72 years old. Naess looked at him and said: "Why have you stopped? Both of us climbed as children, I have only continued to do what is natural. It is you who need to explain things! Please tell me why you don't climb (…running, canoeing, walking, swimming etc.) any more? (Breivik 1991).

To move is to learn. The newest research on animal and human play tell us that during play the brain develop "programs" of "what can I do?" Therefore play is important in children's lives but if they are going to have "good programs". Recent research tells us for instance that early toughening by adventures play will strongly influence adult stress coping abilities. Sport has to with fundamental knowledge about ourselves and the world. It is necessary to realize that this idea is very important moment in long time sports preparation.

Being able to use all your skills, getting immediate feedback, be greatly concentrated, be immersed in something you value, appreciate it and like it give us a feeling of "deep flo**w**". It is experienced in activities like climbing, dance, music composing, and basketball, according to social scientist Csikszentmihalyi. Athletes need to build more of their identity around valuable activities that move their hearts, that give them excitement and joy.

In the context of current serious discussions regarding the modernization of educational targets, methods and means applied in the school system, a completely logic question arises whether the same professional discussion should not be conducted in the area of sports preparation. It is becoming increasingly obvious that dozens untrue ideas still predominate about education, and it is difficult to stamp them out. As a consequences children are uselessly stressed by the applied system of assessment, which cannot motivate positively to learning, which does not support the ability to use the obtained knowledge in practice and to make independent decisions, on the contrary it tries to guide them to discipline, passivity, easy to control, dependence on authorities, etc. (the opposite to Hemingway's attitude: "Sport teaches not only to win, but it mainly teaches to live).

If in this connection we focus on sport, sport remains a phenomenon, and despite its partial and possibly even serious problems it still is a significant means of education of young people, though burdened with the conflicting relation of two "E": **e**conomy versus **e**thics. However, it raises the question whether currently it is still fulfilling its mission of all-round and balanced development of all components forming an athlete. Are the goals of the personality harmonic development not only rather declarative? Is the pursuit of performance not dominating for the majority of trainers, even in the youngest age categories? Is our sports environment not too poor in stimuli?

Training is a long-term systematic process, split into several logically linked phases (the ones that are important for us are: the phase of basic preparation and general preparation, partially the phase of special preparation). Each of these

stages has its own goals and tasks. We know from our own experience that the pursuit for actual results leads to violation of elementary principles of the youth sports preparation. However, sport as said in the introduction should bring joy and pleasure, it should contribute to active health and develop all aspect of the athlete's personality. Let us put a question: "Is it not possible to find any impulses for the sports training in the broad offer of alternative pedagogic approaches?"

We think that it is, and it may be emphasized, that it is the various activities connected with one of the basic components of natural environment – water – that in view of the personality development offers indefinite possibilities to apply a wide range of untraditional approaches, methods and means, predominantly in the area of experience pedagogy, with the aim to affect not only the actual performance in the sense of the development of physical abilities and skills, but to affect the mental and emotional state, but also for example the character or social qualities of athletes by using different and varied activities.

In our opinion there are enough enthusiastic people in the area of sports, in water sports in particular, who find the sense of sports and sports preparation not only in potential financial profit from possible victory. They may feel that "it is a simplistic approach to wish to do sports merely for winning, every victory is relative and can be beaten in the future, that it is far better to go in for sports to gain experience, evident experience that is always undoubted and deep confirmation of one's own existence in a particular time, space." (Hogenová 96). They look for new, not quite traditional ways (methods, means) how to work with their trainees.

A significant contribution of such approaches is the finding that the use of non-standard training methods enables to reach minimum comparable training effect and benefit for the individual personality development as well as positive qualitative changes in the concerned team, which is indisputable.

We are convinced that if we focus on the inner state of an athlete in the initial stages of sports preparation, and if we direct him/her not predominantly to the goal but to the way, to the course of the respective activity (activities), it is more beneficial for him/her and for his/her both sports and personal future than if we just check his/her times on the stopwatch continuously. It is the experience of the respective activity that is in question, then it is the performance, and a good performance may be its result.

Top sports performance can be only achieved by the individuals who have the necessary gift based on long-term and systematic sports preparation. The decisive form of the sports preparation is sports training, which can be defined as "a specialized pedagogic process aimed at reaching the individually best sports performance in the selected sports branch based on all-round development of the athlete" (Choutka, Dovalil, 1991)

As indicated by the definition, the capacity and achieved performance are becoming more and more dominant in the sports training. The desire to reach the best performance is major driving force for the athlete. However, the original content of "sport" – experience, joy, game, is vanishing. And it is the game that is amusing, predominantly for children and youth, which enables to experience, which has a sense. It gives roles, it enables to simulate (imitate), it enables to recognize others as well as oneself, it reveals the character, etc.)

We will try to give some examples and share experience of our experimental training camps where we used some untraditional approaches, methods and means, primarily from the area of experience pedagogy, applied with the aim to affect not only the actual performance in the sense of the development of physical abilities and skills, but with the aim to affect the mental and emotional capacities as well as for example character or social qualities of the participants by means of different and varied activities.

An integral part of sports preparation is training camps. The athletes together with their trainers spend total 168 hours in the weekly action. We know from experience that sports preparation and special sports training takes maximum 35 hours. May the remaining 133 hours be used meaningfully for fulfilling other goals and tasks?

Methods

The methods and principles applied by the different educational systems should ensure the optimisation of ongoing pedagogic processes. Drafting the scenarios (programs) and dramaturgy of our actions, we applied the basic principles used in experience pedagogy.

a) Principle of purposefulness – applied and identified as the educational intention. It covers exercise and development of motor activity (ability, special skills), mental abilities (thinking, will), social skills (enhancement of self-confidence, cooperation ability, development of responsibility) and creative abilities. (Vážanský, Smékal, 1995)

b) Principle of activity – it expresses the general requirement for independent activity of an individual, activate his/her emotional, cognitive and volitional processes, etc. (Jůva, 1995)

c) Principle of adequacy – content, form and methods of education are adequate for the age group and its actual maturity, individual approach is assumed, leads to tolerance and consideration, etc. We simulate situations when individuals of a group are forced to take on the execution of the activities, when their own initiative and independent decision-making are required.

d) Principle of emotionality – it should encourage adequate emotional experience and maintain joyful creative atmosphere (Jůva 1995). Based on Holec (1994), the experience pedagogy develops the individual, respects the individual, and

refines the individual features to the maximum extent. It develops intellect, creativity, social skills, will and self-knowledge.

It is obvious that these principles enrich and develop the content of the basic principles as well as the principles of sports training.

Other dimensions that are offered by some trends of experience pedagogy:

a) Cognitive dimension: the ability to estimate one's own limits, development of self-confidence, The ability to withstand, to overcome one's fear, development of imagination and creativity, performance readiness, etc.

b) Social-affective dimension: the ability to solve conflicts, to apply proposals, to act independently, to cooperate, to take account of the others, to assess and control stress and challenges, to accept and express criticism, the ability to decide in critical situations, etc.

Training camp as a challenge:

The actions may be characterized as actions with an intensive program and training schedule, focused on maximum and mainly meaningful use of the available time by application of dynamic and varied programs and elimination of empty spaces. The interconnection of complex physical activities with interest, creative, artistic and cognitive activities. We always tried to create stimulating atmosphere for creativity by means of suitable motivation. The dominant means used for development of the program was the game ("a game as a prelude of serious things").

Group characteristics:

The participants of the courses (training camps) were members of junior representation teams in water slalom and down race. The athletes achieve the top sports level. It can be stated that the interesting and absolutely untraditional methods and means used in the actions fully took their interest.

It can be stated that the methods and means of experience pedagogy that were applied in our actions can address and address-sporting youth up to the top sports level. We could track certain shifts in the group cohesion, which is very important for creating the overall atmosphere in the team as well as in view of further work of trainers, primarily in psychically demanding situations.

A significant contribution is the confirmation that minimum the comparable training effect can be achieved (mainly regarding the physical preparation) by using non-standard training methods, and the benefit for the personality development of the individuals as well as positive qualitative changes in the team are indisputable

Table 1. Content of the training camp - shares of traditional and untraditional activities.

Percentage share of hours	Trad. TC	Untrad. TC
Spent in physically demanding exercise (games)	17%	24-30%
Other programs (educ., creativity)	2%	20-24%
Others – passive relaxation, meals, sleep	81%	46-55%
Total number of hours	168	168

The selected sports branch was of individual risky character and the impact was positive (racing seasons with very goods results can be only hypothesized). It may be assumed that the impacts predominantly in team sports could be very effective and currently there are tendencies in some sports (basketball, hockey) to apply the above-mentioned untraditional system of preparation.

Results

There are not exact quantitative results but our experiences show the great qualitative development in cohesion of the whole team (also positive communication among team and coaches) and the great fruitfulness of Czech team on Junior World Championships probably reflects the personal development (self-confidence, self-respect, self-fulfilment, high spirit etc.) of competitors.

Table 2. Supposed benefits for individual

Psychological	Sociological	Educational	Physical	Health
Self-concept	Compassion	Problem solving	Fitness	Stress reduction
Self-confidence Self-mastery	Cooperation	Value clarification	Endurance	Wellness behaviour
Self-control	Respect for other	Sport Techniques	Strength	Health value
Self discipline Self-action	Communication	Nature Awareness	Coordination	
Well-being	Behaviour Feedback		Catharsis	
Well-evidence	Friendship		Exercise	
Self-esteem Self-reliance	Conflict resolution			

Discussion

It is obvious that the presented problems may be assessed from various points of views that become a basis for various, frequently very different, opinions regarding the reasons and advantages (disadvantages) of the indicated connection of the two, currently very remote, areas (sports training, experience pedagogy) of educational work with young people. We tried to look at all the problems from various points of view with the aim to optimise the training process (routine) in selected sport. The major problem of the application of these approaches seems to be the professional level of the trainers and instructors. Similarly as in the school system, it is probably necessary to focus on possible modifications of the system of preparation of physical education and sports workers – trainers and teachers.

We try to follow the benefits for the Individual and the society when the system of experienced learning is applied into the training program of the youth. The main goal is the personal development of the athletes.

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CHANGES IN HORMONAL AND PSYCHOLOGICAL PARAMETERS IN ELITE MALE ROWERS DURING THE PREPARATORY PERIOD

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Abstract

Possible hormonal and psychological changes in elite male rowers during 24-week preparatory period were studied. 11 male rowers were tested on seven occasions. Fasting testosterone, cortisol and perceived recovery-stress state were evaluated after a resting day. Maximal oxygen consumption was determined before and after the training period. Training was mainly organized as low-intensity prolonged training sessions. Significant increases in VO_{2max} (from 6.2±0.5 to 6.4±0.6 l/min) were observed as a result of training. RESTQ-index did not change during the study. Standardized recovery and stress scores changed in comparison with pretraining value. Basal testosterone and cortisol were related to mean weekly training volume. The RESTQ-index was significantly related to testosterone and cortisol. Significant relationships between hormonal and perceived recovery-stress state suggest that metabolic and psychological changes should be carefully monitored to avoid unfavorable outcome on the training status in elite rowers.

Introduction

Numerous investigations have been conducted in an attempt to study possible physiological markers of training stress that might subsequently be used to monitor training and prevent possible overtraining that may be associated with chronic hard training (Mäestu et al., 2003). Optimal performance is only achieved when athletes optimally balance training stress with adequate recovery (Kellmann and Kallus, 1999; Mäestu et al., 2003). Recently, in addition to clinical findings, the level of perceived recovery-stress state appears to well reflect the state of an athlete (Kellmann and Kallus, 1999).

Prolonged heavy endurance training regimen has been found to cause an increase and a decrease in the fasting levels of cortisol and testosterone, respectively. In addition, resting cortisol levels have also been reported to remain relatively unchanged after prolonged endurance training in male athletes (Mäestu et al., 2003). The results of these studies suggest that prolonged training may have a variable influence on the hormones of the hypothalamus-pituitary-adrenocortical axis.

Increased levels of basal cortisol have been linked to normal stress response to heavy training, while a decrease in basal cortisol has been used as a late sign of overtraining (Urhausen and Kindermann, 2002). In addition to the hormonal values, the amount of psychologically related stress seems to reflect well the clinical state of athletes (Kellmann and Kallus, 1999). Furthermore, variation in cortisol has been linked to changes in mood, sleep quality, and recovery activities (Barron et al., 1985). These findings suggest that training monitoring in elite athletes should involve a multi-level approach using valid hormonal as well as psychological indices to assess adaptation to certain training load.

The aim of the present investigation was to integrate hormonal and psychological approaches of training monitoring during the course of preparatory period in elite rowers; and to investigate possible relationships between training volume, basal hormone levels and perceived recovery-stress state.

Methods

Eleven elite male rowers (age 20.2±2.9 years; height: 192.7±4.9 cm; weight 91.6±5.8 kg), participated in this study. The subjects were tested on seven occasions over the six month training season at the beginning of the preparatory period and after the weeks 8, 16, 20 and 24 during the preparatory period before the competition period. In these testing sessions perceived recovery-stress state and fasting blood parameters were evaluated after a resting day (Mäestu et al., 2003). A progressive test to exhaustion was performed twice, before and after the 24-week training period, on a rowing ergometer (Concept II, Morrisville, USA) to determine maximal oxygen consumption (VO_{2max}; $VO_{2max/kg}$) and aerobic capacity (Pa_{max}) values. During the preparatory period, training was mainly organized as low-intensity (blood lactate values around 2 $mmol.l^{-1}$) prolonged training sessions. In March, from Week 16 to Week 20, rowers were in training camp where the training load was increased while intensity remained relatively unchanged. The perceived recovery-stress state was assessed using the Recovery-Stress-Questionnaire for Athletes (RESTQ-Sport) and the Standardized Stress, Standardized Recovery and RESTQ-index were calculated (Kellmann and Kallus, 1999).

Results

Significant increases in VO_{2max} (from 6.2±0.5 to 6.4±0.6 l.min^{-1}), $VO_{2max/kg}$ (from 67.6±3.0 to 69.2±3.1 ml.min.$^{-1}$kg^{-1}) and Pa_{max} (from 442.8±40.5 to 465.9±26.2 W) were observed as a result of 24-week training period. At the beginning of the preparation period, the mean value of training volume was about 128 min per day (Figure 1). With regard to this initial value, there was a significant increase ($P<0.05$) after Week 8 to Week 20 (Week 8: ≈129 min.day^{-1}; Week 16: ≈146 min.day^{-1}; Week 20: ≈167 min.day^{-1}). At the end of the study (Week 24), the mean training volume was about 116 min.day^{1}. The Standardized RESTQ-index did not change significantly over the 24-week preparation period. Standardized Stress score significantly decreased after Week 16, while Standardized Recovery increased significantly higher from Week 20 compared to the pretraining score (Figure 1).

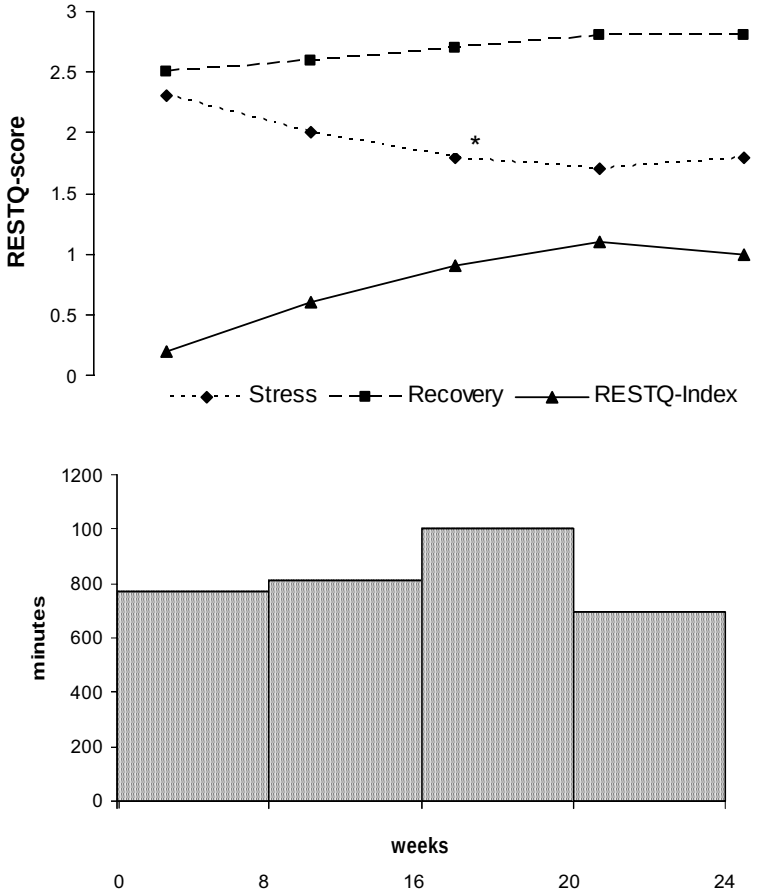

Figure 1. Standardized Stress, Standardized Recovery and RESTQ Index (upper bar) and mean training volume (lower bar) of the 24 week training period in male rowers.
** - significantly different from week 0.*

Fasting cortisol concentration increased during a preparation period and this increase was considered significant after the training camp (Week 20) (Figure 2). Fasting testosterone concentration demonstrated a significant increase after weeks 8 and 20 compared to the initial measurement (Figure 2).

After 24 weeks, all measured blood biochemical parameters were not different ($P>0.05$) from the values of the first measurement session. Significant relationships were observed between mean weekly training volume, and fasting cortisol ($r=0.416$; $P=0.010$) and testosterone ($r=0.527$; $P=0.001$) values. Standardized Stress score was significantly related to fasting cortisol ($r=0.381$; $P=0.002$) value. In addition, RESTQ-index was significantly related to fasting cortisol ($r=0.321$; $P=0.009$), and testosterone ($r=0.349$; $P=0.004$) values.

Discussion

The aim of the present study was to describe training effects of typical preparatory period of elite rowers using perceived recovery-stress state and fasting hormone parameters. A standardized testing session was performed seven times over the 24-week training period to monitor possible changes in these parameters. A 24-week heavy training period

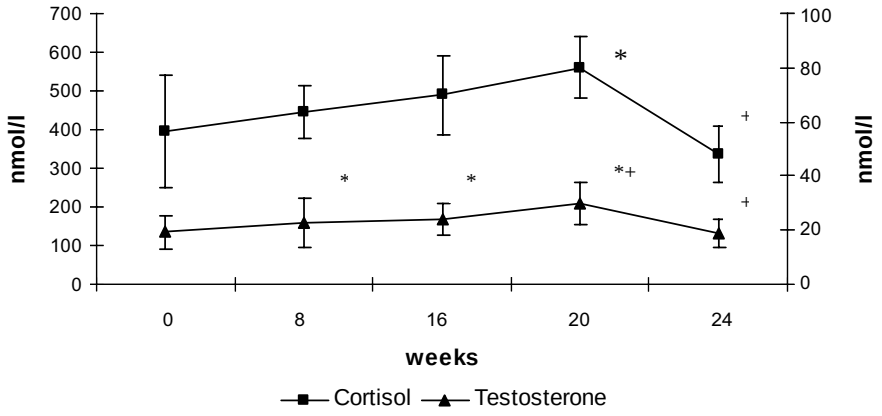

*Figure 2. Fasting cortisol and testosterone concentrations during the 24 week study in elite male rowers. * - significantly different from week 0; + - significantly different from previous week*

resulted in significant improvements of all measured aerobic capacity values (e.g., VO_{2max}: from 6.2±0.5 to 6.4±0.6 l/min), indicating that the main aim of the preparatory training period was successfully achieved.

In association with improved aerobic capacity parameters at the end of the preparation period, changes in circulating anabolic (testosterone) and catabolic (cortisol) hormone concentrations as well as in the activity of creatine kinase in blood were tracked several times throughout the 24-week training period. Basal testosterone concentrations were significantly elevated after Weeks 8 and 20 (see Table 2), showing a high anabolic profile of our athletes following hard endurance training sessions. Furthermore, basal testosterone was significantly related to mean weekly training volume (r=0.416; P=0.010). Although basal testosterone remained within normal recognized values, circulating values were considered high for the predominance of the preparatory period indicating a positive anabolic adaptation (Kokolas et al., 2004) to endurance training as also demonstrated by improved aerobic capacity values. This may mediate increased expression of aerobic enzymes and/or adaptation in other processes, such as erythropoiesis (Kokolas et al., 2004).

Basal cortisol concentrations were also elevated for the predominance of preparatory period indicating also a high catabolic environment of our athletes (Kokolas et al., 2004). Similarly to basal testosterone, basal cortisol was also significantly related to the mean training volume (r=0.527; P=0.001). It has to be considered that activation of catabolic processes are essential tools for adaptation in the high stress situation. Furthermore, high basal cortisol levels suggest a high activity of the adaptation process, whereas a suppression from baseline levels is an indicator of significant reduction in the adaptation reserves of the organism (i.e., overtraining syndrome) (Urhausen and Kindermann, 2002).

In accordance with hormonal values, simultaneously assessed perceived recovery-stress state also demonstrated that rowers did not use all their adaptation resources during the preparation period but adapted positively to training stress (see Figure 1). It has been suggested that the Standardized RESTQ-index could be used as an athletes` resource measure taking into account perceived stress- and recovery-associated aspects at the same time (Kellmann and Kallus, 1999). In our study, RESTQ-Index did not change significantly over the 24-week training period. This would suggest that the training volume during the preparatory period did not affect seriously the psychological resources of adaptivity in our rowers. However, when Standardized Stress and Standardized Recovery scores were presented separately (see Figure 1), it showed that Standardized Stress (after Week 12) and Standardized Recovery (after Week 20) scores even improved during the course of the preparatory period in elite rowers. This could be explained by the fact that when our rowers increased their training volume (but not intensity) especially at training camp, they did not have to deal with everyday problems and they had more time for various recovery activities. This further demonstrates that the current psychological adaptation state of an athlete appears to be very complex.

The interesting finding of our study was that significant relationships were found between basal cortisol and Standardized Stress (r=0.381; P=0.002) and RESTQ-Index (r=-0.321; P=0.009) scores. In addition, basal testosterone (r=-0.349; P=0.004) was related to RESTQ-Index. These close relations between hormonal and psychometric response are very intriguing from a multi-level approach of training monitoring. The hypothalamus has an important role in integrating different stress influences and the answers from the hypothalamus are expressed via the endocrine system, the autonomic nervous system and the behavior (Barron et al., 1985). Changes in basal cortisol levels reflect the metabolic stress as the endpoint of the hypothalamus-pituitary-adrenocortical axis (Barron et al., 1985). Accordingly, changes in basal cortisol have been identified as metabolic signs of changes in psychological adaptation resources (Barron et al., 1985). Currently, it is mainly a subject of speculation how the hypothalamus senses metabolic dysbalance (Barron et al., 1985). This further confirms the need for a multi-level approach of training monitoring in elite rowers.

In conclusion, testosterone and cortisol appear increased during preparatory period. Increases in these stress hormone concentrations represent positive adaptation to current training load. Significant relationships between hormonal and perceived recovery-stress state suggest that metabolic and psychological changes should be carefully monitored to avoid unfavorable outcome on the training status in elite rowers.

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KEY COMPONENTS OF JUMP AS A METHOD OF TEACHING PROCESS IN ACROBATICS

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Abstract

The aim of the paper was to study a structure of acrobats technical preparation at the versatile and directional periods of professional training in relation to the theory of key components of technique. Diagnostic questionnaire, pedagogical experiment, literature analysis and poll questionnaire were applied to the group of acrobatics coaches (n = 25, length of work – 20÷45 y.). Cinematographic analysis systems consist of two 60 Hz cameras and APAS 2000 were also used to analyze acrobatic jump (n = 30, age 11÷25 y.). Cinematographic analysis of the acrobat technique allows to formulate three junction components in back squat somersault after round - off. Consideration of such elements in teaching process, especially the use of training protocols with pressure on junction elements, influenced on the quality performance in the experimental groups. Isolation of junction components in acrobatic technique facilitates the understanding of phase structure in acrobatic exercises.

Key words: *acrobatics, technique, training,*

Introduction

The increase of complexity and difficulties of programs' range for gymnastic competition introduced by International Federation of Gymnastics (FIG), is manifested by the new, more effective means, forms and methods of teaching. Therefore complexity of motion structure causes unknown difficulties in teaching process.

High level of complexity and high mastery are demonstrated by leading athletes who are, as a rule, winners, prize-winners and participants of the major international tournaments and championships of those countries in which sports acrobatics is highly developed. However, analysis of phase structure of executed acrobatic jumps (both basic and competitive of various complexity) shows rather significant and even gross technical errors in exercises of many athletes. This is especially peculiar in the phase of preparatory actions of executed salto and that one of concluding actions [1,3,4,5]. Technical errors prevent the athlete from qualitative execution of the major actions during flight - the salto proper [4,6,7]. In the phase of concluding actions the most typical technical errors (being the consequence of preparatory actions performed with technical errors) are: the lacking untucking, which prevents trunk extension from "gliding" in the space before landing, insufficient or excessive turned salto at the moment of landing, landing in a low squat position [5]. Tumbling is a dynamic exercise requiring control of the linear and angular momenta during the approach and takeoff phases [2]. Technical errors in concluding actions decrease the quality of stable landings as well as transition to another acrobatic jump.

Self-control of technique, presented as a certainty of correctness for complex exercises performance requires deep biomechanical analysis of acrobatic motion and examination the components structure of technical preparation.

Last year the coaches and the scientists isolated special technical preparation as the part of widely understood technical training. However information regarding position and structure of such a stage is still unknown in training process. The acquire of such information was the basic condition to achieve the success for young acrobats. Therefore the aim of the paper was to study a structure of acrobats technical preparation at the versatile and directional periods of professional training in relation to the theory of key components of technique.

Methods

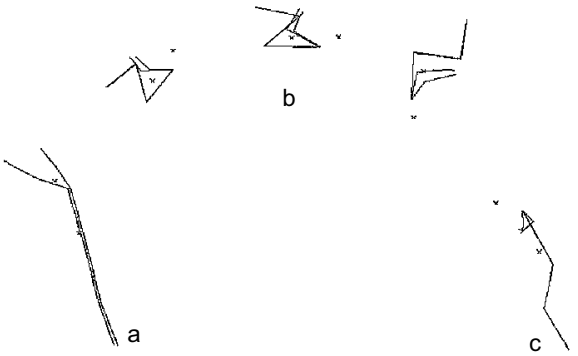
Diagnostic questionnaire, pedagogical experiment, literature analysis and poll questionnaire were applied to the group of acrobatics coaches (n = 25, length of work – 20÷45 y.). Cinematographic analysis systems consist of two 60 Hz - JVC GR – DVL9800 NTSC cameras and APAS 2000 - Ariel Dynamics Inc. were also used to analyze acrobatic jump (n = 30, age 11÷25 y.). Reflective markers (n=17) on the subject were positioned. All marker positions were tracked and reconstructed using the APAS system. Video cameras were placed in key position, 90 degrees to the plane of the path tumble. Dimensions of known factors on the field and various other measured objects in the field of view were used for the calibration points. The video pictures were grabbed and the files were stored in Audio Video Interlace format (AVI). The data coordinate endpoints were then smoothed using a second order low-pass Butterworth digital filter with a 10 Hz

cutoff frequency. The 17 data points were digitized (left and right) :foot, ankle, knee, hip, foot, wrist, elbow, shoulder, hand, and center of the head. Composite control cube consisting of 8 points and 17 data points were digitized and entered into the 2 dimensional linear transformation (DLT) module and converted to real displacements. The real coordinate endpoints were smoothed using a 10 Hz cutoff frequency in a low-pass digital filter. Interbiolink angles during tucked back salto after rund-off, velocity of body links (horizontal, vertical and resultant) and their trajectories, time of execution of acrobatic jump phases were studied.

Fifteen people of the control group and fifteen of the experimental one were involved in the work. A program of experimental group was enlarged by aspects of special technical preparation and its fourth components were specified: program of launching body, program of multiplication posture, program of final posture and program of dynamical connection in exercises. Control group was trained in a traditional manner.

Results

Analysis of the indices of the tuck back salto after round-off execution allowed to outline three key components of sports techniques: launching body posture (LP), multiplication of postures (MP), final posture (FP), (Fig. 1).



a – launching posture of body (LP),
b – "tuck" posture and its multiplication (MP),
c – final posture (FP)

Figure 1. Junction components of tucked salto backward (round-off -salto) performed by champion of Poland in acrobatic jumps

Launching posture (LP) is outlined in the phase of preparatory actions. It is characterized by technically correct position of the body segments on the support for efficient fly up to salto. Individually LP of every athlete is characterized by different position within coordinate system, however all of them are within taking-off sector restricted 7°÷5° before and 5° after vertical line. Athletes assume elastically stiff body position on the support on tiptoe stand elevated up and forward. Joint angles of LP are equal to: shank-thigh 177.72 ± 0.5°; thigh-trunk 178.01 ± 0.73°; trunk-shoulder 149.71 ± 1.51°; shoulder-forearm 155.00 ± 3.82°. During taking-off the above indices are equal to: 179.00 ± 0.48°, 179.80 ± 0.50°, 155.19 ± 0.95°, 163.20 ± 1.70°. During the phase of major actions of tuck backward salto the key element of sports techniques is the "tuck" posture and it's multiplication. MP determines the contents of athlete's movements during the major phase of tuck back salto after round-off. Tightness of tucking, velocity of rotation, height of flight and timeliness of untucking characterizes level of special technical fitness of acrobats. MP is characterized by the following joint angles of the body: shank-thigh 53.70 ± 1.66°; thigh-trunk 48.15 ± 1.01°; trunk-shoulder 29.00 ± 0.90°; shoulder-forearm 115,55 ± 1,70°.

Final body posture is a significant key component of sports techniques in the final phase of tuck back salto after round-off which allows to execute acrobatic jump to stop or to create effective conditions for transition to another jump. As regards touchdown the athletes perform half squat (angle shank-thigh –147.03 ± 1.33°) with forward half bending (angle thigh-trunk 161.40 ± 1.78°), hands forward-up; forward-sideward (angles: trunk-shoulder 108.10 ± 1.40° shoulder-forearm 160.50 ± 2.70°).

The establishment of the key components of acrobatic jump, in their biomechanical analysis and in utilization of obtained results during training and educational process is the reason for further increase of exercise complexity and improvement of acrobats mastery.

Moreover, high quality of key components performance is a guarantee of habitat transfer to other acrobatic elements.

In the next stage of the experiment periods of technical preparation (PT) structure were established (Fig. 2). Described stages are suited to long-term sport improvement: "motion school" – versatile period, special technical preparation – direct period and sport technique of competition exercises – expert period. Such stages are functionally connected to each other, and they support training process.

The first one - "motion school" is the process of building the motion behavior, is the guarantee of harmonious progress of acrobats and it gives the basis for positive transfer of motion habits to more complex exercises. The "motion school" is a starting point in technical preparation of acrobats, however its sense determines the level of competitor progress. "Motion school" is consisted of the following tasks:

1. Motor tasks for young competitors including progress of coordination ability (ability to estimation the body location, ability to static and dynamic balance, ability to environment orientation during supported and unsupported body position, ability to time differentiation and muscle feeling, ability to symmetrical and unsymmetrical motion execution, ability to motion and music linking, ability to vestibule stability and sense).

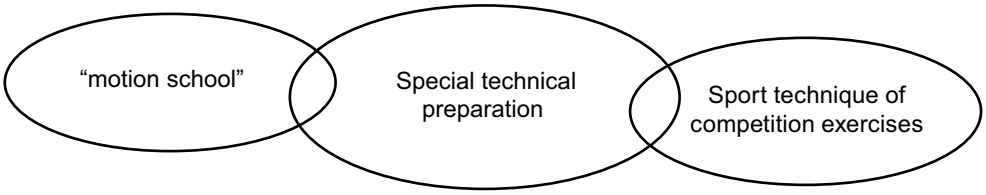


Figure 2. Structure of periods describing technical preparation of

2. Simple exercises consist of basic habits (basic gymnastics, play and game, music, dance, choreography, “small” acrobatics, exercises on incline plane, jumps on the springboard, simple exercises during morning gymnastic and warm-up).
3. Modulations of correct style during gymnastic exercises are characterized by straighten position in the knee joints and toes, dynamics of motion and artistry.

Second component of TP – special technical preparation (STP) will be treated as the process of junction components formulated in sport technique.

Junction components of sport technique are determined by body positions and ability to estimate the sense of limit in body location in structure of one exercise and among all others.

Key components of technique were divided into the following periods in the acrobatic training structure: launching body posture existed in preparatory actions, multiplication of posture existed in main actions, final posture existed in final phase of motion and the fourth one, existed in dynamical connection among all technical element.

Fifteen people of control and fifteen of experimental groups were involved in the work. A program of experimental group was enlarged by aspects of special technical preparation and its fourth components were specified: program of launching body, program of multiplication posture, program of final posture and program of dynamical connection in exercises. Control group was trained in a traditional manner.

Opinion poll and pedagogical experiment results confirm our approach. Hundred percent of coaches said that special technical preparation should be implemented in all periods of long-term training process. They claims that special technical preparation should be approximate 20% of versatile period, 52% of directional period and 28% of technical preparation period.

It is the basis to consecutive approaches regarding identification of key components in technical elements of acrobatic exercises.

Conclusions

1. Cinematographic analysis of the acrobat technique allows formulating three key components in back squat somersault after round - off. Consideration of such elements in teaching process, especially use of training protocols with pressure on key components, influenced on the quality performance in the experimental groups.
2. Analysis of components describing technical preparation in acrobatic training allows to formulate special technical preparation, its content, structure and key components of sport technique were characterized as well.
3. Isolation of key components in acrobatic technique facilitates the understanding of phase structure in acrobatic exercises and allows the coach and competitors to concentrate on training.
4. Results received from pedagogical experiment allow to affirm that special technical preparation with biomechanical indices of key components performance in acrobatic evolution is more effective ($p<0,05$) than traditional manner of training.

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OPTIMISATION OF THE LEARNING PROCESSES OF MOVEMENTS IN RHYTHMIC GYMNASTICS THROUGH MENTAL TRAINING EXERCISES

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Abstract

Mental training is a key factor in the development of performance in sports with complicated movement structures. Mental training aims to improve the regulation of the cognitive function for both sportsmen and sportswomen.

The extent to which the female rhythmic gymnast reflects upon this imagery process is currently of great interest to movement scientists.

In order to improve and control the level of the cognitive component in mental representation "Gymnastic mental" a computer aided tool, together with use of a video, was developed. This system required the performer to align and match up the different images created. The tests involving the Kosak jump and Grand Jete were carried out on a weekly basis over a four week period.

At the end of the four week period the results for the experimental group showed a marked improvement in the mental representation applied to both the two jumps and also the overall movement quality.

The process of motor learning and its application to movement, as shown in Rhythmic Gymnastics, seem to be more effective when mental and motor exercises are executed holistically.

Key words: *Mental training, Gymnastic mental, cognition, jump techniques, motor learning*

Introduction

Mental training is a key factor in the development of performance in sports with complicated movement structures (Dance, Figure Skating, Apparatus Gymnastics, Rhythmic Gymnastics). Mental training aims to improve the regulation of the cognitive function for both sportsmen and sportswomen.

It has been proven in practise, that when the sportsman has repeated a number of times the movement imagination then practise follows it is more efficient (Schnabel, Harre, Krug, Borde.2003)

Mental exercise during sports training can affect mental representation and as a result how a sportsman or woman actually performs sporting techniques. As already stressed in various investigations, this can be statistically quantified when we look at a sportsman or woman's control of ability to regulate certain moves (Schellenberger, Günz 1980, Heuer 1985, 1990, Narciss 1993, Wiemeyer 1994, Gikalov 1994, Munzert 2001). When mental representation is built up with the aid of systematic techniques, performance is enhanced considerably. Mental training should be applied with;

1. Before the competition started as preparation;
2. With training interruptions during illness or injuries;
3. As an supplement during the first phase in learning process
4. As an important supplement during the stabilisation
5. It should be applied consciously under instruction and leadership of trainer.

The extent to which the female rhythmic gymnast reflects upon this imagery process is currently of great interest to movement scientists. Knowledge gained from rhythmic gymnastics can be recalled from what the movement scientist terms explicit memory. This can be further enhanced by means of the sensory elements from the emotional memory. When this mental training is developed with the aid of systematic techniques, performance is enhanced significantly.

Imagery manifests itself in cognitive processes. Gymnastic techniques with their temporal, spatial and dynamic structures are one example of this process. On a more abstract level it has been connected with concepts of image and space, kinaesthetics, tactility, language and symbolism.

If these concepts are adopted, mental representation can therefore be understood as forming part of a mental process. As a result of this, by linking together hitherto unrelated information, new patterns of thought and movement appear that, among other things, affect the way a particular sporting movement is viewed in the sportswoman's imagination.

This premise, which is central to our own specific research, raises the following question:

Question

Can the cognitive components of the rhythmic gymnastic movements be further enhanced with the aid of mental training exercises and to what extent does this affect how the movements themselves are technically performed?

Methods

In order to improve and control the level of the cognitive component in mental representation "Gymnastic mental" a computer aided tool, together with use of a video, was developed (Fig:1). This system required the performer to align and match up the different images created. The series of tests were designed in order to discern the changes in the cognitive components and were undertaken both before and after the training exercises. The tests involving the Kosak jump, Grand Jete and jump with for spread leg and ½ turn were carried out on a weekly basis over a four week period.

As well as the cognitive and motor components were checked in a pre and post test (Fig:2). The motor development of selected techniques was investigated with help of an expert rating.

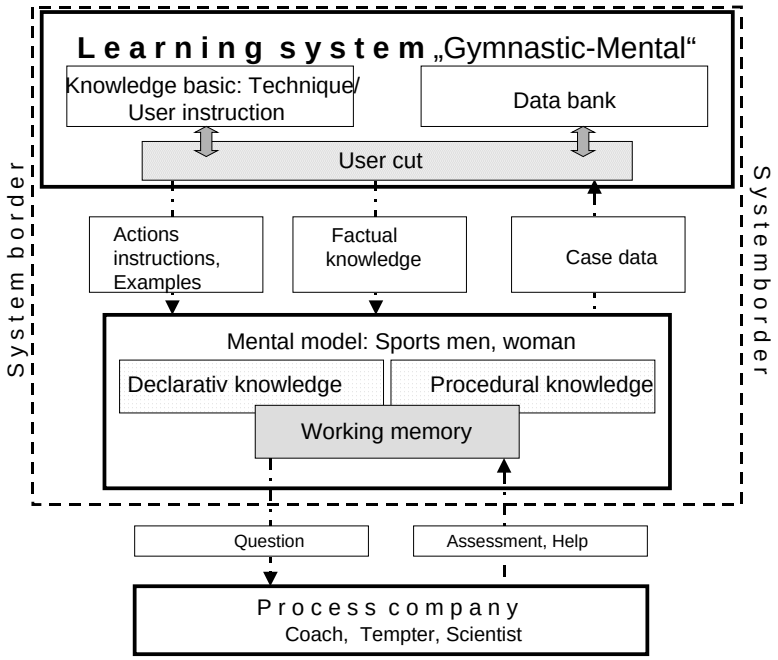

Figure 1: Model of Learning system "Gymnastic mental"

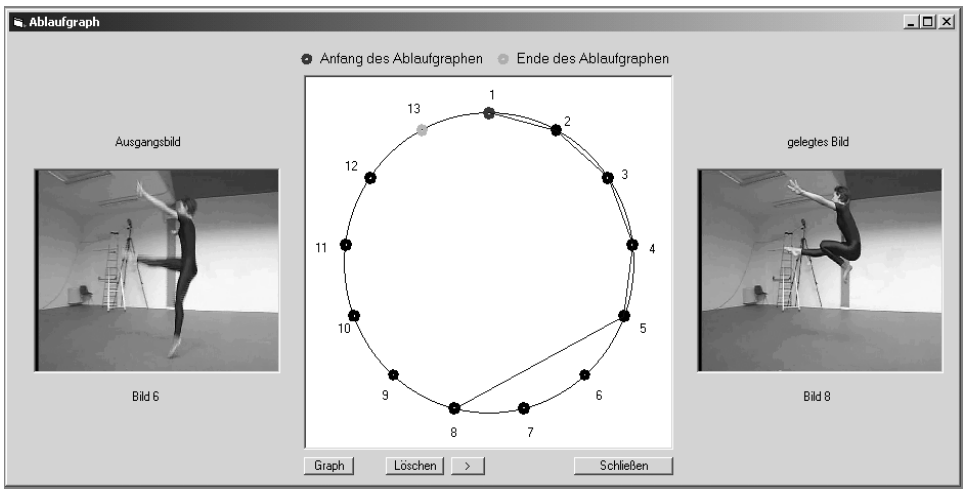

Figure 2: Example of wrong picture row in mental test "kosac jump" (number 5)

Results

At the end of the four week period the results for the experimental group showed a marked improvement in the mental representation applied to the three jumps and also the overall movement quality (Fig:3).

The process of motor learning and its application to movement, as shown in Rhythmic Gymnastics, seem to be more effective when mental and motor exercises are executed holistically.

In comparison of the three jumps the experimental group has the highest improvement regarding the jump with spread leg and ½ turn. This shows that mental training effects especially coordinative selective techniques.

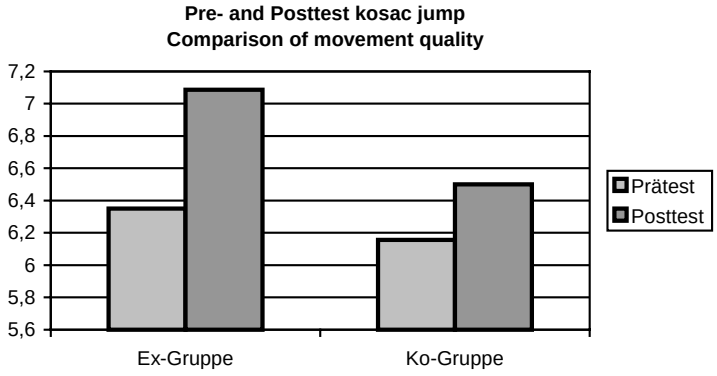

Figure 3: Development of quality of kosac jump

This research indicates that the cognitive reproduction of temporal, spatial, kinaesthetic and linguo-symbolic elements within these movement structures have taken place. These findings confirm the theory that a cognitive element from memory has been both recalled and applied. It has shown that over a four week period a well developed mental reproduction has influenced the motor performance.

Summary and Conclusion

The development of a new research tool, "Gymnastic mental", which was computer/video based, provided a mental training and checking system to assess the links between recall and performance over the four week period.

The results show that sportswoman can both learn and develop their movement imagery and recall to aid their understanding of complicated structures before their execution in practice. Similarly the trainer, working with the performer, can control the movement imagery of the sportswoman while together they can analyse and rectify any mistakes.

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CHARACTERISTICS OF LOADS DURING COMPETITIVE ROWING

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Abstract

The management of the training process for all types of sports requires quantitative and qualitative information about the basic characteristics of competitive and trainings loads. A lot of experimental data was published about changes observed in each one of those parameters. Obtaining new information in this field is significant for the individualization of training. The aim of the study is to systematise and present some quantitative characteristics of trainings loads, measured during the competitive performance of elite women and men scullers. The subject of our research were 18 elite Bulgarian and Turkish scullers: women (6) and men (12) of regular and lightweight categories. The methods of the research included measurements of HR changes ("Pollar`s –S 810; S 710), blood lactate concentration, sports performances ("Speed-coach" timers), average boat speed control competitions. The data was statistically systematized (ANOVA) and comparatively analyzed. The analysis of the results showed that the characteristics of training loads are individually determined and limited. The HR changes for different athletes during competitive rowing ranged from 185 to 200 beats per minute. The maximum score we have had during our research was 198 beats per minute. The blood LA concentration varied individually, ranging from 8.7 – 14.2 m mol l^{-1} during 2000 m competitive rowing.

Introduction

The management of the training process for all types of sports requires quantitative and qualitative information about characteristics of loads. A lot of research (Godik 1980, Zeljazkov 1998, Bompa 1999 etc.) has been done lately on the theoretical aspects of the problem.

Table1 :Parameters of training loads in rowing

Parameters of training loads in rowing	Functional reactions of the organism of the rower
* boat speed (average; minimum; maximum) * stroke rate * duration of rowing cycle (time; distance) * strength in oars * power	* HR changes (average; minimum; maximum) * blood LA concentration * characteristics of breathing * VO_2- max; max/kg

The most important parameters of training loads in rowing and their corresponding functional reactions are systematized in Table 1. A lot of experimental data have been published about their changes (Emchuk 1976, Nelsson 1987, Bompa 1994, Neykov 2001, Bachev 2003 etc.)

For example, the previous existing data of the average HR changes during high intensity and competitive rowing, according to different authors were: 228-240 (Borisov-1952); 220-240 (Bassan -1968); 180-200 (Neycov-2001); 180 -200 (Bachev-2003) etc.

Obtaining new information in this field is significant for the individualization of the training process.

Aim and methods

The aim of the study is to systematize and present some quantitative characteristics of loads and the corresponding functional reactions, measured during competitive rowing of elite women and men scullers. ***The subject of the research*** were 18 elite Bulgarian and Turkish scullers: women (6) and men (12) of regular and lightweight categories. The functional characteristics of some of them are presented in table 2

The methods of our research included measurements of HR changes ("Pollar –S 810; S 710), blood lactate concentration, sports performance ("Speed-coach" timers), average boat speed, stroke rate, distance rowing cycle duration during 2000m regional and national control competitions. The data was statistically systematized (ANOVA) and comparatively analysed.

Table 2: Functional characteristics of some of the subjects of investigation (Bulgarian rowers; bicycle maximal non stop stair test)

Characteristics / Rowers	W	W/kg	VO_2 max	VO_2 max/ kg	HR max
Women 1	300	4.75	3850	58.69	189
Women 2	320	4.34	3400	46.81	181
Men 1	460	4.79	6250	65.10	182
Men2	440	5.79	5850	76.45	199
Men3	390	4.75	4800	58.47	203

Results

The quantitative characteristics of competitive loads and functional reactions of elite Bulgarian rowers are presented on Table 3.

Table No.3: Quantitative characteristics of competitive loads and functional reactions of elite Bulgarian women "1x" rowers.

Parameters	Boat speed (m/s)	Stroke rate (number of cycles per minute)	Distance duration of rowing cycle (m)	HR (beats per minute)	Blood LA concentration (m mol l^{-1})
X - average	4.09	33	7.49	193	12
X - minimum	4.04	31	6.88	188	8.7
X - maximum	4.15	35	8.05	198	14.2
S	0.263	1.414	0.320	3.288	1.874

All the results were systemized in three groups

Individual HR changes during competitive rowing

The quantitative characteristics and percentage distribution of HR changes of light weight "2x" rowers are presented in Table 4 and Fig.2.

Table No.4: Quantitative characteristics and percentage distribution of HR changes of "2x" light weight rowers (2002- Ankara regional championship; Turkish national championship)

Competitions \ Interval		160-170	170-180	180-190	190-200	>200
Ankara regional championship	1	1%	1%	27%	71%	0%
	2	1%	1%	12%	86%	
$\bar{x}$		1%	1%	19.5%	78.5%	0%
Turkish national championship	1	1.3%	0.7%	6%	92%	0%
	2	0.7%	0.7%	4.6%	94%	
$\bar{x}$		1%	0.7%	5.3%	93%	0%
$\bar{x}$		1%	0.8%	12.4%	85.8%	0%

Integrative data

Another example of quantitative characteristics and percentage distribution of HR changes is presented in Table 5.

Table No.5: Quantitative characteristics and percentage distribution of HR changes of Turkish elite rowers – 2000m.

Parameters Competitors	Competition	Sports performance	Scores			Percentage distribution			
			Min	Max	$\bar{x}$	160-170	170-180	180-190	190-200
Women "1x" L.W.	Control	9.18.3	160	192	181	4.3%	31%	53.7%	11%
Men "2x" L.W.	Regional	7.34.5	163	196	189	1%	1%	27%	71%
			160	197	191	1%	1%	12.5%	86%
Men "1x" B	National	8.20.9	161	202	195	1%	1%	6%	83%
Men "1x" B.	National	7.421	163	194	188	1%	2%	24%	73%
Men "2x" L.W.	National	7.22.8	163	180	182	1%	14%	80%	5%
Men "2x" L.W.	National	7.05.2	163	197	191	1.3%	0.7%	6%	92%
			163	198	193	0.7%	0.7%	4.6%	94%

Correlations between HR changes and some other parameters of competitive loads

The coefficients of correlations are presented in Table 6.

Table 6: Coefficients of correlations (above –men, below – women)

Parameters	Boat speed (1)	Stroke rate (2)	Distance duration of rowing cycle (3)	HR (4)	Blood LA concentration (5)
1.	*	0.130	0.375	0.640*	0.990*
2.	-0.228	*	-0.817*	0.010	0.882*
3.	-0.188	-0.625	*	0.322	-0.631*
4.	0.183	0.860*	-0.879*	*	0.630*
5.	0.357	0.553	-0.953*	0.854*	*

Analysis and discussion

The analysis of the individual results showed that after the boat starts there is a period of 40 - 50 sec. time duration of HR increasing to 180-185 beats per minute (Fig.3). This time period, compared with the boat speed and stroke rate acceleration, is four to five times longer. This means that the warming up before the competitive start must be very active. On the other hand in the process of planning the trainings loads, functional effective time duration of 2000m exercises must be increased by 40-50 seconds (8 to 8.30 min.).

The comparison of HR percentage distribution in different types of rowing competitions reveals the following tendency: the average HR changes in 200m control test rowing are 65% in a range of 200-180 beats per minute, 30% in a range of 180-170 beats per minute, and 5% under these values.

These proportions change when the level of competition is higher. During regional and national championships the ratios for one crew – "2x" light weight men – are 80% in an interval of 200-190 beats per minute, and 10% in an interval of 190-180 beats per minute. Taking into consideration these results, HR changes during competitive rowing range in 180-200 beats per minute. The analyses of all rowers' experimental data confirm the same tendency. The HR changes during competitive rowing range between 180-200 beats per minute. The maximum score we have had in our research is 198 beats per minute.

These facts can be used as an objective basis for the structural characteristics and the assessment of competitive loads of elite rowers.

About the correlations between the parameters of loads, as logically expected, high scores of coefficients, were observed between HR changes and stroke rate increase ("r"=0.860), and also between the distance duration of the rowing cycle ("r"= -0.879) and blood LA concentration ("r" = 0.854) in the group of women ($Pt \leq 0.05$).

No significant correlation between boat speed and HR changes has been found with the same competitors. In the group of men rowers significant coefficients were not established between the stroke rate changes and distance rowing cycle duration. On the other hand, high correlation between HR changes and boat speed increase was observed ("r" = 0.640), ($Pt \leq 0.05$).

Conclusions

- The long time period of HR increase after a competitive start requires very active warming up before a competition.
- The HR changes during competitive rowing are over 90% in a range of 180-200 beats per minute.
- There are not repeated and very high correlations between HR changes and other load parameters during competitive rowing.
- The management of the training process can be optimised based on the regular and individual information, obtained from the monitoring of competitive load changes.

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TACTICAL TRAINING INTENSITY ANALYSIS OF NATIONAL U-18 SOCCER TEAM MEMBERS WITH POLAR-TEAM SYSTEM HEART RATE MONITORS*

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Abstract

The purpose of the presented study was to find out the level of intensity of technical-tactical training in U-18 national team members with Polar team system, which took place at summer physical preparations at Rogla 2004. We wanted to know if we could influence the individual player with tactical training in the sense of endurance development. We also tried to find out what the differences in different players' positions intensity inside the team are. We compared a central and side defender, which is quite equal in endurance level. We used Conconi shuttle run test (SRT) for finding out the level of individual endurance preparation. Considering the heart rate frequency during the tests we defined anaerobic threshold for individual player, which we got with observing the heart rate deflection at the SRT.

Key words: *soccer, endurance, heart rate frequency, anaerobic threshold, training intensity*

Introductions

Methods

Ten members of national U-18 soccer team participated in the study. We used Polar heart rate monitors S 610i for getting information about individual endurance preparation, and Polar team-system for finding the level of training intensity. We also compared two defenders with the approximate same level of endurance preparations. Descriptive statistic parameters were calculated for all of those parameters.

Measure technique description:

Preparation and execution of SRT

We used SRT for finding out the level of endurance preparation. We also got information about the level of the average and maximum heart rate and heart rate after 30, 60 and 180 seconds of the race. SRT is based on run where the length of run in one way is limited to 20 meters (figure 1), where the players stop and turn for 180 degrees and run back to the first line. The tempo of the run is recorded by the tape through tape recorder with the sound signal. During the test the level of intensity increased approximately every minute.

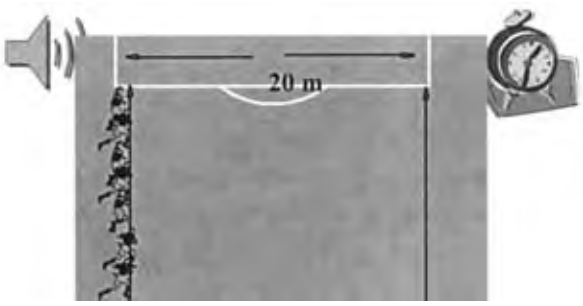

Figure 1: Schulte run with direction changing

Preparation and execution of Polar Team System (PTS)

In team sports where the contacts often take place it is not allowed to use any wireless receiver. That was probably one of the reasons why Polar developed the PTS (Figure 2). The advantage of PTS is that we don't need a watch as our transmitter collects the data. PTS includes 10 Team System transmitters, interface and software.

Figure 2: Polar team System

Three parameters were used at SRT

- The time measured during the run (time)
- Anaerobic threshold – heart rate deflection (Vd)
- Heart rate maximum (FSU-max)

We also used three parameters to determine the intensity of individual training

- The average heart rate (FSU-av)
- Total training time (TT)
- Time above the anaerobic threshold (% above Vd)

* *Young researcher award*

Results

Table 1: Observation of values presentation at the SRT and during the training

		Conconi's test			Intensity of training		
name	place	SRT	FSUmax	Vd (AP)	FSU_av	time	(% above Vd)
Player 1	central defender	12:43	198	145	153	1:41:00	24,8% (25:25)
Player 2	side defender	12:17	206	162	171	1:41:00	30,7% (31:00)

Central defender achieved a little better result in SRT. He has a little lower HRmax (198 Hr/sec) and lower level of heart rate deflection. Table 1 also shows that training was more strain for side defender which has higher HR (171 HR/min) and the time above deflection HR limit was according to some authors (Erčulj, 2001) 30,7% above anaerobic threshold.

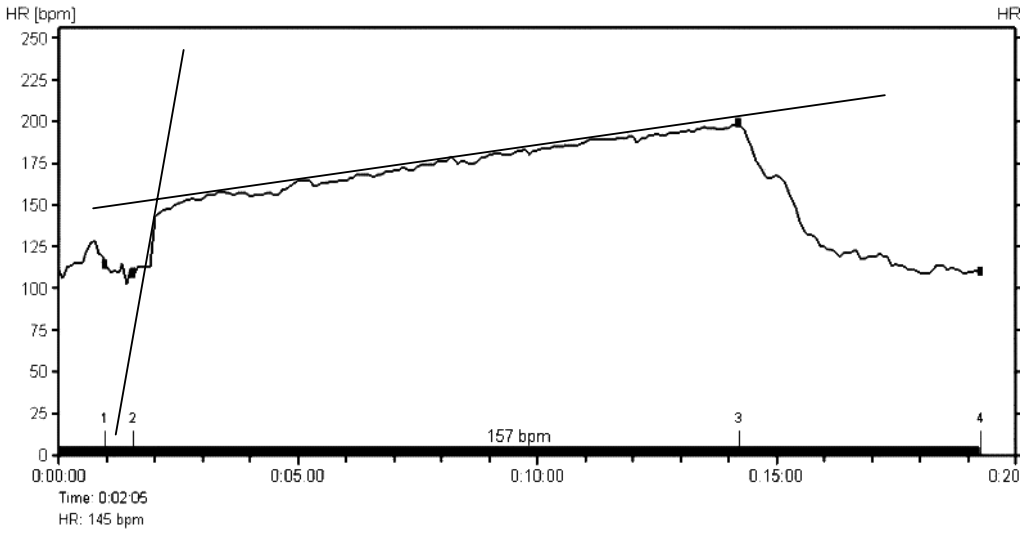

Figure 3: The copy of the heart rate in SRT and heart rate deflection presentation

Figure 3 presents increasing Heart rate line during SRT, where the difference between heart rate in subordination and running speed is clearly evident. When the run starts there is a linear relation between heart rate and the level of the run. When the speed is rising, we come to the point where the run speed increases faster than the heart rate. Under the finding of Italian scientist Conconi the critical point when the straight line is broken is named the anaerobic threshold (Erčulj, 2001). In some cases that kind of intensity is similar to those which define anaerobic threshold, but in most cases it is even higher (Ušaj, 1997).

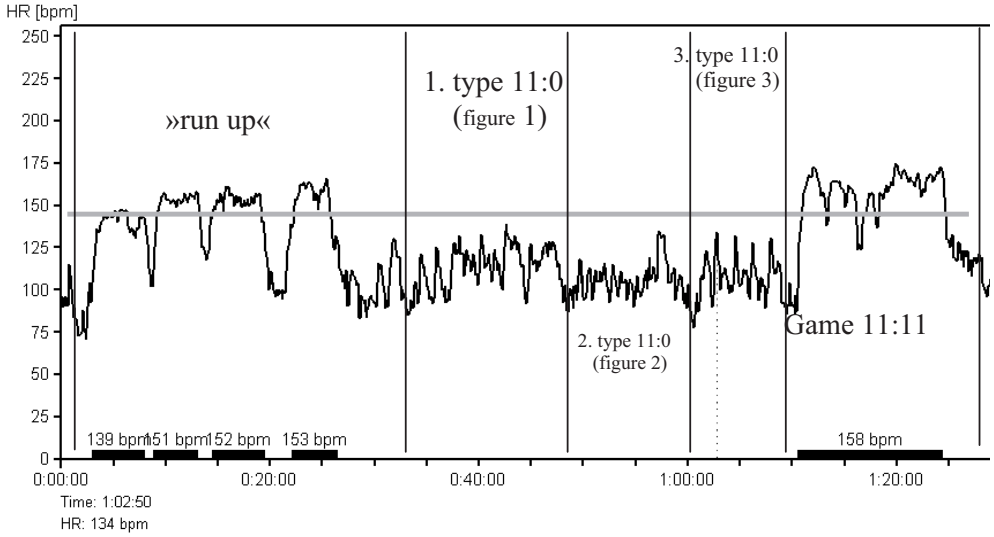

Figure 4: The copy of the heart rate of the central defender during the tactical training

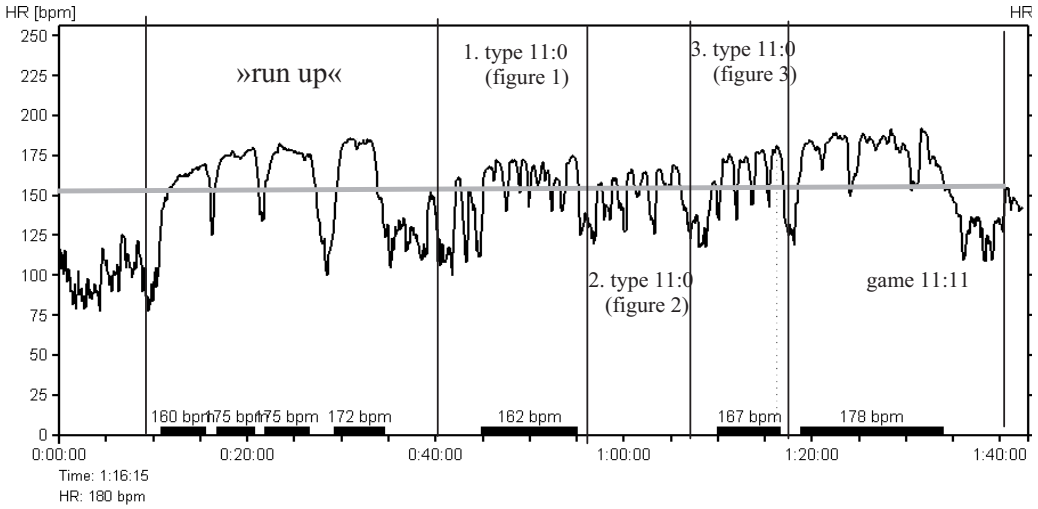

Figure 5: The copy of the heart rate of the side defender during the tactical training

Figure 4 and 5 define heart rate during the tactical training. A wide line shows anaerobic threshold, defined with deflection of heart rate at SRT. We divided both graphs to 5 parts, which illustrate the individual training region. The second part has 4 peaks which present 4 types of tasks in warming up.

Discussion

Training analysis shows that intensity was very high in the preliminary and also in the last part of training, because it was almost always above the anaerobic threshold. In the middle part of training where the players practice three different passes combinations in the phase of attack, we could see some differences in effort, independently of the player's position. The central defender didn't achieve the intensity of anaerobic threshold; while the side defender achieved it always when he was active. The reasons why that happened is presented in figures 4 and 5, where it is evident that each attack starts with the side defender. During the first and second pass he accepts the ball, leads it faster a few meters and passes it to the next player - contrary to the central defender, who, in two passes, doesn't touch the ball at all and moves slowly according to ball position. At the third part of training (figure 3), the side defender comprises to the attack second half of the playground, where he performs cross from the side and because of that the effort of that player is even greater, what we could see in figure 5. Through this pass the ball touches also the central defender, who performs the long pass to the side attacker. The effort made by the long pass is also visible from figure 4, where the smallest sharp peaks indicate increase and decrease of heart rate.

We find out that from the point of endurance development the training was intense enough for the side defender. 30% of training for that player was made above anaerobic threshold. He also has quite higher average heart rate (171 b/min). Central defenders were less burdened than side players because all central players were quite static as they practiced 11: 0. The average heart rate confirms that, because it was relatively low (153 b/min).

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EXERCISE, BONE MINERAL, AND OSTEOPOROSIS

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Abstract

Despite the evidence that young athletes and children engaging in high-impact exercise training accumulate bone mass at a faster rate than their sedentary controls, and that exercise training can prevent bone mineral loss in older women, most studies fail to systematically examine which parameters of exercise are osteogenic. We report small increases in whole-body and leg, but not arm, bone mineral density (BMD) in post-menopausal women who trained for 15 weeks at high exercise intensity, and BMD losses during training at low exercise intensity. Human studies need to systematically examine the osteogenic properties of exercise intensity, pattern, and timing to better define exercise parameters for greater accretion of bone mass in children and adolescents and for prevention of bone mineral loss in aging.

Key words: *exercise training, bone mineral density, osteogenic stimulus*

There is little doubt about the health benefits of physical activity. Most research has focused on the rapid, and more readily measurable, changes in structural and functional improvements that result from exercise. The effects of physical activity on bone mineral is less easily measured as they accumulate slowly, although rapid bone mineral loss that results from inactivity has long been recognized. Two aspects of the effects of physical activity on bone biology have been of particular interest: (1) the capacity of physical activity to increase accretion of peak bone mass during growth and development, and (2) its capacity to retard bone mineral loss with aging. The issue is of great relevance to women because of their smaller skeleton and greater bone mineral loss after the menopause. This paper will briefly review current understanding of these two issues (for more extensive review see Borer 2005), present some research data, and outline areas of research that need resolution.

Physical activity and bone accretion.

During the pubertal growth spurt, that occurs in girls between 10 and 14 years, bones increase in length, mineral content, and in diameter. After the onset of menarche at around 12.5 years, all three processes slow down. The first one ceases within a few years of attaining adolescence, while the other two continue operating throughout the lifespan.

Evidence that physical activity can increase peak bone mass derives from studies of racket-sport athletes and participants in sports generating strong ground-reaction forces (GRFs) and joint-reaction forces (JRFs) who initiate training at a young age and carry it out until adolescence, and from longitudinal research studies in which children were exposed to high-impact activities such as jumping for a period of several months (for review see Borer 2005). Contradictory evidence stems from situations where exercise training of between 5 and 15 hours per week generated energy expenditure in excess of energy intake and caused growth retardation (Daly et al., 2000) illustrating the fact that abundant nutrition is a prerequisite for statural growth.

Physical activity and bone mass retention.

From the onset of puberty through young adulthood, research studies show reduced dependence of bone mass on dietary calcium and minor effects of physical activity on bone mass accretion (Lloyd et al. 1996). This is most likely due to the positive influence of estradiol on intestinal calcium absorption and to the combined influence of high titers of estradiol and growth hormone on bone mass accretion. During the perimenopausal transition, calcium supplementation as well as exercise that generates high-intensity GRFs and JRFs, produce significant increases in BMD in some studies, while exercise training implementing GRFs and JRFs at lesser intensities often report no changes. Since the menopause ushers estradiol withdrawal and attendant increase in the rate of bone mineral loss, it is of particular interest to find out to what extent physical activity can prevent bone loss or help in accumulation of bone mineral. To examine the effects of exercise intensity on BMD in postmenopausal women, we performed the following study (Borer, Fogleman, & Sowers, unpublished data).

Methods

Twenty-five healthy postmenopausal women were initially recruited to a training study that involved walking for the duration of 15 or 30 weeks at one of two exercise intensities. Two subjects withdrew from the study during the first

15 weeks, and an additional eight dropped out during the second 15 weeks, so that changes in BMD measured by DEXA (Lunar DPX) were completed before and after 15 weeks of training in 23 subjects, and after 30 weeks of training in 15 subjects. The aerobic fitness of subjects was assessed from the measurement of their ventilatory threshold (VT is exercise intensity at which the ventilatory rate exceeds the rate of oxygen consumption). After stratification for age, body mass, and VT, subjects were assigned to train at either 95% or at 125% of their VT. Training entailed supervised walking of a 4.83 km distance per day, five days a week, at the assigned speed at a commercial mall. Characteristics of the subjects in the two groups did not differ at the outset. They were, in the fast and slow groups, respectively, age 58.9 and 58.1 years, body mass of 76.4 and 78.5 kg, BMI of 29 and 29.8 kg/m^2, and VT of 5.38 and 5.4 km/h. In addition, there were no differences in total body (1.187 +/- 0.02 vs 1.172 +/- 0.02 g/cm^2), leg (1.291 +/- 0.01 vs 1.245 0.02 g/cm^2), or arm (1.31 +/- 0.004 vs 1.172 +/- 0.06 g/cm^2) BMDs between the two groups at the outset .

Results

After 15 weeks of training, total BMD increased by 0.403 +/- 0.21 percent in the fast walkers and decreased by 0.903 +/- 0.298 percent in the slow walkers (t= 3.601, p=0.0015). The results were similar for leg BMD change, where there was an 0.079 +/0.33 percent increase in the fast walkers, and a 1.086 +/- 0.46 percent decrease in the slow walkers (t=2.096, p=0.047). By contrast, BMD of the arm bones was unaffected by training. After 30 weeks of training, the fast walkers maintained their total body BMD gains, while slow walkers restored the BMD lost during the first 15 weeks of training. During the second training period. BMD increased by 1.57 +/- 1.05 percent in the slow walkers, who thus made up for the BMD loss during the first 15 weeks and added a 50% increase to the recovered amount. By contrast, fast walkers lost 1.068 +/- 0.41 %, which represented a slightly greater loss of BMD than they gained during the first 15 weeks of training (t=2.561, p=0.023). Changes in arm BMD were again not significant.

Discussion and implications

This study confirms the observation of others that exercise intensity is an important parameter of exercise training for maintenance and accretion of bone mineral in postmenopausal women (Hatori et al, 1993). It also shows that BMD gains can be lost over time, if exercise intensity is not sustained or increased, a finding that was also previously reported.

While exercise intensity, that was achieved in this case with increased speed of walking, increases mechanical bone loading, additional osteogenic properties of mechanical stimulation have been defined in studies using animal models. When rodent limb is subjected to repetitive compressive stresses along its long axis, it responds with periosteal growth and increases in BMD if the following conditions are met:

(1) the stress is of greater than habitual intensity; (2) it is applied at a high frequency ;(3) it is applied for a short period of time comprising a limited number of stress cycles (beyond which stimulation becomes ineffective); (4) it is applied in an un-accustomed orientation; and (5) it is re-applied after an interval of at least 8 hours (Turner & Robling, 2004) . Animal studies thus demonstrated that bone reacts to dynamic rather than static loading, which is the type of loading one obtains from vigorous physical activity. The intensity and orientation of loading needs to exceed the usually encountered stresses. This intense stimulus can be relatively brief (in the rodents 30 rapid loading cycles are sufficient). And a period of about 8 hours of rest must intervene between the stresses to produce superior osteogenic response.

It appears that only athletes approximate the conditions for optimal osteogenic response. They often train twice a day, in the morning before their daily non-athletic commitments, and in the afternoon. They usually attain higher exercise intensities, and in some sports like gymnastics, load their bones in unusual orientations. Superior BMDs and increased bone diameters of athletes in some sports are often discounted as reflecting the self-selection of individuals with particular physiques for particular sports. However, a 20 to 25% increase in the bone mineral content (BMC) of stroke arm relative to control arm in racket-sport players who started training as children, can not be accounted for by self-selection in view of the selective change in the trained arm (Kannus et al., 1995). Most human training studies to date, that examined the role of physical activity on bone mineral, failed to observe the above rules for optimal intensity, pattern and timing of bone loading to obtain a superior osteogenic response. In most longitudinal research studies, training is usually done once a day, for 30 to 45 minutes, two to three times a week, at variable intensities, and often using customary loading patters. No studies to date appear to have examined the osteogenic effect to human bone of loading stimulation at 8 hour intervals.

Animal studies were designed to isolate mechanical stimulation of a limb from the composite hormonal and mechanical stimulation that is obtained during physical activity. Intense exercise stimulates secretion of both growth hormone and of parathyroid hormone (Borer 2005). Both hormones have anabolic effects on the bone, that depend entirely on the intermittent, rather than continuous, nature of hormonal stimulation. Concomitant hormonal and mechanical stimulation during intense physical activities is probably the real reason for the effectiveness of dynamic exercise to produce site-specific bone mass accretion. Therefore, it is imperative that human experiments be designed to examine the relative importance of exercise intensity, pattern, and timing on both bone mass accretion during growth, and bone mass preservation during aging.

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LACTATE METABOLISM IN INACTIVE ARM MUSCLES DURING CYCLING AT MAXIMAL LACTATE STEADY STATE INTENSITY

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Abstract

Two groups of subjects performed continuous exercise on cycle ergometer at maximal lactate steady state (maxLAss) intensity at two conditions: with resting arm and with resting arm with additional heating. The aim of the study was to ascertain lactate metabolism in arm assessed from the difference in lactate concentration (ΔLA) from arterialized-capillary ([LA]c) and venous blood ([LA]v) during both conditions. The results showed positive ΔLA which may lead to conclusion that lactate is metabolized by arm muscles during leg exercise with resting arms. On the contrary, the ΔLA changed to negative values during the resting and heating condition, which can be explained as lactate production (release). The reason of change from muscle lactate uptake to lactate production (release) may be in increasing muscle temperature, blood flow and circulating adrenaline. This may influence significantly on lactate balance during maxLAss intensity.

Key words: *lactate concentration, difference, capillary, venous, blood*

Introduction

During continuous exercise at the intensity that corresponds to maximal lactate steady state (maxLAss) the lactate concentration ([LA]) is steady (with small fluctuations) at about 3 – 5 mmol/l, after its initial increase at the beginning of exercise. Therefore, the rate of lactate production, after the initial phase of exercise matches the rate of its elimination (Brooks, 1991). This is characteristic for arterial and arterialized capillary blood. Arterial blood flow is directed towards all organs in spite they have different activity during exercise. Some (exercising muscles, heart, brain…) are crucial for exercise performance and selectively take the greatest part of circulating blood flow for their function. The others (low and non-active muscles, splanchnic organs, liver, kidneys…) receive small part of arterial blood. Therefore, by central and peripheral blood flow regulation the cardiovascular system redistributes blood flow where it is mostly needed (Astrand and Rodahl, 1986; Secher et al., 2000). Low- and non-active muscles have reduced nervous activation, metabolism and blood delivery. Their mass may be relatively large. During cycling muscles of both arms are almost inactive. Therefore, due to their low metabolism, they can contribute to the characteristics of maxLAss, by the uptake of lactate produced in working muscles and/or by the production of lactate in some conditions. The first aim of the study was therefore to ascertain the difference between [LA] across the arm to asses whether the arm muscles produce or extract lactate which is transported by arterial blood. Blood flow in the arms may increase during work, as the muscle temperature increases. The second aim of the study was to determine what effect, during leg work at maxLAss, for lactate metabolism in the arm has the increase of muscle temperature (with additional heating of forearm) without arm activity.

Methods

Two groups of healthy subjects of different cycling performance level participated in the study. GROUP A (N= 7 subjects, 25 ± 4 years, 73 ± 5 kg, 175 ± 10 cm) exercised for 1 hour at pre-determined maxLAss intensity. GROUP B (N= 7 subjects, 23 ± 3 years, 75 ± 5 kg, 182 ± 7 cm) exercised for 1 hour at pre-determined maxLAss intensity however with additional electrical heating of the forearm region (39-40 ºC). The venous catheter was inserted in the antecubital vein approximately 10 min before the exercise for obtaining venous blood samples. Additionally, the ear-lobe was hyperemied by using Capsolin paste for obtaining arterialized capillary blood samples. Blood lactate concentration was measured from 10 µl samples and dissolved in cuvetes by using Laboratory Photometer 420 (dr. Lange, Germany). Samples were taken before exercise, after warm up, at 1., 2., 3., 5., 10., and every 10 min until 1 hour in GROUP A. The number of blood samples was reduced in GROUP B to resting, after warm up, and at 10., 20., 40., and 60 min of exercise.

Results were analyzed by comparison of [LA] between arterialized-capillary ([LA]c) and venous blood ([LA]v) samples in each of both exercising conditions: resting arm and resting & heating arm conditions by using paired t-test at selected time intervals. Additionally the differences between arterialized-capillary and venous blood [LA] (ΔLA) were calculated for both conditions. Differences between (ΔLA) of both conditions were compared thereafter by using t-test.

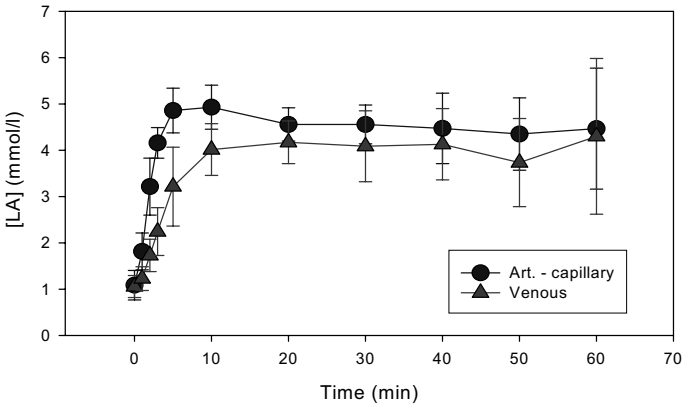

Figure 1. [LA]c and [LA]v during cycling at maxLAss intensity with resting forearm.

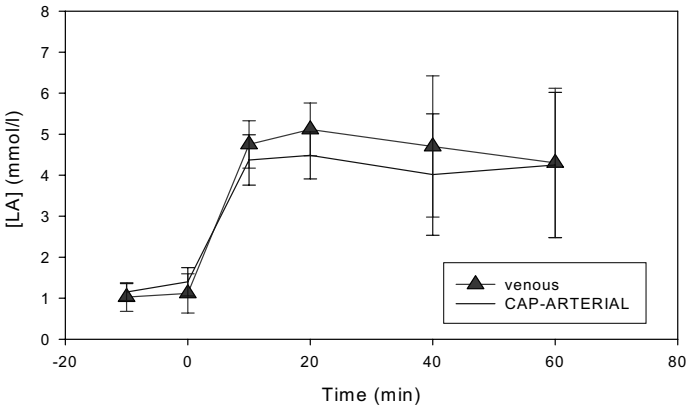

Figure 2. [LA]c and [LA]v during cycling at maxLAss intensity with additionally heated resting forearm

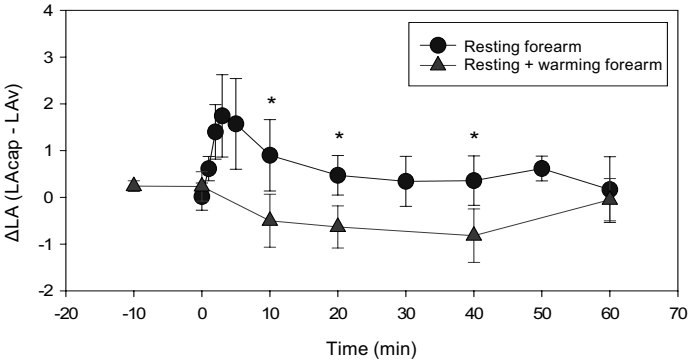

Figure 3. The ΔLA of two groups of subjects (resting forearm, group A and resting & warmed forearm, group B) during cycling at maxLAss intensity (= P<0.01).*

Results

The [LA]c increased, in approximately 5 min, to 4.9 ± 0.5 mmol/l in GROUP A, and thereafter fell (and remaind steady) to 4.6 ± 0.7 mmol/l (Fig. 1). The [LA]v increased to 4.0 ± 0.6 mmol/l, reaching steady values between 10 and 20 min of exercise. The differences between arterial-capillary and venous [LA] were significant at the intervals before [LA]v reached steady state. Although the mean [LA]v was always lower than [LA]c, to the end of the test, the difference after 10 min of exercise was not statistically significant.

With additional forearm heating, [LA]c increased in GROUP B to 4.4 ± 0.9 mmol/l. It fluctuated at similar values to the end of exercise (Fig. 2). The values were similar as in GROUP A. The [LA]v increased to 4.7 ± 1.7 mmol/l which was higher than [LA]c, but the difference never reached statistical significance. Therefore, the different groups of subjects reached very similar [LA]c. Similarly, there was also no significant difference of [LA]v between resting and resting & heating arm conditions. However, there was a clear tendency towards higher [LA]v, when additional heating was applied.

When differences between [LA]c and [LA]v were calculated (ΔLA) and compared between both conditions, there were significant differences in ΔLA (Fig. 3). The initial values of ΔLA were similar for both conditions. However they changed thereafter in opposite ways: ΔLA of resting forearm increased to approximately steady values of +0.4 ± 0.5 mmol/l, while ΔLA of resting & heating forearm decreased to about -0.7 ± 0.5 mmol/l. The difference was significant (P<0.01), except for the last measurement at the end of exercise.

Discussion and conclusions

The main finding of this study is the positive difference of lactate concentration between arterialized-capillary and venous blood in resting arm muscles during maximal lactate steady state intensity, indicating extraction of the circulating lactate by resting arm muscles.

In contrary, higher levels of lactate concentration in venous blood with additional heating of the forearm muscles indicates production of lactic acid during this condition.

The metabolism of muscles resting during exercise is influenced by several factors. The blood lactate is easily combusted metabolite therefore a very usable fuel (Brooks, 1991). At lower muscle temperature and blood flow there is no significant increase of glycogenolysis (Astrand and Rodahl, 1986; Secher et al., 2000). It is probably suitable for muscle uptake of circulating lactate as fuel in low capacity, predominantly fast twitch arm muscle (Brooks, 1991). In spite of the increased concentration of circulating adrenalin which stimulates glycogenolysis (Galbo, 1992; Kjaer, 2000), lower muscle temperature and low blood flow seems to prevent this effect.

The increase of muscle temperature by using additional heating, directly increases muscle metabolism (Astrand and Rodahl, 1986). It also increases perfusion by increasing number of open capillaries (Astrand and Rodahl, 1986; Secher et al., 2000). Circulating adrenaline may have stronger influence on resting muscle metabolism in situation of additional heating (Kjaer, 2000). In spite of additional lactate, which comes in larger amount into the muscle by arterial blood, the

resting and warmed muscle does not selected it as a preferable fuel, probably because of increased metabolism caused by increased temperature, adrenalin and other factors (Astrand and Rodahl, 1986; Brooks, 1991; Galbo, 1992).

The importance of both presented phenomena is unclear by methods used, i.e. measurement of lactate concentration in arterialized-capillary and venous blood. The additional measurement needed for estimating the rates and amounts of lactate uptake and/or production is blood flow (Secher et al., 2000; Astrand and Rodahl, 1986; Brooks, 1991). Only by calculating the amount of lactate production and uptake in exercising and resting muscles it may be possible to estimate the relative importance of presented phenomena. However if the mass of both arms is accounted, then about 1 mmol/l difference in lactate concentration in a single resting arm may be considered important during prolonged continuous exercise at maxLAss.

In conclusion, the results showed that non-exercising muscles can be an important contributor to lactate metabolism during exercise at the maxLAss intensity, where lactate production is in balance lactate uptake. Low metabolism in resting arm muscles, causes small increase of muscle temperature and blood flow. These are circumstances where arm muscles may use lactate as a fuel. This possible advantage in balancing of increased lactate concentration may be however disbalanced if temperature and consequently blood flow and adrenaline increased in arm muscles.

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ELECTROMYOGRAPHIC THRESHOLD INTENSITY IN ATHLETES WITH DIFFERENT PHYSICAL ACTIVITY PATTERNS

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Abstract

The aim of this study was to investigate the EMG thresholds in four lower limb muscles and to compare them with ventilatory threshold as an alternative for detecting aerobic-anaerobic transition intensity. 49 subjects (23.8±5.7 years, 182.7±5.3 cm, 79.1±8.6 kg) were investigated on cycle ergometer. Expired gas and EMG activity were recorded from vastus lateralis, vastus medialis, biceps femoris and gastrocnemius lateralis. Ventilatory threshold and EMG thresholds from different muscles were not significantly different. When thresholds were analyzed among different groups of subjects no significant difference was observed between ventilatory threshold and EMG thresholds despite threshold differences between the groups. All EMG thresholds were significantly related to maximal aerobic power (r=0.73-0.83) and were highly correlated to each other (r=0.57–0.88). It can be concluded that EMG activity from leg muscles provides an alternative when detecting subjects´ individual aerobic-anaerobic transition intensity.

Key words: *Aerobic-anaerobic transition, ventilatory threshold, cycling*

Introduction

The transition from aerobic to anaerobic metabolism has been in focus during the last few decades. This concept has important implications in exercise science, and in occupational, preventive, and rehabilitative medicine. Surface electromyography (EMG) can also be used to study muscle activity non-invasively. Increase in EMG activity is considered to characterize the recruitment of additional motor units and an increase in motor unit rate coding to compensate for the deficit in contractility resulting from impairment of fatigued motor units, as the strength of a muscle contraction increases (Moritani et al., 1993). Different studies have reported that during incremental exercise a non-linearity for EMG activity exists (Bearden & Moffatt, 2001; Lucia et al., 1999). These breakpoints are also explained as EMG thresholds (EMGT). EMGTs are characterized as an increased contribution of fast twitch motor units to maintain the required energy supply for muscle contraction (Lucia et al., 1999). Many studies investigating EMGTs have also tried to compare them with lactate and ventilatory threshold (VT) as a transition phase from aerobic to anaerobic work intensities (Bearden & Moffatt, 2001; Hug et al., 2003; Moritani et al., 1993). It appears that the EMGTs may appear at the same time (Bearden & Moffatt, 2001; Hug et al., 2003) or even later (Moritani et al., 1993) than VT.

It has been suggested that there might be difficulties in detecting the break points in EMG value. Hug et al. (2003) investigated EMGTs on eight different muscles in a group of professional road cyclists and reported that thresholds were not always detected, showing the occurrence from 50 to 100%. To date, much EMG studies have been done sport specifically, which may influence the result due to muscle adaptation (Bearden & Moffatt, 2001; Hug et al., 2003, Lucia et al., 1999). To our knowledge, a very few studies have investigated the EMG response on a cycling ergometer among different sports which could influence the muscle to fatigue earlier due to unaccustomed work.

The aims of this study were to compare the EMGT with VT and to find if there is a sport specific difference in EMGT and VT values in athletes of different sports discipline.

Methods

In this study, 49 subjects (age 23.8±5.7 years, height 182.7±5.3 cm, body mass 79.1±8.6 kg) (11 cyclists, 10 handball players, 9 kayakers, 8 power lifters and 11 non trained individuals) were investigated. The representatives of different sports were at national level and were training regularly. Non trained individuals had no training experience at all.

The incremental test until volitional exhaustion was performed on electromagnetically braked cycle ergometer (Tunturi, Finland). Subjects were allowed to choose their pedalling rate (rpm) freely as the cycle ergometer provided an exercise intensity that was independent from pedalling rate. However, they were asked not to decrease pedalling rate below 60 rpm. The incremental testing started at 50 W and the load was increased by 25 W every minute (modified from Hug et al., 2003). The incremental test was interrupted if the desired power or pedalling rate could not be maintained. A two minute unloaded exercise was provided for recovery.

Throughout the exercise protocol, subjects breathed through open-circuit telemetrical system (MedGraphics VO2000, St. Paul, USA). The measurement system was calibrated prior to each testing as approved by the manufacturer. During the incremental test, oxygen consumption (VO_2), ventilation (VE), carbon dioxide consumption (VCO_2) and the ventilatory equivalents for O2 ($VEVO_2$) and CO2 ($VECO_2$) were recorded every 10 second interval. The VT was determined by using the criterion of an increase in both $VEVO_2$ and $VECO_2$. Two independent observers detected VT according the following criteria. If there was a difference between these investigations, a third investigator was included. The maximal aerobic power (Pa_{max}) was determined as the maximal power during the incremental test (Hoffman et al., 1994).

During the test, EMG activity was continuously recorded from four muscles of the left foot [vastus lateralis (VL), vastus medialis (VM), biceps femoris (BF) and gastrocnemius lateralis (GL)] (Bearden & Moffatt, 2001). A pair of surface electrodes (Ag/AgCl electrodes, Skintact, UK) was attached to the skin with a 2 cm inter-electrode distance. The electrodes were applied on the muscle belly longitudinally. EMG activity was recorded with a ME3000P8 amplifier (Mega Electronics, Finland). The raw EMG signals were converted into the computer as an integrated EMG. The EMGT was calculated as the nonlinear increase of EMG value compared with the increases in power. In order to compare the exercise intensity at which all thresholds occurred, mean values of VT and EMGT were expressed in power output (W) (Lucia et al., 1999). EMGT was also detected by two independent observers. In case of the EMGT was not detected, these data were excluded from the later analysis.

Results

The subjects´ VO_{2max} averaged 56.1±11.1 ml.min.$^{-1}$kg^{-1}, the average aerobic power was 348.5±61.0 W and the corresponding VT was 271.4±64.0 W. VT and EMGTs from four different muscles were not significantly different in the whole group of subjects (Table 1).

Table 1. Ventilatory threshold and different EMG thresholds from four different muscles (p>0.05)

Parameter	Mean±SD
Ventilatory threshold (W)	276.4±61.0
Vastus lateralis threshold (W)	263.1±65.6
Vastus medialis threshold (W)	266.1±64.6
Biceps femoris threshold (W)	263.8±62.8
Gastrognemius lateralis threshold (W)	259.7±58.6

When thresholds were analyzed among different groups of subjects no significant difference was observed between VT and EMGTs despite threshold differences between the studied groups. All EMGT were significantly related to Pa_{max} (r=0.73 – r=0.83; p<0.05) and were highly correlated to each other (r=0.57 – r=0.88). The intercorrelations between different thresholds are presented in Table 2.

Over 50% statistical generality (i.e., r^2>0.50) was observed between VT and vastus lateralis threshold (VLT) and VT and vastus medialis threshold (VMT) indicating that these indices discriminated threshold similarly.

Table 2. The correlation coefficients (r) and shared variance (r^2) between different EMG threshold measurements and ventilatory threshold (n=49)

Parameter	Ventilatory threshold (r)	Ventilatory threshold (r^2)
Vastus lateralis threshold (W)	0.81*	0.66
Vastus medialis threshold (W)	0.73*	0.53
Biceps femoris threshold (W)	0.69*	0.48
Gastrognemius lateralis threshold (W)	0.58*	0.33

Discussion

The main finding of our study was that EMGTs of four different leg muscles were not different from VT during the incremental ramp test. This was the case with all the studied groups. Furthermore, shared variance between VT and measured EMGT was greater than 50% showing that these indices could be used to discriminate the threshold intensity in athletes of various sports disciplines and supports previous findings that EMGT is an alternative for detecting aerobic-anaerobic transition in both athletes and non trained individuals. As previous studies have used relatively homogenous groups, this study presents the use of EMGT in subjects at a different performance level and different kinds of sport. This study is in line with previous studies reporting similarity of EMG threshold and VT (Bearden & Moffatt, 2001; Hug et al., 2003; Lucia et al., 1999).

It has to be considered that EMGTs of different muscles are not always detectable. In our study, the occurrence of EMGT was from 80 to 98%, with BF and GL showing slightly worse results than VL and VM. To our knowledge at least one study has also investigated the occurrence of EMGTs (Hug et al., 2003), who reported the occurrence from 63 to 100% of second EMGT (EMGT2). However, in that study the data are difficult to interpret because only eight subjects were studied and therefore every missing value can cause significant decrease or increase in the percent of occurrence of EMGT. The explanation of the occurrence of EMGT might depend whether the cadence during the cycling is fixed or not. During fixed cadence, the increases in exercise intensity may be accomplished only by increasing the muscle power (Takaishi et al., 1992), which indeed, may cause a more clear recruitment of faster motor units and therefore reflect the threshold detection. While in a real life situations, both muscle power and cadence are increased while attempting to increase the exercise intensity (Lucia et al., 1999).

Measured VT and EMGT measured at different leg muscles in this study were highly correlated with each other (r=0.58-0.81). The substantial common variance (i.e. $r^2 = 0.53 – 0.66$) reported among threshold indices suggested that these indices could be used to discriminate between the aerobic-anaerobic transition. All selected EMGT points were significantly related to maximal performance (r=0.73-0.83; $p<0.05$). Of the calculated EMGT parameters compared in this study, vastus lateralis threshold (VLTH) was the most highly correlated with maximal performance (r = 0.83). The fact that VLTH was the most highly correlated to maximal cycling performance supports previous findings that VL is the most dominant muscle used in cycling (Hug et al., 2003; Lucia et al., 1999). Furthermore, as EMGT in different muscles appeared at the same time, it seems that muscle fatigability is not significantly affected by muscle fiber type distribution (Lucia et al., 1999).

In our study, we used subjects from different sport disciplines. It was interesting to find that in different sports, EMGT were similar to VT, despite the different nature of their sport with regard to cycling activity. For example, handball players use actively their leg muscles during their sport but in kayaking the leg muscle work is mostly passive. It is therefore reasonable to conclude that in kayaking EMGT from leg muscles should appear before VT than in handball players and/or cycling, because their leg muscles should become more easily fatigued. These results indicate that EMGT are not sport specific and could be used in different sports as well as in non sportsmen in studying muscle fatigue.

Conclusion

This study indicated that EMG presents the alternative non invasive method to study the aerobic-anaerobic transition intensity as did previous studies (Bearden & Moffatt, 2001; Hug et al., 2003; Lucia et al., 1999). According to the results of this study EMGT can also be used in athletes of different sport disciplines and various performance levels.

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CHARACTERISTIC SYMPTOMS OF ELITE ORIENTEERS EXPERIENCING OVERTRAINING SYNDROME

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Abstract

Overtraining syndrome (OTS) of athletes is a chronic state of impaired physical performance despite extensive training. No theory for the onset of OTS has been commonly accepted, and the symptoms are various and individual. There are no objective markers of OTS. We assessed the training background; performance; symptoms of OTS; and incidence of illnesses in self-reportedly overtrained elite orienteers by a retrospective questionnaire study. The most common symptoms of OTS reported were slow recovery and fatigue. There were differences in psychological variables group, and the incidence of common infectious diseases was higher in OTS subjects vs. controls. Single variables differed most markedly in areas of recovery and performance capacity. Gender difference was not seen, but age seemed to relate to OTS. Marked symptoms of muscle damage in seemed to correlate with the incidence of illnesses.

Key words: *staleness-exhaustion, athlete, fatigue, performance, muscle damage*

Introduction

Overtraining syndrome, or staleness, continues to defy exact characterisation despite of decades of research. A characteristic symptom for this maladaptative state is the chronically impaired physical performance despite continuous and extensive training; the presence of this symptom is the key requirement for the condition to be acknowledged. Overtraining (OT), where the experienced decrement of performance lasts from months to year, must be distinguished from overreaching, a short-term condition where the decrements last from days to weeks (Fry et al. 1991). For this study it is sufficient to regard overtraining as a condition where the decrements in performance can be regarded as "chronic". In this paper, we use the term overtraining syndrome (OTS) to address the condition.

There are numerous symptoms that may, or may not be associated with OTS. Following selected symptoms of OTS are suggested by several authors: chronic fatigue, altered mood state, increased rate of infections, loss of motivation, insomnia, changes in heart rate, loss of co-ordination, slow recovery from exercise, and muscle soreness (for recent review, see Urhausen and Kindermann 2002).

Several types of OT has been suggested, such as excessive training volume vs. excessive training intensity – derived OTS, and the classical autonomic nervous system dominance based division to sympathetic and parasympathetic types of overtraining (for review, see Halson and Jeukendrup 2004). One currently prominent hypothesis proposes skeletal muscle cell structural damage as the reason for the onset of OTS (Smith 2004). Furthermore, the authors´ personal experiences with endurance athletes suggest a relationship between OTS and extensive muscle damage.

Orienteering, a sport of running in uncontrolled environment (f x forest), is a typical representative of endurance sport. The competition performance lasts between 12-90 minutes, and the intensity remains close to 70% of maximal aerobic capacity. The training regime of Elite orienteers remind closely that of long distance runners, or cross-country skiers. No previous studies with exclusively orienteers experiencing OTS have been documented.

The aims of his study were:

1) to characterise the spectrum and prevalence of symptoms traditionally connected to overtraining in self-reportedly overtrained elite orienteers,
2) to find out, whether there are differences in experienced performance capacity and psychological state in everyday training and life between the OTS athletes and a control group matched by training background and performance level, and finally,
3) to compare OT subjects with prominent symptoms of muscle damage to those without for eventual discrepancies in other parameters measured.

Methods

The subjects of this study were collected by individually searching out elite orienteers, who were known to have experienced OTS symptoms during the last three years from the time of study (2000-2002). Additional subjects were

found by peer-network of subjects. All the subjects competed at least at an international level in orienteering, their best results ranging from representing national teams to gold medal in World Championships.

Two criteria were used for classifying athletes as "overtrained": a) deterioration of competition results and performance in training despite typical training for each individual, and 2) experienced chronic physical overload.

For separate overtraining studies, two retrospective questionnaire forms had been prepared at University of Kuopio, Finland, and at University of Southern Denmark, Denmark. These were combined to a single questionnaire for this study. The original form was compiled in Finnish language, and was further translated to English, Danish, and Swedish.

Answers to the following topics were collected in free form: extra stressors in life; symptoms of overtraining; time usage for different activities on a typical day, and if there had been any changes in those before or during the OT period. General training and competition history was recorded. Athletes' health was assessed for incidence of illnesses and/or traumas, medication, and medical investigations during the weeks before and under the OT period. The incidence of common infectious diseases was also asked separately.

Subjects were asked to estimate the effect of typical OTS symptoms to their performance in training and in competition. Questions on the scale 1-5, and mood states on the scale 1-4, estimated physical performance capacity as well as psychological, muscular and somatic symptoms of OTS. The questions were classified in following groups:

- Performance capacity (working capacity in easy; and hard performance; tournament endurance);
- Positive psychological variables (persistence in training; persistence in competition; willingness to compete; willingness to train; mood states: helpful, brisk, calm, lively, relaxed);
- Negative psychological variables (psychological symptoms; mood states: irritated, sad, moody, tired, anguished, disarrayed, lacking concentration, desperate, nervous);
- Sleep disturbances (insomnia; waking up at nights);
- Nutritional disturbances (overeating; indigestion; diarrhoea or irregularities in stomach activity; loss of appetite;);
- Neural problems (head ache, dizziness, overly fast or irregular heart rate, shaking of hands, sweating without exercise, neurological disorders);
- Structural disturbances (musculoskeletal system injuries; tumours; surgical operations; unusual bruises / bleeding; dental problems);
- Neuromuscular function (co-ordination of movement; elasticity, bouncing; muscle cramps at rest, and during exercise; involuntary shaking of muscles; feeling of strength in training; maximal power output);
- Symptoms of muscle damage (muscle stiffness; muscle pain at rest, during exercise, and while touching).

The answers of the OT subjects (8 male, 4 female, age avr 25,7 yrs) were compared to those of Control group (7 male, 4 female, age avr 28,5 yrs). The OT group was further divided to subjects with more symptoms of muscle damage (mOT) and those with less (nOT), based on the total score in question group "symptoms of muscle damage". The mean score of the Control group was used as a divider. Differing scales (1-4 vs. 1-5) were matched. Statistically significant differences in single questions were analysed with χ^2 test, using Yates´ correction when appropriate. Level of α was set at 0.05. Logistical analysis was performed on selected variables to find out the explanatory weight on perceived OTS. Differences between groups were assessed by two-tailed Student´s t-test.

SAS statistical software (SAS Institute inc., Cary, NC, USA) was used for analyses.

Results

Figure 1 shows the symptoms of OT sorted by the experienced effect on performance.

Comparison of the OT group vs. Control group by single question shows statistically significant differences for the following variables:

Highly significant differences ($p<0.01$)

OT mean > Control mean: amount and intensity of previous training related to own capacity *Control mean > OT mean*: maximal power output; feeling of strength in training; ability to recover; willingness to train; tournament endurance; rate of muscle recovery; working capacity in training.

Significant differences ($p<0.05$)

OT mean > Control mean: involuntary shaking of muscles; overly fast or irregular heart rate; muscle cramps; muscle pain in training and at rest

Control mean > OT mean: willingness to compete; persistence in competition.

In addition, the estimation of following mood states differed from OT to control group:

OT mean > Control mean: sad, moody, tired, disarrayed, lacking concentration, desperate

Control mean > OT mean: brisk, calm, relaxed, trusty

Logistical analysis revealed significant correlation between the existence OTS and age. Existence of OTS symptoms did not show correlation with gender or training background.

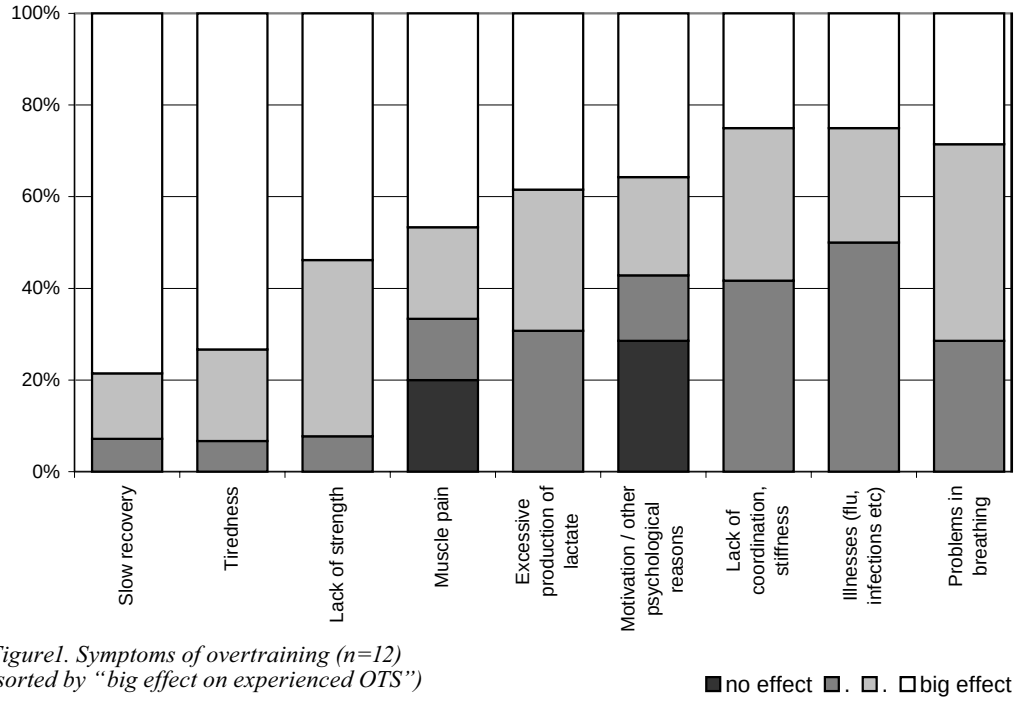

Figure1. Symptoms of overtraining (n=12) (sorted by "big effect on experienced OTS")

Table 1 summarises p-values from comparison of subject groups by scores in question groups:

Table 1. p-values from analyses by question groups comparing; OT group with control group; OT groups divided by score in symptoms of muscle damage to control group, and with one another.

Legend: overtraining (OT), control (C), and OT groups with large (mOT) and small (nOT) score in symptoms of muscle damage. Error size (p) with significant (*, p>0.05) and highly significant (**, p<0.01) values marked. **Boldface** used for marking **higher** value and grey background for lower values

Variable group	OT vs C	mOT vs C	nOT vs C	mOT vs nOT
Sleep disturbances	0,403	0,091	0,716	0,176
Nutritional disturbances	0,655	0,347	0,841	0,431
Positive psychological variables	0,000 **	0,000 **	0,000 **	0,434
Negative psychological variables	**0,000 ** **	**0,000 ** **	**0,000 ** **	0,406
Neural disturbances	0,057	0,083	0,083	0,940
Structural disturbances	0,512	0,510	0,739	0,780
Neuromuscular function	0,168	0,057	0,772	0,250
Common infectious diseases	**0,000 ** **	**0,000 ** **	**0,000 ** **	**0,000 ** **
Performance variables	0,000 **	0,000 **	0,000 **	0,163
Symptoms of muscle damage	0,362	**0,000 ** **	**0,027 * **	**0,000 ** **

Discussion

The overall results of this study are consistent with results from other studies with endurance athletes (for review, see Halson and Jeukendrup 2004). In our study, the most prevalent symptoms of OTS for elite orienteers were slow recovery, tiredness, and lack of strength. Highly significant differences between OT and Control group were seen in positive and negative psychological variable groups (including mood states); incidence of common infectious diseases; and – as expected from our definition of OTS – in decrements in performance (perceived maximal power output and working capacity in training).

All these variables have previously been documented to be associated to ots (halson and jeukendrup 2004). In this study, especially psychological variables show distinctly different profiles in both mean values (more negative, less positive for the ot group) and sd values (larger in ot groups). These findings underline the previous findings that the profile of mood states (poms) test is one of the most useful indicators for monitoring ots, but also, that the individual variation is large (morgan et al. 1987).

The characteristics for orienteers with more or less symptoms of muscle damage differed otherwise only in incidence of common infectious diseases. We therefore conclude that the symptoms of OTS for orienteers seem to be independent of the prevalence of muscle damage associated symptoms. Interestingly, the incidence of infectious diseases seemed to correlate with the severity of muscle damage symptoms - this discussion is, however, beyond the scope of this study.

Another interesting finding is that according to this study, OT phenomenon seems to be explained by the age of athletes, younger subjects being more vulnerable to OT. As training background was not shown to be associated with the symptoms, it can be suggested that age in itself is associated with experienced OTS. The logical reasons would be that with increasing age, the athletes experience (or recognise) either less/weaker symptoms of OT, have better resistance to negative psychological changes, or both. We should, however, not rule out the possibilities of selectivity in sample, and the effects of sample size to the results in this study.

A problem associated with the use of retrospective questionnaire study has been documented: negative mood states tend to become stronger with passing time. However, the results of this study are well in accordance with those of previous OT studies, seemingly showing that a retrospective study can produce results comparable to more direct methods.

A very highly significant correlation to OTS were seen in answers concerning the rate of recovery, working capacity in high-intensity training and competitions, and a single mood state „brisk“. A systematic, regular assessment of these variables could be a valuable tool for athletes and coaches in avoiding the OTS.

We conclude that the OTS in elite orienteers is similar to this condition in other endurance sports. We could not see gender differences in OTS, but age seemed to relate to perceived symptoms of OTS. Differences in OT symptom profile between the OT athletes with severe symptoms of muscle damage and those without were not seen, which seems to rule out the existence of separate, muscle damage-type of overtraining. Of the psychological assessments done, perceived rate of recovery, feeling of fatigue and the mood state “brisk” correlated strongest with symptoms of OTS, and could therefore be used as a simple alternative for POMS test in practical monitoring of training.

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CHARACTERISTICS OF SOME PARAMETERS OF CARDIO – VASCULAR AND RESPIRATORY SYSTEM IN ROWERS WITH DIFFERENT TRAINING PERIOD

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Abstract

Rowing is one of the sport events with aerobic-anaerobic manner of energy production. This research was aimed at establishing morphologic characteristics and functional abilities of cardio-vascular and respiratory system in rowers regarding their different training period and status among international competition. Thus determining those parameters which could be used as a predicting factor for efficiency of rower's performance on rowing ergometer. The research sample comprised 37 rowers who performed a 9-minute continuous increasing test on rowing ergometer. The 37 rowers were divided into two groups on the basis of the training period, their achievements were compared within the groups as well as with the achievements of the world champion. Differences were found in the average time on 500m in the last minute of test, in the distance covered during the test, in the anaerobic capacity, absolute (ml/min) and relative (ml/kgmin) oxygen consumption. The latter establishes a different finding with regards to the existing literature, where only differences in absolute oxygen consumption are established.

Key words: *rowing, aerobic training, consumption of oxygen, anaerobic capacity.*

Introduction

Rowing is one of the sport events with aerobic-anaerobic manner of energy production. The race time, which spans from 5 and a half minute with an 8-member crew to seven minutes with individual rowers at an international level, marks the enormous needed capacity of systems which provide muscles with oxygen. The short race time and the muscle mass volume which is activated during rowing on the other hand also require an anaerobic mode of energy production.

The main objective of a rowing competition is to cover the distance of 2000 meters in the shortest time, which implies maintaining the highest possible average speed. Although the tactic elements need to be taken into consideration, this thesis focuses only on the analysis and interpretation of the physiological systems of human organism which are activated during an activity such as rowing. The intention of this research was to establish morphological characteristics and functional abilities of cardio-vascular and respiratory system in rowers regarding their different training period and status among international competition. Thus determining those parameters which could be used as a predicting factor for efficiency of rower's performance on rowing ergometer.

Methods

a.) Selection of study subjects

The sample comprised 37 men rowers of Slovenian rowing clubs which took part in test on rowing ergometer at the Institute of Sport (Faculty of sport, Ljubljana) in April 2002 and April 2003. The rowers were divided into 3 groups, the first group was represented only by the best individual rower (world champion), whose average 3-year results (in the period 2001-2003) were used as reference values. The second group was formed with rowers with 13-19-year training period (6 study subjects) and the third group included rowers with 2-6-year training period (7 rowers). Some additional data about study subjects, such as club membership, training period, weekly training intensity, categorization, previous participation in other sport events were gathered with the use of a questionnaire.

b.) Test protocol

After an initial 15-minute warming-up of low intensity (rowing ergometer speed lower than the speed at the beginning of the test) all study subjects performed a 9-minute continuous increasing test on rowing ergometer. The test was adjusted to individual capabilities of participants. The load intensity was determined with preceding testing out of which an average time on 500 meters was calculated under the condition that lactate values in rower's blood reached 4 mmol (AT). The first three minutes of the test are rowed at a pace corresponding to the time set for 4 mmol lactate blood value + 9 seconds (AT+9s). The next three minutes are rowed at AT + 6 seconds, followed by two minutes at AT + 3 seconds and the final minute at AT pace. Physiological variables were measured with Oxycon Beta and an ECG machine which recorded data

throughout the test and an additional 8 minutes after the test. The blood for lactate concentration analysis was taken from the ear lobe before the initial warm-up and in the third and eighth minute after the test's conclusion. Anthropometric variables were measured before the test with anthropometric instruments according to Martin. The additional data regarding the study subjects were collected by the questionnaire.

c.) Data processing methods

Descriptive statistics of the sample was established on the basis of basic statistical parameters. All the measured data are numerical and are presented as mean ± standard deviation (SD), followed by minimum and maximum value. The normal distribution of the parameters was tested with Kolmogorov-Smirnov test. The differences between individual groups were analyzed by Student's t-test. Pearson's correlation coefficient was used to determine the bivariate correlation between a single measured parameters and the average time on 500m in the last minute of the test. Multivariate linear regression was used to determine the selected independent factors predicting the average time on 500m in the last minute of the test. A p value < 0.05 was considered statistically significant. The statistical analysis was performed with SPSS 12.0.1 for Windows (SPSS Inc., 2003).

Results

a.) Characteristics of entire study group of rowers

General data and entire sample characteristics are shown in table 1.

Table 1: General data, anthropometric values and values of some physiological parameters of the entire sample of rowers gained during the test(SD=standard deviation)

VARIABLE	Min-Max	Mean ± SD
Age (years)	15-30	**21**±3.5
Training period (years)	2-19	**9.5**±3.8
Number of trainings per week	5.0-12.0	**9.2**±1.8
Duration of single training (hours)	1.5-3.5	**2**±.4
Duration of trainings (hours/week)	7.50-31.50	**18.5**±4.6
Body height (cm)	173.0-199.5	**185.6**±6.0
Body mass (kg)	66.0-103.0	**82.8**±7.8
Width of shoulders (cm)	39.2-46.3	**42.3**±1.5
Width of pelvis (cm)	27.0-33.0	**29.5**±1.5
Body index	1.29-1.57	**1.4**±0.06
Body mass index	20.97-26.84	**24**±1.4
Average time on 500m in the last minute of test (s)	85.5-106.8	**95.9**±5.1
Distance covered during the test on ergometer (m)	2500-2978	**2704**±114.1
Heart rate at rest (beat/min)	49-96	**70**±11.4
Maximal pulse rate (beat/min)	183-211	**194**±6.1
Maximal frequency of breathing (/min)	58-89	**70**±7.2
Minute breathing volume (l/min)	149.5-248.0	**187**±21.6
Respiratory quotient in the last stage of loading	0.92-1.13	**1.03**±0.04
Maximal absolute oxygen consumption (ml/min)	4614-7669	**5726**±683.4
Maximal relative oxygen consumption (ml/kgmin)	61.3-84.5	**71.1**±6.1
Oxygen equivalent in the last stage of loading (ml/l)	25.8-36.5	**32**±2.5
Concentration of lactate at rest (mmol/l)	0.5-2.2	**1.5**±0.36
Concentration of lactate 3 min after loading (mmol/l)	6.1-14.2	**10.2**±2.0
Concentration of lactate 8 min after loading (mmol/l)	6.9-17.5	**11.4**±2.4

All variables distribute normally according to Kolmogorov-Smirnov test.

b.) Differences between groups of rowers

The results show statistically important differences between the world champion and the other two groups in the width of shoulders, the average time on 500m in the last minute of the test, distance covered, minute breathing volume and maximum oxygen consumption. Some differences between younger and older rowers can also be noted (table 2).

Table 2: Group differences in general data, anthropometric values and values of some physiological parameters presented as p-values (ns=non significant)

VARIABLE	old-young	old-ref. rower	young-ref. rower
	p	*p*	*p*
Duration of trainings	0.**00**	ns	0.00
Body height	ns	ns	ns
Body mass	ns	ns	ns
Width of shoulders	ns	**0.00**	**0.00**
Width of pelvis	ns	**0.00**	ns
Body index	0.**02**	ns	**0.00**
Body mass index	0.**03**	ns	ns
Average time on 500m in the last minute of test	0.**01**	**0.00**	0.00
Distance covered during the test on ergometer	0.**00**	**0.00**	**0.00**
Heart rate at rest	ns	ns	ns
Maximal heart rate	ns	ns	**0.02**
Maximal frequency of breathing	ns	ns	ns
Minute breathing volume	ns	**0.01**	0.00
Respiratory quotient in the last stage of loading	0.**01**	**0.05**	ns
Maximal absolute oxygen consumption	ns	**0.00**	ns
Maximal relative oxygen consumption	ns	**0.00**	ns
Oxygen equivalent on the last stage of loading	ns	ns	ns
Concentration of lactate at rest	ns	ns	ns
Concentration of lactate 3 min after loading	ns	**0.00**	ns
Concentration of lactate 8 min after loading	0.**00**	ns	**0.00**

Statistically characteristic difference introduces p value smaller than 0.05.

c.) Correlation and dependence of average time on 500m in the last minute of the test

The average time on 500 meters in the last minute of the test was negatively correlated with many parameters, among general parameters are: period of training, number of trainings per week, duration of trainings and distance covered; among anthropologic parameters are: body height and mass, width of shoulders and body mass index; among physiological parameters are: minute breathing volume and maximal absolute oxygen consumption (table 3).

Table 3: Correlation and dependence of the average time on 500min the last minute of the test on general, anthropometric and physiological variables achieved during the test (ns=non significant)

VARIABLE	Average time on 500m in the last minute of test	
	Correlation - Pearson's coeff. (p)	Multiple linear regression-p (r)
Age	**-0.576 (0.00)**	-
Training period	**-0.555 (0.00)**	-
Number of trainings per week	**-0.469 (0.00)**	-
Duration of single training	ns	-
Duration of trainings	**-0.419 (0.01)**	ns
Body height	**-0.485 (0.00)**	-
Body mass	**-0.681 (0.00)**	-
Width of shoulders	**-0.568 (0.00)**	-
Width of pelvis	ns	-
Body index	ns	ns
Body mass index	**-0.539 (0.00)**	ns
Average time on 500m in the last minute of test	-	-
Distance covered during the test on ergometer	**-0.842 (0.00)**	**0.01 (-0.69)**
Heart rate at rest	ns	ns
Maximal heart rate	ns	ns
Maximal frequency of breathing	ns	ns
Minute breathing volume	**-0.681 (0.00)**	ns
Respiratory quotient on the last stage of loading	ns	ns
Maximal absolute oxygen consumption	**-0.736 (0.00)**	ns
Maximal relative oxygen consumption	ns	-
Oxygen equivalent in the last stage of loading	ns	-
Concentration of lactate at rest	ns	ns
Concentration of lactate 3 min after loading	ns	ns
Concentration of lactate 8 min after loading	ns	ns

Percentage of explained variance: 72.5%; characteristic of the model: p= 0.000.
Statistically characteristic correlation and dependence introduce p values lower than 0. 05.

Discussion and conclusion

Rowing is among those sport events in which aerobic processes for energy production are prevailing. Oxygen consumption is the parameter to evaluate and show aerobic capacity as the integrity of several organic systems and their function. Oxygen consumption increases during training as a result of changes in respiratory and cardio-vascular system, blood and muscles. Minute breathing volume is one of the parameters influenced by aerobic training and also measured in this test. The values of minute breathing volume gained with our test were up to four times higher than those with non-trained subjects and higher than values with subjects in other sport events (Grujić et. al). The average oxygen consumption was 5700 ml/min or 71 ml/kgmin with peak values up to 7700 ml/min or 85 ml/kgmin. Rowing requires and activates all body muscles and since none of the rowers were over nourished (average body mass index 24, the highest value 27) we can conclude that the measured values indicate the real consumption. The measured values also correspond to values measured by other authors (Grujić et al; Hagerman et al; Secher et al; Fletcher et al).

The two rower groups characteristically differ from the reference rower in the average time on 500m in the last minute of the test ($p=0.00$), distance covered during test ($p=0.00$) and in absolute (ml/min; $p=0.00$) and relative (ml/kgmin; $p=0.00$) oxygen consumption. These differences vary from the existing literature where only difference in absolute oxygen consumption is stated (Grujić et al; Hagerman et al; Secher et al). With regard to group differences the average time on 500m in the last minute of test was established as a predicting variable for a successful performance on rowing ergometer. It directly shows us the middle speed of a rower.

The correlation analysis shows that successful rowers are all tall and heavy and with several years of aerobic training. The average time on 500m in the last minute of the test correlates negatively with the distance covered in test on rowing ergometer ($k=-0.842$; $p=0.00$) and with maximal absolute oxygen consumption ($k=-0.736$; $p=0.00$). The latter denotes that the more the rower is aerobically trained the shorter the time, the higher mean pace and the longer the distance covered.

The regression analysis shows the dependence of the average time on 500m in the last minute of test on the distance covered in test ($p=0.01$) which is dependent on time ($p=0.01$) and absolute oxygen consumption ($p=0.00$). Absolute oxygen consumption depends on maximal heart rate ($p=0.01$), maximal breathing frequency ($p=0.01$), minute breathing volume ($p=0.01$) and distance covered in test ($p=0.00$). The dependence of the predicting variable on other measured independent variables could not be proven, although high correlation between some of them and high statistical significance of multiple linear regression model (percentage of explained variance higher than 70%) were established. The reason should probably be in the high mutual correlation between independent variables and the small sample used (Morrison).

In addition to using maximal amount of oxidative energy during the 9-minute test on the rowing ergometer the rowers, in 20-40%, also acquired energy with anaerobic glycolysis. Limiting factors in the test were: maximal oxygen consumption, the ability to use 100% of oxygen for the longest period of time and lactate tolerance. The differences in lactate levels were perceivable especially in the 8th minute after test in rowers with shorter training period ($p=0.00$) while the values in rowers with longer training period correspond to or were even higher than those of the reference rower. We can therefore conclude that rowers with longer training period and the reference rower have larger anaerobic capacity. This means they have a better ability to disperse lactic acid from muscles and reuse it as a source of energy, besides having higher tolerance for lactic acid.

In conclusion we find that rowers with different training periods differ between themselves in the average time on 500m in the last minute of test, distance covered during test, anaerobic capacity and absolute (ml/min) and relative (ml/kgmin) oxygen consumption. The last finding differs from statements in contemporary literature where only differences in absolute oxygen consumption between more and less successful rowers are stated.

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COLLOCATIONS AND DENTAL-OROFACIAL SPORT INJURIES

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Abstract

An attempt was made to show how the prototype meaning expressed in one language is communicated in another, how this non-specific meaning becomes more specific in two different languages, and how the collocations differ in the two languages analysed, in this case, in English and Croatian. The examples for this investigation were chosen from the area of sport injuries, namely, dental and orofacial sport injuries.

Reality, not only the theoretical linguistic approach, was taken into account since there is no model of grammatical description capable of providing an impeccable description. Both the context and the situation play an important role in shaping and establishing the actual nuances of word meanings.

Key words: *translation, sport injuries, dental medicine, kinesiology*

Introduction

The term *collocation* can be defined as a specific or habitual co-occurrence of words. It is the way words combine in a language to produce natural-sounding speech and writing (*Oxford Collocations Dictionary for Students of English*, 2002, p. vii). From the lexical point of view, collocations differ from words and fixed expressions in that we can develop a principled methodology for their successful translation. Since nouns have the highest information contents, they frequently call the shots in collocations and almost always the best starting point for a good translation. Firth said (1957, p. 196) that the words are recognized according to the company they keep, thus obviously paraphrasing the Biblical saying: *You'll be known by the company you keep*. He was also interested in how meaning is attributed to words in combination with other words. Firth himself was trapped by his own concept according to which the words attract each other because their meaning is such as it is, and their meaning is such because they attract each other the way they do. Collocations comply with the statistical predictability and incidence. The range of possible combinations of words stretches from the completely predictable ones to those that are entirely unpredictable. Some authors think that words combine by having their inherent prototype or core meaning, that is, their semantic potential (for example, Ivir, 1988, Ivir, 1992-1993) that, in a collocation, creates a concrete specific preferred meaning or is allowed by its actual collocate. The prototype meaning potential is actualised in such a way that one aspect of the extralinguistic content, which is potentially included into it, is in English put into focus, whereas in Croatian it behaves differently (some other aspect is put into focus). Although in many cases collocations match in the two systems, sometimes there are discrepancies of different types which are the result of two different perceptions of the extralinguistic reality in the two systems. In analysing the collocations the well known fact that they are specific in the language of dental medicine and kinesiology is confirmed, as well as in any other technical language.

Methods

The goal of this paper is to explain the complex relationship between lexical elements that combine to form collocations used in highly specific fields, in this case, in kinesiology and dental medicine. An attempt is made to show how the prototype meaning expressed in one language is communicated in another, how this non-specific meaning becomes more specific both in the first and in the second language, and how the collocations differ in the two languages analysed, in this case, in English and Croatian. The examples for this investigation were chosen from the area of sport injuries, namely, dental and orofacial sport injuries. The texts discussing the fabrication and use of mouthguards as protection against such injuries were the source for some of the examples described. As a part of our linguistic research the contrastive approach was applied.

Discussion

Sport injuries are frequent, not only in contact sports, but also in other sports such as alpine skiing or cycling. "The only sport more dangerous than skiing is sky-diving – if parachute does not open", said R. J. Johnson (quoted by Pećina, 2002). Hence, the occurrence rate expectations as regards injuries in alpine skiing is extremely high.

The use of mouthguards is highly recommended in certain groups of sport, such as contact and collision sports. W. C. Goldwin, the Director of Sports Dentistry at the University of Michigan Dental School, defined contact sport as any sport in which an object can hit the jaw or teeth (quoted by Jerolimov, Seifert & Carek, 2000, quoting Diangelis & Bakland, 1998). This definition was extended by I. L. Kerr, President of the Dental Health Board at the Olympic Committee of the United States of America (quoted by Jerolimov, Seifert & Carek, 2000), to include any activity that can induce stress in the stomathognatic system resulting in a comprehensive clenching of the teeth. Newsome, Tran and Cooke (2001) quote Dorney (1998) who defined contact sports as those sports in which players physically interact with each other, trying to prevent the opposing team or person from winning. Sports such as basketball, handball, ice hockey, American football, rugby, judo, etc. are considered *contact sports.* Baseball and boxing on the other hand may be classified as *collision sports*, that is, there exists the possibility of colliding either with a hard (baseball) or a soft (boxing gloves) object. The term *contact sports* may be translated into Croatian as *kontaktni* or *doticajni sportovi* (for the latter see Badel, Jerolimov, Pandurić, & Perenčević, 2004) and the term *collision sports* as *kolizijski sportovi.* In these two cases the two terms match entirely, which means that complete equivalence is achieved. These *ad litteram* translations are not expected to pose any problems regarding their translation. Difficulties arise when we encounter the so-called partial equivalence, or in cases where there is no equivalence at all. A few representative examples of the last two types of equivalence – partial and zero – have been chosen.

The English term *mouthguard* (also *mouth protector* and *protective mouthpiece*) denotes the device that protects the mouth against sport injuries. The term frequently used as its Croatian equivalent, *štitnik*, is less precise because in this form it may be used to denote all protective pieces of equipment used in sports, as for example, in football *štitnik za potkoljenicu*, that is, the *shin pad*, or *vratni štitnik* na maski as *neck guard/neck flap* on the fencing mask, again *vratni štitnik* or *neck role* in American football, *štitnik za koljeno*, that is, *knee pad,* for example in field hockey, etc. However, apart from this rather inaccurate term, there exists a more precise Croatian term in dental and kinesiological literature, namely, *intraoralni štitnik* or *štitnik za zube* (*intraoral mouthguard*). This mouthguard includes the following three types. As the first example of partial equivalence between English and Croatian let us explain the English term *stock or ready--made (commercial, over-the-counter) mouthguard* (Newsome, Tran, & Cooke, 2001) that is translated into Croatian as *gotov* ili *konfekcijski štitnik* (Badel, 2004). *Mouth-formed* or *self-adapted mouthguard* is translated into Croatian as *polugotov konfekcijski štitnik*, and a *custom-made mouthguard* as *individualni štitnik*. In all cases only one part of the English collocation matches its counterpart in Croatian. In the article by Jennings (1990) the term *gum shields* is used. Its translation into Croatian could be *intraoralni štitnik* (*intraoral štitnik* could be then translated into English as *intraoral protector*).

The English term *cauliflower ear* (*ear contusion*), a partially deformed auricle caused by injury and subsequent perichondritis, sustained in, for example, wrestling or boxing, has a zero equivalent *otohematom* in Croatian (the *ad litteram* translation of this term into English could be approximately *otohaematoma*), namely, none of the elements of the English collocation is to be found in the Croatian term. Although it is the English language that is characterized by the economy of expression, in this particular example, the Croatian language proves to be more economic than English. Likewise, the collocation *death rate* is to be translated into Croatian as *mortalitet* although it is possible to use *mortality* in English as well. However, *mortality* in this particular context is used less frequently than the term *death rate.* For example, in the text *Bicycle helmets – does the dental profession have a role in promoting their use?* (Chapman & Curran, 2004) the term *death rate* is used in the text: "The highest overall injury and TBI death rates are amongst 10-15-year-olds, particularly boys." Upon reviewing the dental and sports-related literature, it becomes evident that the incidence of the term *death rate* is higher than that of the term *mortality.* The latter example has been found to appear only in one article, namely, in the abovementioned text by Chapman and Curran: "This review of the literature shows that the case made against the wearing of bicycle helmets is weak, relying on: /…/ cost-effectiveness analysis of mortality, *not morbidity*, statistics." By contrast, the Croatian term *natalitet* never appears as *natality* in English, but as *birth rate.*

The English term *mild event* is vague unless it is clarified by context. For instance, when speaking about sport injuries sustained in cycling Chapman and Curran (2004) discuss the severity of head injuries, namely, the less and the more serious head injuries. Later in the text they use the term *mild events* to denote less severe injuries. Without the context the translation into Croatian would be almost impossible, however, if the context is provided, as in this case, then the possible translation into Croatian could be *lakše ozljede*. This is an example of the zero equivalence between English and Croatian terms.

In medicine, dental medicine and veterinary science the terms *trauma* and *injury* may be found to occur interchangeably. The former denotes a wound or injury, whether physical or psychic (*Dorland's Illustrated Medical Dictionary*, 1994, p. 1735), and the latter "a harm or hurt; a wound or maim" and "usually applied to damage inflicted to the body by an external force" (*Dorland's Illustrated Medical Dictionary*, 1994, p. 843). The term *trauma* was derived from Greek *trauma* meaning *wound* (Hoad, 1996, p. 502), whereas the term *injury* was derived from the Latin word *injuria* meaning *unlawful conduct, injustice Webster's Encyclopedic Unabridged Dictionary of the English Language* (1996, 983). The terms *trauma* and *injury* display different semantic fields, namely, the former is much broader in meaning than the latter. The first example of the usage of the term *trauma* within the concept of dental medicine is the term *dental trauma* or *dental injury* and it is

literally translated into Croatian as *dentalna trauma* or *ozljeda stomatognatskog sustava*. The second example is the term *occlusal trauma* that is an "injury to any part of the masticatory system as a result of occlusal dysfunction" (*Dorland's Illustrated Medical Dictionary*, 1994, p. 1735). The translation of this term into Croatian may vary – *okluzalna trauma* but also *okluzijska trauma*. The terms *orofacial injury* and *orofacial trauma* are used interchangeably (for example, see Ranalli, 2002).

The Croatian term *zadobiti ozljedu* may be translated into English in various ways, thus forming a vast variety of English collocations: *to receive a [dental/oral] injury*, for example, "Each player has 1 chance in 10 of receiving a dental or oral injury while participating in contact sports." (Waked, Lee, & Caputo, 2002), *to incur a [dental/oral] injury* - "Boys are more likely than girls to incur injuries" (Newsome, Tran, & Cooke, 2001), *to sustain a [dental/oral] injury* (for example, Newsome, Tran, & Cooke, 2001: "This paper reviews the literature relating to injuries sustained during participation in sporting activities and use of a mouthguard in preventing such injuries", and *to suffer a [dental/oral] injury*, for example, again in the article by Newsome, Tran and Cooke (2001) a sentence may be found: " … it has also been shown that an athlete who has sustained a concussion is four times more likely to suffer a further concussion in the future". This last example shows that the English language is richer in synonyms that can be interchangeably used, however, each of them has its own nuance that specifies its realm of meaning.

Conclusion

Although the rules regarding the way collocations are made are not explicitly specified for any language, each native speaker will apply them successfully because he/she perceives them intuitively. Since they are highly characteristic for each individual language the speaker will make mistakes if, governed by intuition, follows the patterns of his/her mother tongue, and the collocation-related rules in one language, for example, in mother tongue, do not match the collocation-related rules of a foreign language. The risk is lower in translating a text written in a foreign language into mother tongue, because of intuition that helps us to avoid the unacceptable lexical combinations. *Ad litteram* translation can interfere with the translation process thus resulting in wrong translation. Reality, not only the theoretical linguistic approach, was taken into account since there is no model of grammatical description capable of providing an impeccable description. Both the context and the situation play an important role in shaping and establishing the actual nuances of word meanings.

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AGE RELATED CHANGES OF THE SKELETAL MUSCLE CONTRACTILE PROPERTIES

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Abstract

Age related changes of the skeletal muscle contractile properties have been investigated widely but not in non-invasive and selective way. In *Laboratory for electrical engineering*, University of Ljubljana, tensiomyographic (TMG) method has been developed and calibrated through last decade. Its usefulness was demonstrated in age-related testing of the contractile properties of four skeletal muscles. From every muscle was evident that delay and contraction time increases with age where less consistent results were obtained for relaxation and sustain times. From TMG detected mechanical twitch response we could conclude that skeletal muscle became slower with age, nervous system reacts with longer delay and that tendons are stiffer.

Key words: *Skeletal muscle, Tensiomyography, Ageing, Fibre type, Contraction time*

Introduction

Age related changes of the skeletal muscle contractile properties have been investigated widely but mostly through a theoretical models or studies in medical cases. Lack of the suitable methods has been the limitation in such studies but nowadays huge progress could be made using non-invasive and selective method called Tensiomyography (TMG). TMG method has been developed in Slovenia in Laboratory for electrical engineering, University of Ljubljana. So far has been evaluated with skeletal muscle composition (Dahmane et al., 2000 and 2005), muscle tone (Valenčič, 1990) and muscle peak torque (Valenčič, 1990). Its usefulness was demonstrated for monitoring muscle atrophy of above-knee amputees (Burger et al., 1996), patients with neuromuscular diseases (Knez et al., 1999), patients with spastic muscles (Grabljevec et al., 2004), skeletal muscle contractile properties adaptation on specific training process (Kerševan et al., 2002; Djordjevič et al., 2002) and chronological monitoring of child motor development (Pišot et al., 2001). The aim of the study was to demonstrate the usefulness of the TMG method in objective, selective and non-invasive testing of the contractile properties age-related changes of the four skeletal muscles.

Research methods

Eighty male subjects were included in the study aged from 6 to 77 years (average 32.5 ± 15.4 years). Average height and weight were 180.0 ± 9.6cm and 79.7 ± 14.1kg, respectively. Subjects have no history of neuromuscular disorders and volunteered for investigation. Each subject was fully informed about possible risks and nature of the experiments and signed the informed consent.

On every subject contractile properties of four leg skeletal muscles were measured using TMG method. Three heads of the quadriceps muscles (*vastus medialis* – VM*, vastus lateralis* – VL*, rectus femoris* – RF) and the lateral head of the hamstring muscles (*biceps femoris* – BF).

TMG method protocol consisted of bipolar selective transcutaneous twitch electrical stimulation evoking supramaximal skeletal belly mechanical response. Mechanical muscle belly response was detected as a transversal muscle belly enlargement during isometric twitch contraction. Digital displacement sensor was used for that purpose and personal computer for acquiring the sensors' position every millisecond for one second. TMG result is skeletal muscle response as a time-curve from which four time parameters (*Delay time* – Td, *Contraction time* – Tc, *Sustain time* – Ts, *Relaxation time* – Tr, all in milliseconds) are extracted and the amplitude of the overall response (*Maximal displacement* – Dm in millimetres). For each skeletal muscle two supramaximal responses are stored and an average of both further analysed.

Statistical analysis included Pearson coefficient analysis with significance testing to evaluate the changes of two series of data for its relations. An alpha of $p < 0.05$ was considered statistically significant for all comparisons.

Results and discussion

Results of the study have demonstrated significant degenerative changes of the Td and Tc in all four skeletal muscles. Td and Tc has been found significantly dependent on the subjects' age where positive correlations are presented on Figure

1. Focusing just on the BF muscle results we noticed broken trend for Tc. While in age from six to thirty we have found negative trend but in later years positive trend was significant. In general still positive trend was predominantly significant. These findings agree with most of the studies conducted so far and the known knowledge adding a great value for further investigations with selective and non-invasive methodology approach. Detecting Td and Tc of the mechanical response was always a problem as there was no suitable non-invasive method available. Some attempts have been done detecting the distal limb torque twitch response but the relevance of these results are questioned as the results didn't depend just on the intrinsic muscle belly properties but also tendons, surrounding tissue and joints characteristics, which obviously changes with age too. Another very interesting aspect was found in BF muscle where we could observe negative trend in the early age with huge standard deviation in the middle age and positive correlation in later years. Knowing that the

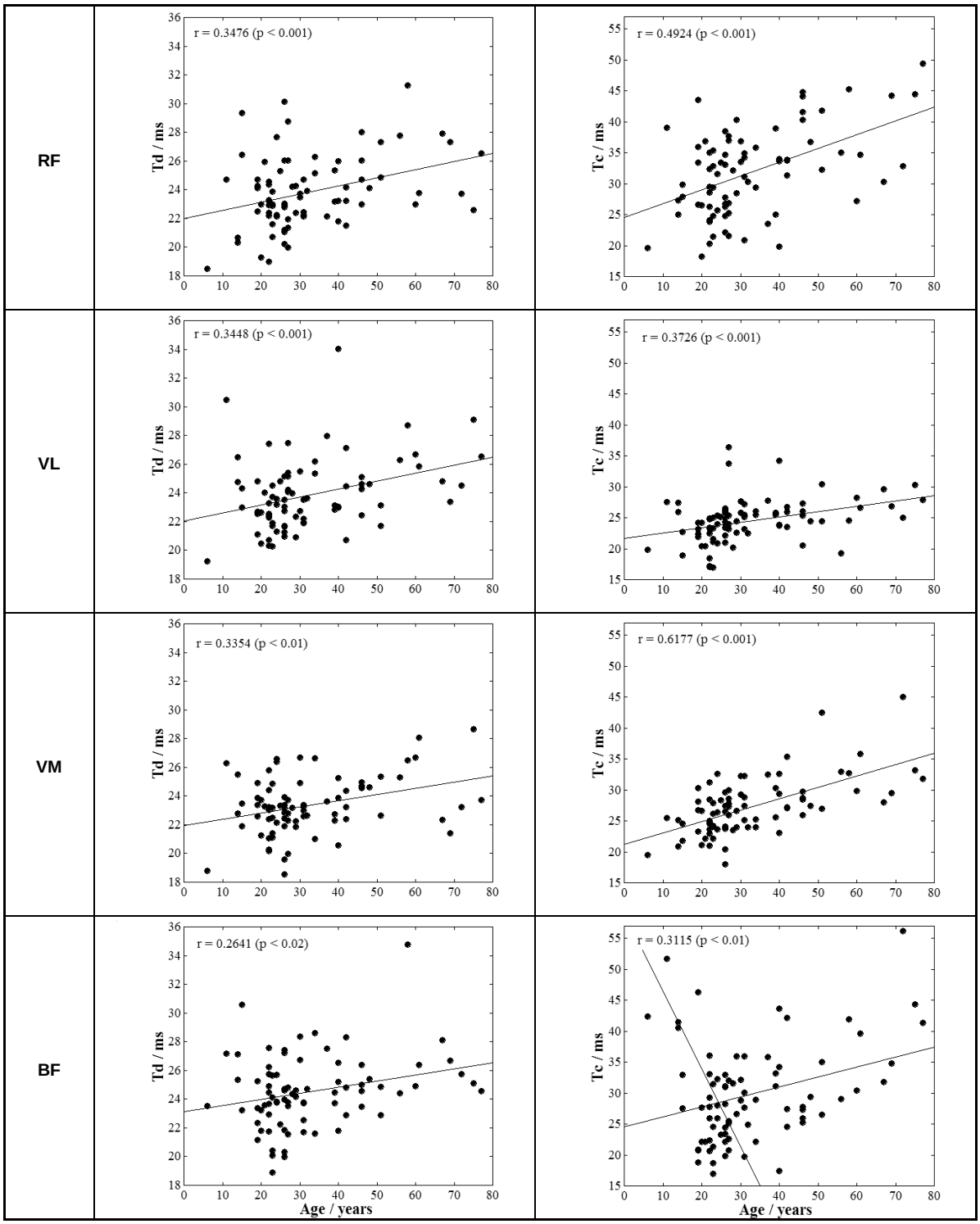

Figure 1: Correlation presentation of the Td and Tc regarding to subjects' age in all four measured muscles

BF muscle is on of the most important for the knee stability and is the key muscle from the anterior crucial ligament point of view it is important to preserve the muscles' quality as long as possible. We could conclude that BF muscle has the biggest ability to adopt to a certain physical activity and this issue should be investigated more. This conclusion is confirmed with a large proportion of the satellite-type muscle fibres in BF muscle.

Results for the Ts (Figure 2) show some discrepancy while there were found significant positive correlations for RF and VL muscles no significance were found for VM and BF muscles. In contrary, slightly negative correlation was observed for VM muscle. Even more, significant positive correlation for Tr was found just for VL muscle while for VM muscle was found significant negative correlation. For RF and BF non-significant positive and negative correlations were found, respectively.

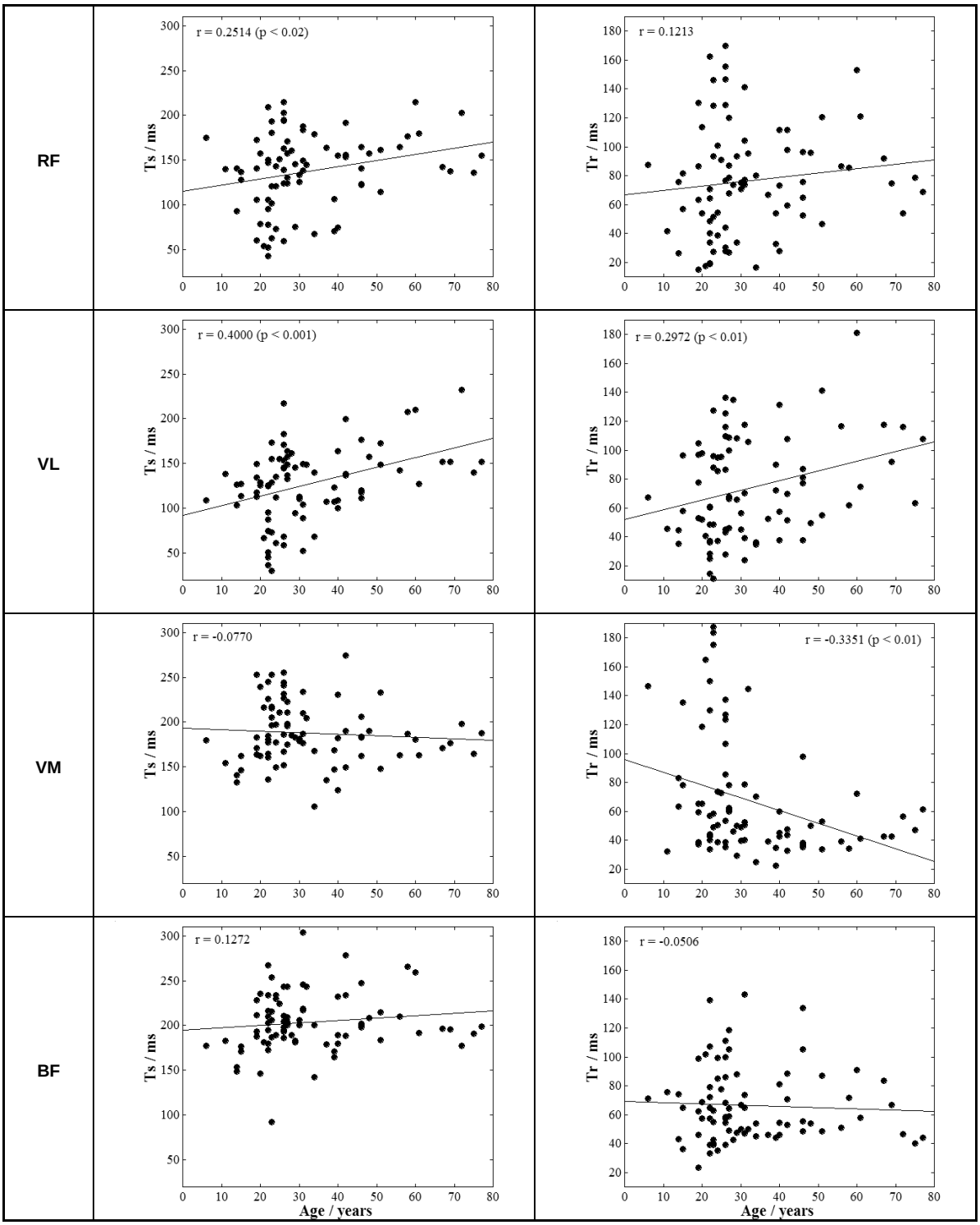

Figure 2: Correlation presentation of the Ts and Tr regarding to subjects' age in all four measured muscles.

Conclusion

Available data suggest that the contractile proprieties of the skeletal muscle become mature early in infancy or in early childhood. After birth and apparently by 1 to 2 years of age, some motor units of human skeletal muscle of mixed composition acquire the properties of slow twitch fibbers as Tc for these fibbers become slower and Tr increase. The maturity of the contractile proprieties of some muscle groups is exemplified by the relative constancy in the ratio of muscle strength to muscle cross-sectional area ratio for some muscle group (e.g., knee flexors) across age during growth. However, the ratio increases from childhood to maturity for other muscle groups (e.g., elbow flexors), suggesting that growth in contractile force proceeds at a greater than the increase in muscle mass or that the ability to develop voluntary maximum force improves with age for these muscles (Malina et al. 2004).

The obtained results showed that degenerative changes of contractile parameters take place in all measured muscles. Some of the muscles measured are on every-day basis involved in work-out in non athletes but BF muscle is not. Therefore BF muscle should be studied in more details as it has huge importance for the quality of life and should be with preventive work-out preserved to guarantee knee joint stability and enable physical activities.

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PHYSICAL ACTIVITY LEVEL IN REGARD TO AGE, GENDER AND EDUCATIONAL LEVEL IN CROATIAN POPULATION

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Abstract

The objective of this study was to determine the variability of physical activity at work, sport and leisure time in regard to gender, age and educational level . The sample consisted of 1537 (858 men, 679 women) employed adults, aged 20-65 years. The physical activity level and educational level were obtained by means of questionnaire. Three basic indices were calculated from the results of this questionnaire: work index, sport index, and leisure-time index. Educational level was negatively correlated with work index and positively with sport index in both sexes. Negative correlation between education and leisure-time activity was observed in younger men. The study revealed the increase in the sport activity level in women in the fifth and sixth life decade, when their activity slightly surpassed that in men.

Key words: *exercise, educational status, leisure activities*

Introduction

The level of habitual physical activity in individuals varies to a large extent within a particular population (Salonen et al, 1982; Leon et al, 1978; Paffenbarger et al, 1986; Sternfeld et al., 1999). It depends on a whole series of factors, such as age, gender, health status, cultural and biological heritage, and socio-economic status as well (Paffenbarger et al, 1986).

There are numerous methods for assessing the level of habitual physical activity (Pafenbarger et al., 1993; Haskel et al., 1993; Blair et al., 1985). The Baecke questionnaire (Baecke et al., 1982) is an example of a well-constructed tool, which carefully analyses the most frequent types of light physical activity. This questionnaire allows the determination of the total results of physical, occupational and sport activities during leisure time, and leisure-time activity excluding sport. The Baecke questionnaire shows a high correlation with energy expenditure, as measured by the double-labelled water method (Philippaertes et al., 1999). Because of its simplicity, it is highly recommended in large-scale studies. The objective of this study was to determine the variability of physical activity at work, sport activities during leisure time, and leisure time activities without sport in the adult employed population. The hypothesis of the study was that the level of physical activity and its relation to individual educational level varied according to gender and age.

Materials and Methods

The sample consisted of 1537 (858 men and 679 women) employed adults, aged 20-65 years, from northern part of Croatia. The subjects were randomly selected by general practitioners who were asked to send a letter of invitation to every registered employed patient, aged between 20 and 65. The structure of the sample regarding age, educational level and smoking habits is presented in Table 1.

Table 1. Number (N) and percentage (%) of men and women in the study sample with respect to age, educational level, and smoking characteristics

	Men (N=858)		Women (N=679)		p
Age	N	%	N	%	
< 30	139	16.20	99	14.58	
30 – 39.5	314	36.60	197	29.01	
40 – 49.5	266	31.00	314	46.24	
> 50	139	16.20	69	10.16	
Education					
Primary	162	18.88	200	29.46	0.0001
Secondary	545	63.52	338	49.78	0.0001
Higher	151	17.60	141	20.76	0.2400

The subjects filled in the Baecke questionnaire (Baecke et al., 1982) to assess the level of habitual physical activity. The questionnaire was composed of 16 items checking physical workload, load during sport activity, and load during leisure time and two additional questions regarding educational level and smoking habit. Three basic indices were calculated from the results of this questionnaire: work index, sport index, and leisure-time index. The lowest possible index value was 1.0, representing the lowest level of physical activity, whereas 5.0 was the highest possible value, signifying the highest level of habitual physical activity.

The significance of the obtained differences was determined by means of t-test (or by the U-test in the case of non-normal distribution). The relationships among physical activity indices and between the indices and the level of education were determined by correlation analysis.

Results

On average, men displayed significantly higher levels of both physical activity at work and sport activity during leisure time, whereas women were significantly more active in leisure time activities (Table 2).

Table 2. Mean values ± SD in work, sport, and leisure-time indices (mean ±SD) according to the gender (scale from 1 to 5, higher values signifying higher physical load)

Index	Men	Women	p
Work	3.05 ± 0.78	2.93 ± 0.93	< 0.001
Sport	2.42 ± 0.64	2.20 ± 0.58	< 0.000
Leisure time	2.88 ± 0.60	2.96 ± 0.59	0.015

The correlation matrix of activity indices and education level was calculated in the sample according to gender and age (Table 3).

Table 3. Correlation coefficients and their significance between the level of education and work, sport, and leisure time indices for men and women according to the age group (under and over 45 years of age)

Index	Men	Women
Age < 45 years	r	r
Work index	-0.52*	-0.34*
Sport index	0.17*	0.21*
Leisure time index	-0.09*	-0.06
Age > 45 years		
Work index	-0.53*	-0.46*
Sport index	0.28*	0.21*
Leisure time index	-0.07	- 0.10

$p < 0.05$

Significant negative correlation between work index and education level was observed in all subgroups. Significantly positive correlation between sport activity index and education level was observed in both genders and in both age groups. Significant correlation between leisure-time activities except sport and educational level was found only in younger men.

Discussion

High negative correlation between the education level and work index could be ascribed to less physical load at workplaces designed for highly educated people, meaning that there was more desk job and less physical work.

Sport activity level in both sexes was positively correlated with their educational level. That was expected, as people with higher education were being less physically active at work, and tried to compensate it through sport. However, the higher the intensity and the extent of exercising, the smaller percentage of women participated in that activity.

The leisure-time index comprised all physical activities during free time, except sport activities. Higher values of leisure-time index in women, although not significant, should mostly be attributed to housekeeping and gardening. The lack of significant correlation with educational level points out that, except for sport activity, all the subjects spend their free time in more or less the same way. The only exceptions were younger men in whom weak, but nevertheless significant negative correlation between the level of education and leisure-time index was revealed.

In conclusion, our study showed significant differences in the levels of all examined dimensions of habitual physical activity regarding gender. Educational level was negatively correlated with work index and positively with sport index in both sexes. Negative correlation between education and leisure-time activity level was observed only in younger men. Significantly higher work index and lower sport index in both genders reflected the social and economic aspects connected with cigarette smoking habits. Health promotion programs for physical activity should be particularly directed to smokers and to the less educated part of population.

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DYNAMICS OF LUNG FUNCTION CHANGE IN YOUNG TEAM HANDBALL PLAYERS*

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Abstract

The purpose of this study was to evaluate the dynamics of lung function and its changes through growth and development in young team handball players. Respiratory functional indicators were measured in 73 young team handball players that have been divided into four different age categories.The following parameters have been measured: vital capacity (VC), forced expiratory volume in the first second (FEV1), maximum expiratory flow (PEF), forced expiratory flow at 50% FVC (MEF50), forced expiratory flow at 25% FVC (MEF25). Our results suggest that relative values of ventilatory parameters rise progressively with the duration of the period of training and that departures towards lower values can be potential indicators of inferior functional abilities and bad performance in young team handball players.

Key words: *young team handball players, spirometric parameters, dynamics of lung function*

Introduction

Team handball belongs to the group of polystructural sport activities where cyclic and non-cyclic structures of movement are equally present. From the point of view of variety of structural wholes of movement, it is one of the most complex sports. In this game, both aerobic and anaerobic systems are equally engaged. From the point of view of energetic processes domination, it falls into the group of mixed sports. Hypotetically, it is possible to say that efficiency in team handball is defined by the following functional and motoric abilities: endurance (30 %), mobility (10 %), speed (25 %), strenght (20 %) and co-ordination (15 %). In order to be able to obtain top results in team handball, functional ablities, both aerobic and anaerobic, should be highly trained. The study of the ventilatory function of the lungs is a constituent part of functional diagnostics. Spirometry is a method of measuring the volume of air used by the lungs in breathing. It is used to measure static and dynamic lung volume and capacities. Consequently, the objective of this study is to outline the dynamics of lung function change in young team handball players and establish the differences in the changes of some spirometric parameters in four different age categories.

Methods

The sample of subjects consisted of 73 young team handball players divided into four different age categories: team handball school (U-12), U-14, U-16, juniors (U-18). All subjects take part in organised team handball training 3-8 times a week per 1,5-2 hours. The members of team handball school (U-12) train 3-4 times a week per 1,5 hours, the members of U-14 category train 5-6 times a week per 1,5-2 hours, the members of U-16 train 6-7 times a week per 1,5-2 hours, whereas the juniors (U-18) train 7-9 times a week per 1,5-2 hours. All subjects have been training without breaks for at least 6 months.

Respiratory functional indicators have been measured in resting by means of the pulmonary function measuring device “Master Lab” produced by Jaeger. The pulmonary function measuring device is completely automatised. It consists of three functional units: “Master Lab Pneumo”, “Master Lab Transfer” and “Master Lab Body”, which runs on a computer system. The computer software contains programs designed for measuring pulmonary function: spirometry, flow-volume curve, diffusion by means of the techniques of one inhalation and bodily pletismography. The programs contain all technical criteria, technical indicators and reference values in CECA and ATS standards.

The following parameters have been measured: vital capacity (VC), forced expiratory volume in the first second (FEV1), maximum expiratory flow (PEF), forced expiratory flow at 50% FVC (MEF50), forced expiratory flow at 25% FVC (MEF25), height (HEIGHT) and body mass (MASS). The respiratory indicators are expressed as percents of expected values in respect to age, sex, height and weight .

The basic statistical parameters (arithmetic mean, standard deviation and minimum and maximum results) have been obtained by using the software package “STATISTICA”, i.e. the programme Statistica for “Windows Ver.5.5”.

* *This study is part of a project approved by the Ministry of Science and Technology of the Republic of Croatia entitled “A model of objectivisation of locomotive system injuries”, No. STIRP-03/2002.*

Results and discussion

Table 1 shows the basic anthropometric parameters and respriratory parameters that have been measured according to age groups. As expected, an increase in height and weight can be perceived. The respiratory parameters that have been measured are represented in percentages, as deviations from reference values.

Table 1. Anthropometric and spirometric descriptive parameters

	U-12 N=23	U-14 N=20	U-16 N=17	U-18 N=13
	AS±SD	AS±SD	AS±SD	AS±SD
HEIGHT	159,30±9,18	175,40±7,65	184,17±5,24	187,92±5,18
MASS	50,47±10,73	64,00±8,81	68,47±10,54	83,07±9,26
VC%	0,87±0,13	0,86±0,13	0,96±0,10	1,08±0,08
FEV1%	1,01±0,12	1,01±0,08	1,06±0,11	1,21±0,12
PEF%	0,97±0,18	1,00±0,17	1,12±0,12	1,37±0,17
MEF50%	1,03±0,21	1,10±0,20	1,11±0,22	1,29±0,29
MEF25%	1,04±0,28	1,41±0,31	1,28±0,33	1,45±0,42

Lung ventilation is rarely mentioned as a significant factor of aerobic capacity since it is considered that sportsmen belong into the group of healthy people with regular biochemical parameters, heart function indicators and ventilatory parameters. Results of the study of ventilatory parameters in various groups of sportsmen indicate that there is a considerable difference between sportsmen and study subjects who don't practice sports (1). The values of vital capacity for sportsmen who have been studied are by 20-40% above reference values. In an anthropometrically similar group of people who are not sportsmen, the vital capacity is within normal values, i.e. 80-90% of reference values, but, in respect to sportsmen, it is 40-60% lower.

Figure 1. shows the measured spirometric parameters distributed in team handball players' different age groups. The vital capacity shows results below the average in respect to reference values in age categories from 12-16, whereas the oldest age group (16-18 years) shows vital capacity values above the average. The FEV1 and PEF values don't show significant departures from reference values in the age groups 12-14, whereas the age group 16-18 shows a considerable increase. Parameters MEF50 and MEF25 show values above the reference ones both in younger (12-14 years), and particularly in age groups older than 16. According to our results, years of training have the smallest influence on the increase of FEV1 (19,95%) and VC (21,60%). It has a slightly bigger influence on the increase of MEF50 (26,58%), but the most significant increase has been noticed with PEF (40,29%) and MEF25 (41,41%).

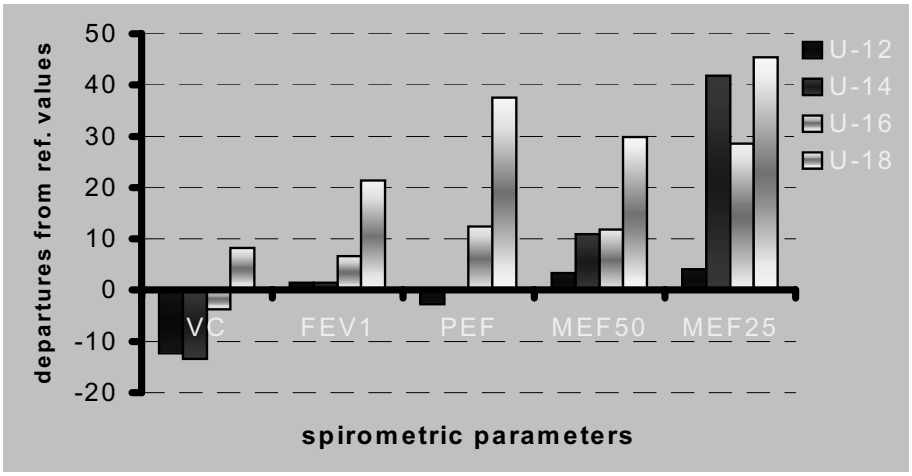

Figure 1. Changes in the spirometric parameters

Some studies compare the spirometric characteristics of top sportsmen (and basketball players among them) with a healthy population of non- sportsmen. As expected, a better functional ability of sportsmen has been defined. Other studies deal with functional ability of some sportsmen in different phases of their preparations. In this paper we have studied the dynamics of functional abilities among younger age groups of team handball players. A relative increase of respiratory parameters in older age groups in respect to the younger ones could be the result of the increase of functional ability of the respiratory muscles as a consequence of years of training.

Conclusion

The ventiltatory function of the lungs has been analysed on a sample of 73 young team handball players divided into 4 age groups. The primary objective of this study has been to outline the dynamics of changes of the lung function through age categories.

The conclusion is that relative values of ventilatory parameters rise progressively with the duration of the period of training. Departures towards lower values can be potential indicators of inferior functional abilities. The results thus obtained can be useful in the running of the traning process.

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CARDIO-RESPIRATORY ENDURANCE OF CHILDREN WITH LATERAL SPINAL CURVATURE

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Abstract

The aim of the presented research was to define the limits of cardio-respiratory endurance of rural boys and girls with low level functional scoliosis when compared against people of the same age with correct body posture.

The survey took place in 1998-1999 at schools selected at the territory of Eastern Poland. Body posture and physical agility were assessed in 1537 children aged 10-19 years, therein 744 girls and 793 boys. Low level scoliosis was discovered at all surveyed age groups in altogether 495 children what made 31,3% of the whole body of the surveyed children. The research proves that the level of cardio-respiratory endurance is differentiated what is characteristic for the age and sex of the surveyed children. Nevertheless the research results prove that there is no significant difference in the analyzed aspect of physical agility between children with lateral spinal curvature and children with correct body posture.

Key words: *girls, boys, low level scoliosis, cardio-respiratory endurance.*

Introduction

Somatic development disorders and body posture defects are the most frequently encountered problems with health condition and development of children and youth. Scientific research reveals that during recent years the number of obese children and children with lateral spinal curvatures has grown up. Lateral spinal curvatures belong to group of the most dangerous body posture defects. Those defects can appear at any age and the most often changes caused by them are aggravating. And even if in youth those changes have no symptoms, in adulthood and elderly age their repercussions will be easily noticed. That happens because scoliosis badly influences the disposition and functions of internal organs, affects work of heart and big blood vessels, and causes difficulties in ventilation of lungs. Children with somatic and motor development disorders are extremely susceptible to defects of spine positioning and its framework (Głowacki et al. 2003).

Scientific research into motor functions of humans hasn't payed a lot of attention to development of physical agility of children with developmental disorders and to children with static disorders in particular. However it is always underlined that low physical activity of children subject them to body posture disorders; also it is often said that changes in bone and muscle structure badly influence physical activity of children and youth. Yet, there has not been done any systematic research in this domain. Regarding the above described situation the assessment of cardio-respiratory endurance of boys and girls with low level scoliosis took place by comparing their results against the results of children of the same age with correct body posture.

Methods

The research on biological development of children and youth was done in years 1998-1999 within research project of Scientific research Committee Nr 4PO5D02314. Body posture and physical agility survey covered 1537 children, therein 744 girls and 793 boys aged 10-19 years old. Calendar age of the surveyed children was defined according to the principles of the International Biologic Program. Such somatoscopic methods as point rating method of Wolański, orthopaedic examination (Kutzner-Kozińska et al. 2001) and Adam's test (Głowacki et al. 2003) were used to define body posture.

Cardio-respiratory endurance was examined by means of physical agility test "Eurofit" (1988). Development of morphological and functional traits of girls and boys was analyzed in the following age groups 9-10, 11-12, 13-14, 15-16, 17-19, regarding differentiation between children with correct body posture and children low level lateral spinal curvature. Basic statistic calculations, arithmetic means and standard deviation were used to analyze the data compiled. Statistic significance of the described differences was evaluated by means of t-Student test.

Results

Low level lateral spinal curvatures i.e. cases of initial disorders of body static in frontal plane were discovered at all ages in the surveyed children, altogether 495 people (32,2%). Those changes were functional and were found the most

often in puberty period, between years 11 and 14 in girls and between years 9-14 in boys. The surveyed people were examined while they were standing. Deviations of vertebral axis from mechanical one in frontal plane that measured 1cm and more as well as deformations of shoulder triangle were regarded. Depending on the localization of the curvature there were found misplacements of shoulder, scapula or pelvis. When the trunk is bent forward spinous processes take their proper place and the geometry of back is symmetrical (tab. 1).

Table 1. Cases of low level scoliosis in boys and girls.

Age	N	Correct body posture		low level scoliosis	
		N	%	N	%
Girls					
9 – 10	39	30	76,9	9	23,1
11 - 12	184	120	65,2	64	34,8
13 - 14	183	120	65,6	63	34,4
15 - 16	162	115	71,0	47	29,0
17 - 19	176	128	72,7	48	27,3
Together	744	513	69,0	231	31,0
Boys					
9 – 10	73	46	63,0	27	37,0
11 - 12	202	129	63,9	73	36,1
13 - 14	207	134	64,7	73	35,3
15 - 16	130	94	72,3	36	27,7
17 - 19	181	126	69,6	55	30,4
Together	793	529	66,7	264	33,3
All	1537	1042	67,8	495	32,2

The average magnitudes of endurance test results were differentiated in selected groups of children (tab. 2, fig. 1).

Table 2. Cardio-respiratory endurance of boys and girls with correct body posture and with low level scoliosis (number of stages)

Age	Correct body posture		Low level scoliosis		F	P
	$\bar{x}$ ± SD	S $\bar{x}$	$\bar{x}$ ± SD	S $\bar{x}$		
Girls						
9 - 10	5,36 ± 1,06	0,19	5,33 ± 1,22	0,40	0,006	0,937
11 - 12	5,54 ± 1,30	0,11	5,78 ± 0,84	0,10	1,753	0,187
13 - 14	5,85 ± 0,98	0,09	5,98 ± 1,05	0,13	0,637	0,425
15 - 16	6,13 ± 1,65	0,15	6,25 ± 1,64	0,24	0,190	0,662
17 - 19	5,71 ± 1,55	0,13	5,75 ± 1,85	0,26	0,012	0,910
Boys						
9 - 10	5,15 ± 1,17	0,17	5,62 ± 1,00	0,19	3,1210	0,0815
11 - 12	5,86 ± 1,26	0,11	6,05 ± 1,10	0,12	1,2006	0,2745
13 - 14	7,04 ± 1,32	0,11	6,86 ± 1,19	0,13	0,9572	0,3290
15 - 16	8,64 ± 2,03	0,22	8,97 ± 2,09	0,34	0,6474	0,4226
17 - 19	9,38 ± 2,63	0,23	9,65 ± 2,51	0,33	0,4253	0,5151

There has been observed a slight uprise in level of the examined physical agility factor in girls between years 9-10 and 15-16. Arithmetic means of those measurements were 0,72 stage greater in 15-16 year old girls with correct body posture and 0,97 stage greater in scoliotic girls when compared against younger girls. Alarming is the fact that surveyed girls aged 17-19 years old, no matter if body posture is, correct are characterized by lower level of cardio-respiratory endurance than younger girls.

In boys cardio-respiratory endurance improved with age. Measurements results in the oldest group were in average 4,23 stages better in boys with correct body posture and 4,03 stages better in scoliotic boys when compared against measurement results obtained by the youngest children surveyed.

Both in boys and girls, children with low level lateral spinal curvature presented better level of cardio-respiratory endurance. However, those differences were little and not significant statistically.

The selected groups of boys and girls obtained similar results in endurance test, thus boys and girls with correct body posture often obtained here slightly worse results. However in groups of children with scoliosis, girls obtained very often results on average level where boys obtained results of high level (tab. 3).

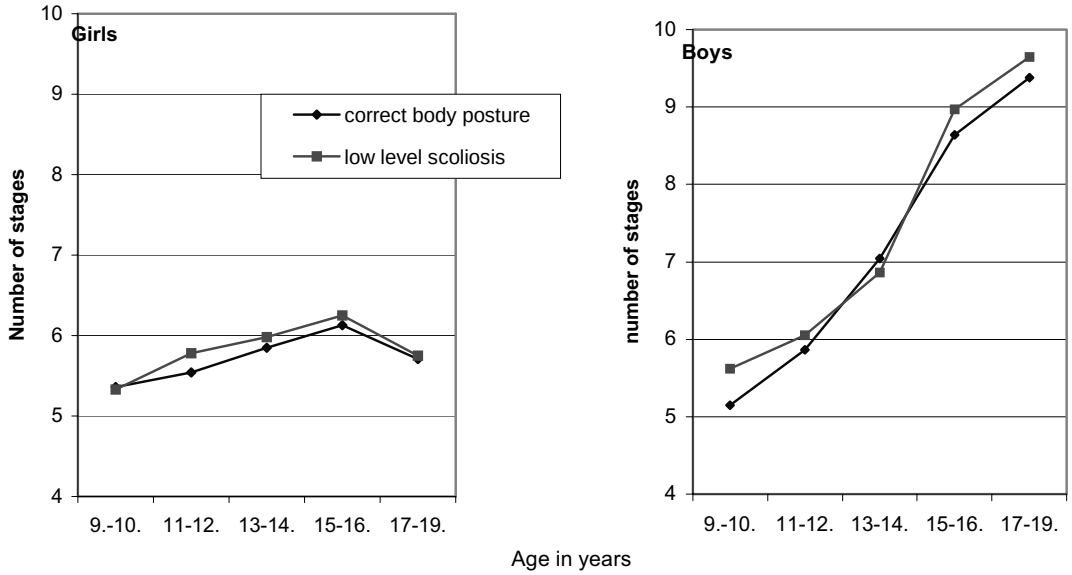

Fig. 1 Cardio-respiratory endurance

Table 3. Results of endurance test in examined groups of children

Body posture	Low magnitudes (< $\bar{x}$ -0,5SD)		Average magnitudes (SD- $\bar{x}$ +SD)		High magnitudes (> $\bar{x}$ +0,5SD)	
	N	%	N	%	N	%
Girls						
Correct body posture	191	37,3	171	33,3	151	29,4
Low level scoliosis	77	33,3	86	37,3	68	29,4
Boys						
Correct body posture	194	36,6	151	28,5	184	34,9
Low level scoliosis	87	33,0	81	30,7	96	36,3

Discussion

The presented research results prove that the level of cardio-respiratory endurance in rural children is differentiated, what is characteristic for age and sex of the examined people. Average magnitudes of research results increased with age, where those changes were more marked in boys. Sexual dimorphism was also clearly expressed by better results obtained by boys when compared against girls of the same age. The presented research results of analyzing cardio-respiratory endurance are in accordance with results proved by other scientists (Osiński 2000).

However there is no marked correlation between cardio-respiratory endurance level and correctness of body posture proved by presented research. Better results obtained by scoliotic children can be caused by the fact that their body constitution is slimmer, they possess lower adiposity level and lower body mass when compared to children of the same age with correct body posture (Skład 2000).

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VALIDATION OF SIMPLE METHODS FOR ESTIMATING BODY COMPOSITION OF ATHLETES

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Abstract

The purpose of this study was to evaluate the accuracy of skinfold equations (SF) and bioelectrical impedance analysis (BIA) for predicting body composition of trained populations. Underwater weighing technique (UW) at residual volume was used to derive the criterion measures of percent body fat (%BF). Studies were performed in 52 male and 34 female subjects who exercised regularly at least 2 hours per day, 4 days per week. The different %BF estimates by the three methods were compared using a one-way ANOVA, with posthoc Scheffe's test when values were significantly different. Linear regression analysis was used for comparing the %BFs among the methods. The result showed significant differences among the three methods. %BF by SF (M:10.3±1.2%, 15.6±2.8%) was lower (P<.05) while %BF by BIA (15.6±2.8%, 23.6±3.8%) was higher (P<.05) than the reference values by UW (M:11.9±2.1%, F:18.7±3.0%). These results suggest that both BIA and SF don't provide valid estimate of %BF in trained population.

Key words: *%BF, UW, BIA, SF*

Introduction

There is considerable interest in the relationship between body composition (BC) and sports as it is known that BC has a significant effect on athletic performance as well as that exercise has the potential to alter BC. In addition, the assessment of BC in athletes can be used to determine their status of preparation for athletic competition as well as to profile the unique sport-specific characteristics that differentiate athletes from other populations. Coaches increasingly attempt to optimize body compositional make-up to improve athletic performance, and demands for attainment of target percent body fat (%BF) appear common practice.

For the assessment of BC of athletes there is a need for a fast and easy method to estimate body fat and/or fat-free mass (FFM) accurately and reliably. Several methods of determining BC are currently recognized, such as underwater weighing method (UW), skinfold equation (SF), and bioelectrical impedance analysis (BIA). However, UW requires expensive laboratory equipment and an extensive amount of time and effort for completion of the test. In contrast, common field methods such as BIA and SF are portable, inexpensive, noninvasive, and require minimal amounts of time and training. As such, field methods have greater potential for use by hospitals, corporations, universities, and sports and fitness facilities.

The generalized SF developed by Jackson and Pollock (1978) for men, and Jackson, Pollock and Ward (1980) for women are commonly used for athletic populations. Predictive accuracy of these equations for athletes has been determined using cross-validation techniques. The reported correlation coefficients and standard errors of estimate (SEEs) for relative body fat were r=0.83 and ±2.47 %BF for male equation (1) and r=0.81 and ±3.18 percent for female equation.

The use of BIA to determine BC is becoming increasingly popular. Studies in adults have shown that BIA is an easy, applicable method for estimating FFM (9) or total body water (TBW) (7). It is evident from recent studies that the use of BIA in the assessment of BC in athletes requires that specific prediction formulas be different from those established for adults. Athletes are typically on the low end of the %BF range, it would seem important to determine this accuracy of the new equations in lean individuals in general and specifically in athletes. The purpose of this study was to evaluate the accuracy of SF and BIA for predicting BC in athletes. The UW was used as the criterion measure.

Methods

Subjects

The subjects for this study were 52 male and 34 female athletes who exercised regularly at least 2 hours per day, 4 days per week. The average competitive experience periods of the male and female athletes was 8±3 years and 7±8 years, respectively. The written informed consent was obtained from each participant.

All subjects had been instructed to fast for eight hours prior to their scheduled testing time, to avoid the consumption of foods and alcohol and to avoid strenuous exercise or competition for 24 hours prior to testing. Body weight was

measured to the nearest 0.1 kg in subjects wearing light underwear on a calibrated balance-beam scale and height was measured to the nearest 0.5 cm. Three methods for determining BC (UW, SF, and BIA) were sequentially administered to each subject.

Underwater weighing (UW)

UW was performed in a water tank utilizing a load cell and digital indicator (Quark PFT, Cosmed) that was suspended from a support structure and connected to a chair positioned in the water at a depth of approximately 80cm. The underwater weight was recorded with the head fully immersed under water after a forced maximal expiration. The subjects were asked to remain submerged for a minimum of 3 seconds to allow the digital indicator to stabilize prior to raising the head out of the water. A minimum of 5 trials were performed and the 3 highest underwater weights were averaged and used in subsequent calculations. Body density was converted to %BF using the equation of Brozek et al. (1963).

Skinfold thickness (SF)

Measurements of double-thickness subcutaneous adipose were made by the same observer, using Lange skinfold caliper with a constant calibrated pressure. Biceps, triceps, subscapular and supra-iliac skinfolds were measured 3 times at each site to the nearest 0.5 mm with the mean value recorded. All SF measurement were taken on the right side of the body. Body density was determined from the 3 skinfold measures using the prediction validated by Jackson (1981) for male and Lohman et al. (1988) for female. %BF was estimated by using the equation of Brozek et al. (1963).

Bioelectrical Impedance Analysis (BIA)

Bioelectrical resistance was measured by using a model TBF-534(Tanita, Tokyo, Japan) which is foot-to-foot BIA system. Subject inputed age, gender and height, then steped onto the platform, and then electrodes in the foot sensor pads sent a signal through the body. The manufacturer-supplied equations incorporate gender, mass, height, activity category and a measured impedance value to determine %BF.

Statistical Analysis

A one-way ANOVA was used to determine differences among the three groups for a basis of descriptive characteristics. Significant differences($P<.05$) were analyzed by using Scheffe's post hoc comparison technique. Linear regression analysis was used for comparing the %BFs in three groups.

Results

The data for the subjects are displayed in Table 1. %BF by SF was lower ($P<.05$) while %BF by BIA was higher ($P<.05$) than the reference values by UW. BIA equations significantly overestimated %BF as determined by UW in trained subjects. The predictive ability of BC methods using UW as the criterion in %BF is displayed in Table 2. Correlation coefficients ranged from $r=0.45$ to $r=0.87$. The correlations between UW and BIA and SF were not great. The SEE values of BIA and SF using UW were 2.91% and 2.74% in male, 3.20% and 2.67% in female, respectively.

Table 1. Physical characteristics of subjects (M ± SD)

Variable	Male (n=52)	Female (n=34)
Height, cm	176.5±5.7	164.9±4.3
Weight, kg	73.7±6.1	60.1±6.0
BMI, kg/m^2	23.6±1.7	22.1±1.8
%BF by UW	11.9±2.1	18.7±3.0
%BF by BIA	15.6±2.8	23.6±3.8
%BF by SF	10.3±1.2	15.6±2.8

Discussion

Accurate body composition assessment is beneficial for athletes, as it can be indicative of health and performance status(2). The purpose of this study was to evaluate the accuracy of SF and BIA for predicting BC in trained populations. The results clearly show that in this sample, %BF from BIA and SF are poorly correlated with UW.

Many BIA and SF methods use prediction equations which are calibrated against the UW method. UW is a valid method for estimating body composition. While a highly accurate laboratory technique such as UWould be preferred for determining BC characteristics, it is often necessary to use a practical field-based method such as BIA and SF.

There are many population specific as well as generalized BIA and SF available for estimating BC in various populations. The decision regarding which equation to use should be based on its accuracy for the population being examined (5). There have been reports that the equations supplied by the various manufactures of BIA overestimate %BF in lean individuals (1,4,6,9).

Table 2. The predictive ability of BC methods using UWW as the criterion in %BF

Sex	Methods	Slope	Intercept	SEE	r
Male	BIA	0.35	6.51	2.91	0.45
	SF	0.46	6.53	2.74	0.59
Female	BIA	1.01	-0.14	3.20	0.87
	SF	0.54	9.44	2.67	0.50

Keller and Katch (1985) found the overestimation using the BIA equations to be 6.8 units of %BF (15.9 vs. 9.1 percent) in a group of 54 athletes. Although Hodgdon and Fitzgerald (1987) found the correlation between %BFs by UW and BIA was r=0.82 for their entire heterogeneous sample, the relationship deviated form the line of identity at both extremes of the distribution. In the current study, using the all subjects, a difference of 4.7 units of %BF between BIA and UW in comparably lean subjects is in agreement with Keller and Katch (1985) and Hodgdon and Fitzgerald (1987).

It is difficult to speculate on what they may be biasing the prediction of %BF for these lean subjects. The more homogeneous the sample the more likely that correlations will be low. The combination of a homogeneous sample and a relatively small number of subjects present significant problems in comparing results from different studies. However, it can be concluded that the determination of %BF using equations supplied by the BIA manufacturer is problematic.

The results suggest that the correlations between UW and BIA and SF were not great and the SEE values were not appropriate for predicting %BF in these lean subjects. Therefor it can be concluded that BIA and SF have limited utility in estimating %BF in physically trained population. Future research should be directed to develope BIA prediction equations for physically trained population validated against a reference method.

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CROSS REFERENCE ANALYSIS OF FOOTBALL PLAYERS OF 1ST CROATIAN FOOTBALL LEAGUE ON THE TEST 300 YARDS SHUTTLE RUN AT TWO TIME POINTS

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Abstract

A test on 300 yards at two time points, by the end of the first and the beginning of second competition period, has been performed on the 33 players in two clubs of the 1st Croatian football league. On the basis of results received, level of glicolitical abilities has been analysed along with the analysis of the difference in the level of footballers training. By standard procedures of descriptive statistic, the anthropometric measurements have been dealt with (height, mass and estimated body fat level) along with testing parameters on the 300 yards (result, maximum heart frequency and maximum lactate concentration) in both testing. Analysis of differences in two clubs in the two measurements has been performed by using the Student t-test for dependent and independent samples. On the basis of results received, it can be concluded that the better result in the 300 yards test along with higher levels of maximal lactate, points to the higher level of training, which is one of the basic conditions for achieving quality competing results in football.

Key words: *football, 300 yards test, lactate*

Introduction

Football is one of the most popular sport games. According to the structural complexity, football is counted as the complex sport activity, while it is, according to the physiological classification, anaerobic and aerobic sport with phases of high tension like sprints, fast changes in movement direction, jumps etc. Modern football demands strong athlete, with high stamina and high level of motor and functional abilities (aerobic and anaerobic capacity, speed, explosive strength, coordination etc.) and the sense for collective play and improvisation. In line with the modern football play, new demands are set for the players. Game intensity is higher and recovery opportunities during games are reducing. Speed stamina, which is considered as a primary motored ability has even greater role in modern football.

From all the players, no matter the game position, high level of different forms of physiological readiness, especially specific anaerobic stamina is demanded. Coach, on the basis of motor and functional tests and own evaluation of players abilities, has the option of targeted approach focused on individuals specific weaknesses. This enables the individual and systematic work, decreases possible errors in training methodology and negative consequences on players development.

The aim of the study was to explore the level of glicolitical abilities of the 1st Croatian football league players and make cross-reference analysis of the 300 yards shuttle run test at two time points.

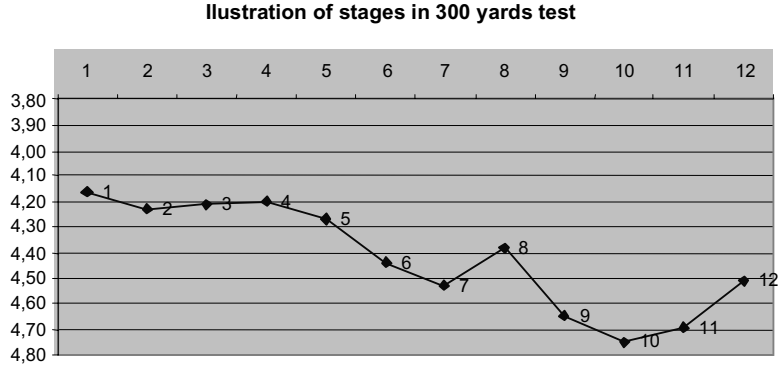

Illustration 1. Illustration of stages in 300 yards test

The 300 yards shuttle run test

One of the possible indicators of training levels in glicolitical abilities is the test of speed stamina assessment –300 yards shuttle run test, consisting of 12 stages of 25 yards in length (22.84m). It is important to emphasize that each of 12 stages must be ran at maximum speed, because that is the only way the coach can monitor and value the level of glitolitical readiness, basing his evaluation on the basis of total result and th result of each individual stage. Parameters that are recorded are total time and time on each stage and at the end of the test the lactate quantity accumulated in the body is measured.

Methods

Results of 33 players from two clubs of the 1st Croatian football league in the season 2004/2005 have been analyzed. Measurements have been performed at two time points, at the end of the first and the beginning of second competition period. Sample contains 10 defenders, 15 midfielders, and 8 attackers, with average age of 23.4 years and average player experience of 13.9 years (Table 1).

Table 1. (Average age and the average players experience)

	Age (± SD)	Experience (± SD)
Club A	23.1 ± 3.87	14.2 ± 3.70
Club B	23.8 ± 4.58	13.5 ± 3.31
Total	23.4 ± 4.18	13.9 ± 3.48

In total of 10 variables were registered and measured: age, game position, experience, body height (ABH), body mass (ABM), percentage of body fat (%BF), body fat in kilos (Kg BM), 300 yards test result (MBI3Y), maximal lactate concentration (Lmax), and maximal heart rate in 300 yards test (HR max/test).

Data gathered were processed by standard statistic procedures calculating the descriptive parameters –arithmetic mean (AM) and standard deviation (SD) of the results. Statistical meaning of differences between average value of the club results in initial and final measurement are analyzed using the Student t-test for independent samples, and differences between average values of first and second measurement with Student t-test for dependent samples. All statistical procedures are performed using the statistical package Statistic for Windows 6.0.

Results

The obtained results are presented in tables. Table 2 shows total results for both tests.

Table 2. Total results illustration (arithmetic middle -AM ± standard deviation -SD)

	Height (cm)	Mass (kg)	% BM*	Kg BM*	MBI3* (sec.)	HR max-test*	Lmax* (mmol/l)
1. measurement	183.2± 7.40	79.4 ± 6.79	11.5 ± 2.74	9.2 ± 2.59	57.43 ± 2.46	183 ± 8.36	15.3 ± 1.71
2. measurement	183.2± 7.40	79.1 ± 6.47	11.4 ± 2.60	9.3 ± 2.51	56.17 ± 1.96	182 ± 8.54	15.0 ± 1.86

* legend in text

Comparing the results from the test, parameters dependent on the training, body mass ($t=1.48$, $p>0.05$), percentage of fat ($t=0.61$, $p>0.05$) and body fat mass ($t=-0.45$, $p>0.05$), have not changed significant. Concerning the results of the 300 yards test, there were significant changes ($t=2.49$, $p<0.05$) in the sense of improvement. In the other two variables, maximal heart rate ($t=1.28$, $p>0.05$) and maximal lactate concentration ($t=0.35$, $p>0.05$), there were no significant changes.

The results of the first and the second measurements of clubs A and B are presented in tables 3 and 4. When we compare the results of the first measurement, only significant change between clubs is in the 300 yards shuttle run test ($t=-4.80$, $p<0.05$).

After initial part the players have admitted to the second measurement, in which statistically significant differences can be noted in 3 variables: result in the 300 yards test ($t=2.29$, $p<0.05$), maximal heart rate ($t=-2.84$, $p<0.05$) and maximal lactate concentration ($t=-6.87$. $p<0.05$).

Table 3. The first and the second measurement of the club A (arithmetic mean -AM ± standard deviation-SD)

	Height (cm)	Mass (kg)	%BM*	Kg BM*	MBI3Y.* (sec.)	HR max-test*	Lmax* (mmol/l)
1. measurement	183.4± 9.09	79.5± 8.05	11.9± 2.99	9.6 ± 2.94	58.97± 2.23	185± 8.76	15.2± 2.03
2. measurement	183.4± 9.09	79.2± 7.80	11.9± 2.89	9.8 ± 2.99	55.46± 1.99	186± 6.77	16.4± 1.15

* legend in text

By comparing the two measurements in the Club A, the significant difference can be seen in the 300 yards shuttle run test ($t=7.30$, $p<0.05$) and maximal lactate concentration ($t=-2.56$, $p<0.05$), while the maximum heart rate not changed ($t=-0.94$, $p>0.05$).

Table 4. The first the and second measurement of the club B (arithmetic middle -AM ± standard deviation-SD)

	Height (cm)	Mass (kg)	%BM*	Kg BM*	MBI3Y.* (sec.)	HR max-test*	Lmax* (mmol/l)
1. measurement	183.0± 5.33	79.3± 5.39	11.0± 2.45	8.8 ± 2.17	55.80± 1.44	180± 7.35	15.3± 1.36
2. measurement	183.0± 5.33	79.0± 4.92	10.8± 2.18	8.8 ± 1,81	56.93± 1.67	178± 8.64	13.6± 1.23

* legend in text

Analyzing the results in the club B, statistically significant difference in the 300 yards shuttle run test is noted ($t=-3.13$, $p<0.05$), maximal heart rate ($t=4.88$, $p<0.05$) and maximal lactate concentration ($t=4.59$, $p<0.05$)

Discussion

Studying the results, it can be seen that some variables don't change (height, mass, percentage of body fat, body fat mass), and some variables are changing (300 yards test result, maximum lactate concentration, maximum heart rate in the test). Analyzing the club results in the first measurement (Table 3), it can be concluded that Club B has finished season more ready, which is confirmed by its competing results. Club A has experienced fall in competing results, and from the total of 30 taken points in midseason, in the last five games they have taken only four. Club B experiences significantly different situation, they have improved competing effect and in the last five games have taken almost half of the possible points. Above stated confirms that Club A has timed its form and concentrated on the first part of the midseason, and Club B for the second part of the midseason. Applying the same analysis on the second measurement (Table 4), we can conclude that Club A has better results in all three variables, so we can assume that there are differences in planning and programming of the sport form. Worse test results, smaller concentration of lactate and lower pulse with Club B, can be the consequence of the exhaustion after pre-seaason. To perform complete analysis, information about extensity and intensity of training in the preparing period is needed.

Finally, let us look at the differences between first and second measurement of both clubs (Table 5 and 6). Club A has experienced positive changes in all three monitored variables; therefore we can conclude that the club is totally ready for continuance of the championship. Club B results analysis in all three monitored variables, shows negative changes and it can be concluded that pre-season period was hard for most players, and recovery time, for achieving more quality results, to short.

Conclusions

Level of the aerobic and anaerobic ability, closely tied with the number of meters ran in the game and with the possibility of repeating certain stages with maximal and sub maximal speed, is among the most important indicators of the athletes' readiness from the aspect of the general and specific preparation. Most important specific motor ability of the football players is speed stamina, which is set by lactate and glicolitical abilities, and also by technique of certain footballers and the degree of his movement economy. On the basis of the test results of the two clubs from the 1st Croatian football league club at two time points, at the end and at the beginning of the competition period, it can be concluded that better result in the 300 yards test and higher level of maximal lactate, means higher level of training readiness.

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PHYSICAL FITNESS IS NOT IN RELATION TO CROATIAN ELITE TENNIS PLAYER RANKING?

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Abstract

The aim of the study was to determine the eventual relation of results obtained in standard testing protocols used in tennis to current ranking of elite tennis players as well as on maximal serve velocity. Twenty Croatian national and international male elite tennis players were ranked according to the ATP and National ranking order at the end of the season and underwent a laboratory exercise testing procedure, which encompassed measurements of morphological, motor and functional characteristics and abilities. The insight into relation of the measured abilities to an overall ranking was obtained by multiple regression analysis. Neither the model nor any single variable proved to be significant in predicting the ranking of Croatian elite tennis players or maximal service speed. Very good results in the tests of aerobic capacity, strength and coordination probably contributed to the lack of significant correlation between the proposed model and the ranking of players because all subjects were well prepared from physical fitness point of view. Also, the sample comprised only top-level athletes among whom the ranking is probably influenced by slight differences in tennis technique and, of course, psychological factors.

Introduction

According to Groppel and Roetert, (1992), the general consensus on fitness development is that tennis players should incorporate flexibility, strength and endurance training in their programmes to minimise asymmetry and injuries, while simultaneously enhancing performance. Insight into energy pathways in tennis shows the game of tennis has aerobic and anaerobic component. These findings suggest that training programmes should be designed specific to the actual energy and muscular demands of the game. Generally, improvement of physical fitness in elite sport should improve the performance and also the ranking of the athlete in individual sport. That is way various models of test protocols have been established for every sport on basis of functional or motor abilities that should contribute to the performance in the sport in question (Muller, 2000). Relations between resistance training volume, ball control skills and isokinetic muscular performance and overall tennis performance were observed (Perry et al., 2004; Ellenbecker and Roetert, 2004). The goal of functional and motor testing in tennis is to determine the level of physical fitness of the athlete on individual basis. Specific training programs can then be designed based on an athlete's fitness testing results. (Roetert et al., 1995). That would lead to the conclusion that an athlete (i.e. tennis player) that performs better in fitness tests should also perform better in competition and therefore have better ranking. Proper conditioning in elite tennis players is advisable especially for players who prefer to play from the baseline (Smekal et al., 2001).

The aim of the study was to determine the eventual relation of performance in standard testing protocols used in tennis to current ranking of elite tennis players as well as on maximal serve velocity.

Methods

Twenty male Croatian tennis players of national and international level (general characteristics of the sample presented in Table 1) were ranked according to the ATP and National ranking order at the end of the season.

Table 1. General characteristics of the subjects (Mean and Standard deviation)

N = 20	Mean	Std. Dev.
Age	21.4	3.5
Years in training	13.8	4.1
Height	184.4	7.1
Weigth	77.6	7.3
Percentage of fat	12.1	4.1
Body Mass Index	22.8	1.7

The players underwent standard laboratory fitness testing of morphological, motor and functional characteristics and abilities. The measured variables were:

- Counter movement jump (cm)
- 15 sec hopping test– measured on Kistler platform (cm)
- Hand tapping (N)
- Cating (N)
- Bench press with 70% body weight (N)
- Pole turning (cm)
- Maximal exhaustion VO2 test on treadmill (ml/kg/min)
- Radar maximal serve speed test (km/h)

Results

Means and standard deviations for each measured variable were obtained by descriptive statistics (Table 2).

Table 2. Descriptive statistics of the measured variables (Mean and Standard deviation)

N=20	Mean	Std. Dev.
Counter movement jump (cm)	47.8	4.9
15 sec hopping (average cm)	41.9	6.3
Hand tapping (N)	38.7	4.2
Cating (N)	33.9	3.6
Bench with 70% body weight (N repetit.)	12.6	5.0
Shoulder flexibility- pole turn (cm)	86.9	15.8
Aerobic capacity (ml/kg/min)	53.6	5.9
Max serve speed	188.9	9.1

The insight to the eventual relation of the measured abilities to an overall ranking was obtained by multiple regression analysis (Table 3). Neither the model nor any single variable proved to be significant in predicting the ranking of the subjects.

We also tried to determine the possible relation of standard functional and motor tests results to maximal serving velocity of the subjects. There were no variables that could predict with statistic significance the criterion variable e.g. maximal serving velocity.

Table 3. The results of multiple regression analysis: the significance of proposed model on rank of subjects

Regression Summary for Dependent Variable: RANK
R= .712 R_c= .507 Adjusted R_c= .113
F(8.10)=1.286 p<.3476 Std.Error of est.: 5.387

	BETA	St. Err. of BETA	B	St. Err. of B	t(10)	p-level
Intercpt			-7.05	33.04	-0.21	0.835
Counter movement jump	0.27	0.31	0.32	0.36	0.89	0.393
15 sec hopping	0.58	0.31	0.53	0.28	1.89	0.089
Hand tapping	0.02	0.31	0.02	0.42	0.06	0.956
Cating	-0.25	0.28	-0.40	0.44	-0.91	0.383
Bench with 70% body weight	-0.70	0.37	-0.79	0.422	-1.87	0.091
Shoulder flexibility- pole turn	-0.38	0.24	-0.14	0.09	-1.55	0.152
Aerobic capacity	0.48	0.29	0.46	0.27	1.60	0.120
Max serve speed	-0.08	0.27	-0.05	0.17	-0.31	0.764

Table 4. The results of multiple regression analysis: the significance of proposed model on maximal serves velocity

Regression Summary for Dependent Variable: SERVMAX
R= .579 R_c= .336 Adjusted R_c= .0039
F(6.12)=1.012 p< .461 Std.Error of estimate: 9.077

	BETA	St. Err. of BETA	B	St. Err. of B	t(12)	p-level
Intercpt			151.97	28.08	5.41	0.000
Counter movement jump	0.09	0.31	0.15	0.57	0.27	0.791
15 sec hopping	-0.35	0.31	-0.50	0.45	-1.12	0.284
Hand tapping	0.13	0.33	0.27	0.70	0.39	0.704
Cating	0.16	0.29	0.40	0.72	0.56	0.586
Bench with 70% body weight	0.61	0.29	1.11	0.53	2.10	0.058
Shoulder flexibility- pole turn	0.23	0.25	0.13	0.14	0.94	0.367

Discussion

None of the of the functional and motor abilities that are usually being tested in tennis players showed a significant relation to ranking. Possible explanation may lay in the fact that the sample comprised only top level athletes among whom the ranking might be influenced by slight differenced in tennis technique and some other factors (for example psychosocial factors). Mean values that were obtained in laboratory testing were very high with relatively small standard deviations in almost all measured parameters (Table 2). That reveals that all subjects were well prepared from physical fitness point of view. Very good results in aerobic capacity, strength and coordination test probably contributed to the lack of significance of the proposed model on ranking. Of course, we should not conclude that physical conditioning is not important for tennis performance but at the elite level, tennis players should previously developed a sound general physical fitness base (Chandler, 1995). It has been observed previously that in high level sports the “second best” athletes are sometimes even

better prepared than those who are better ranked. In our study no relation between player's serve velocity and ranking was determined. Cohen et al. (1994) related strength and flexibility to serve velocity, suggesting that it may be possible to increase a tennis player's serve velocity through specifically directed muscular strengthening or stretching regimens. However, they stated that prospective studies must be undertaken to demonstrate these possibilities. Also, according to Pugh et al (2003) strength is not the only factor involved in producing ball speed during the tennis serve.

Some authors claim that stretching prior to vigorous physical activity has been shown to decrease high-force muscular performance, but adding stretching to the traditional 5-minute warm-up in tennis does not affect serving performance (Knudson et al.,2004). That could explain the lack of influence of flexibility of shoulder on ranking of tennis players that was observed in our study.

There is evidence that using field-testing in addition to laboratory exercise testing contributes to better prediction of performance under sport-specific conditions because of differences observed in physiological adaptations and responses between laboratory and field testing (Smekal et al., 1995).

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PROGRESSION OF MORPHOLOGICAL, MOTOR AND FUNCTIONAL CHARACTERISTICS OF AN ELITE TENNIS PLAYER FROM AGE 13 TO 16

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Abstract

Diagnostic procedures in sports enable the insight into the condition of morphological characteristics, as well as in motor and functional components of the level of training of athletes. Morphological characteristics, motor and functional abilities, as well as sports results of an elite young tennis-player have been surveyed longitudinally from the age of 12.9 to 16.1 years. The results of the tested subject indicate the dynamics of the development and the significance of particular general and specific fitness components in junior tennis.

Key words: *tennis, growth and development, sports diagnostics*

Introduction

Tennis is a polystructural sports activity with acyclic type of motions. A large number of motion structures and situations in the tennis play (technical and tactical variants) indicate that the success of a tennis-player is determined by the level and the structure of a large number of abilities and characteristics, some of which can be measured and analysed. Measuring of these abilities and characteristics enables higher quality of planning, programming and control of the training process, as well as the improvement of sports fitness. The anthropological status consists of morphological (anthropometric) characteristics, motor abilities, functional abilities, cognitive abilities, conative dimensions, as well as health and social status. All the above mentioned dimensions are highly mutually connected, however, this survey puts emphasis to morphological characteristics, and motor and functional abilities. Motor abilities have been stated as the most significant factor for achieving success in tennis (Milanović, 1997). The question is, what are the most significant variables which determine the success in tennis. Investigations in the area of tennis are very rare, and there are no available data about the functional and the motor abilities of elite junior and senior tennis players.

The primary aim of this research is to present the anthropological status and competitive results one of the world's best juniors in tennis during the period of three years.

The anthropological status of one of the world's best juniors in tennis cannot serve for modal values. Although, the presentation of his anthropometrical characteristics, functional and motor abilities and competitive results, being continually surveyed through the period of three years, may give some useful information and the basis for future investigations.

Methods

The subject was measured four times during the period of three years, from the age of 12.9 until the age of 16.1 years. The measurements took place at the Sport-diagnostic centre of the Faculty of Kinesiology, University of Zagreb. Table 1.shows the position of the subject on the European junior tennis rank list at the end of calendar year for his age. It should be noted that the lower placement in the last year was due to the small number of played tournaments, because the subject started to participate in the older age category (under 18 years).

The following anthropometric variables were measured: body height (stature-STAT), body weight (WGH), arm span (AS), upper arm skinfold (triceps brachii, SK. T), scapular skinfold (SK.S), pectoral skinfold (SK.P), abdomen skinfold (SK.A), upper arm skinfold (biceps brachii, SK.B), thigh skinfold (SK.T), lower leg skinfold (SK.L), and the percentage of body fat (% FAT), which was calculated from skinfold values. Body composition of the tennis player was assesed by the skinfold method (Jackson et al, 1985), and the equation for the assessment of body density (BD). The value of body density was inserted into the equation for the estimation of body fat (% of the body fat = (495/BD - 450; Siri, 1956). New methods for assessment of body composition are developed, but it appears that the skinfold method is still the standard, when it comes to practical field and/or even laboratory testing.

Table 1. The position of the subject on the European ranking list (for players born in 1988) during the testting period

	2001	2002	2003	2004
ETA U - 16	1	6	1	10

For the evaluation of functional characteristics, a progressive treadmill test to volitional exhaustion was performed in order to determine the following variables: maximal oxygen uptake (VO_2max), relative maximal oxygen uptake (RVO_2max), maximum running speed ($SPEED_{max}$), maximal heart rate (HR_{max}) and the running speed at the anaerobic threshold ($Speed_{VT}$). A standard battery of seven tests was applied for the evaluation of motor abilities. Agility was measured by three tests, very similar to specific movements in tennis (*Schonborn*, 2001.): side step agility (MAGKUS), frontal agility (MAG9NN), frontal agility with turns (MAG9OK). For the evaluation of explosive strenght (speed) the 20-m run test (ME20M) was used. The explosive strength - jumping type - was measured by three tests: squat jump (MESJ), countermovement jump (MECM), and jump with arm-swinging (MEMAX). The explosive strength - throwing type - was measured by two tests, medicine ball throwing from lying position (MEMBLI), and forehand medicine ball throwing (MEBMFOR). Hand tapping (MFRTAR) and *cating* (MFRCAT) were used for measurement of the speed of repetitive movements. For the measurement of relative repetitive strength we used sit-ups in 60 seconds (MRSSPOT), squatting in 60 seconds (MRCUC) and four tests for measurement of flexibility: *sit and reach* (MFLSAR), bending forward with legs extension (MFLPRR), legs extension in lying position (MFLZLP) and rotation with pole (MFLIP). Tests for evaluation of explosive strength of the jumping type were not performed in the first measurement, due to technical reasons.

Results and discussion

Table 2. shows the results of the measurements of anthropometric and morphological characteristics. Body height is above-average and corresponds to the 100. percentile for age in all four measurements. The increase between measurements follows is expected according to his chronological age and the stage of growth and development. Body height is an advantage in most motor skills, including tennis, and it is one of the most important morphological characteristics (Filipčič, Filipčič, Leskošek, 2004.), especially for faster surfaces. The world rankings show that leading tennis-players are on average significantly higher than the normal population. Besides body height, a large arm span is also advantageus, as it is observed in our subject. (85 percentiles), The body weight of our subject, although above average for the age, is average in relation to his body height during the whole testing period. The values of the skinfolds, and the extrapolated body fat percentage are below average, and did not change significantly during the three-year period.

The aerobic capacity (VO_2max) is 25-30% above-average and was expectedly increasing from the first test at age 12.9, until the age of 16 following the body mass increase, while the relative VO_2max did not change much, except for the last measurement in which it reached the highest value (Table 3). The achievement in the progressive treadmill test (maximal running speed, $SPEED_{max}$) and the running speed at the anaerobic treshold ($Speed_{VT}$) in the last measurement, indicate an excellent aerobic capacity, being already in the category of elite senior tennis-players.

In the domain of motor abilities, he achieved the best results in *agility tests,*in the *speed test* and in tests of *explosive power of throwing type* in the third testing, even better than in the last testing session. In the period just about the third test the examinee also achieved excellent results in competition, winning several important junior tournaments, as the under-16 Europian Championships. After that the results were not so good, and it was also accompanied by deterioration of results in those three tests. This highlights the importance of high level of preparation of those, according to Jonat and Krempel (1987), dominant motor abilities, for high achievements in tennis. In tennis terms, agility stands for "footing" (footwork) which is in positive correlation with the space orientation, leg coordination, and the speed of performing complex motor tasks. Also, it has a high correlation with the reorganisation of stereotypic movements, and tennis technique.

Table 2. The anthropometric and morphological characteristics at specific age

AGE	12.9 years	14.6 years	15.6 years	16.1 years
STAT (cm)	175.8	190.1	193.1	195.1
WGH (kg)	55.0	69.0	75.5	76.5
AS (cm)	178.0	190.0	193.9	194.1
SK. T (mm)	6.7	7.5	9.1	8.2
SK. S (mm)	5.0	5.8	5.8	6.5
SK. P (mm)	5.5	5.4	5.8	5.3
SK. A (mm)	7.9	8.5	7.6	10.5
SK. B (mm)	3.6	3.7	4.1	3.7
SK. T (mm)	11.1	10.0	15.5	10.9
SK. L (mm)	9.2	8.3	8.0	6.5
% FAT	4.8	5.5	6.6	6.3

Abbreviations: see page 2

Table 3. The results of the aerobic capacity treadmill tests of the subject at specific age

AGE	12.9 years	14.6 years	15.6 years	16.1 years
VO_2max *(l O_2/min)*	3.09	3.95	4.12	4.73
RVO_2max *(mlO_2/kg/min)*	56.2	57.2	54.6	61.8
$SPEED_{MAX}$ *(km/h)*	15	17	17	18
HR_{MAX} *(bpm)*	204	202	198	196
Speed VT *(km/h)*	10.5	12.5	12.5	13.5

Abbreviations: see page 2

Table 4. The results of motor ability tests of the subject at specific age

AGE	12.9 years	14.6 years	15.6 years	16.1 years
MAGKUS (sec)	9.5	8.5	7.6	8.2
MAG9OK (sec)	8.1	7.9	7.2	8.0
MAG9NN sec)	8.1	8.0	7.5	7.9
ME20M (sec)	3.6	3.9	3.4	3.4
MESJ (cm)	-	43.3	46.5	47.3
MECM (cm)	-	44.8	46.0	48.3
MEMAX (cm)	-	54.1	53.9	54.7
MEBML (dm)	93	118.3	135.5	124.8
MEBMFOR (dm)	143.5	173.5	196.8	194.8
MFRTAR (freq)	27	34	35	37
MFRCAT (freq)	28	29	29	31
MRSSPOT (no.rep.)	44	55	55	59
MRCUC (no.rep.)	56	63	59	63
MFLSAR (cm)	3.3	13.3	14.2	15.4
MFLPRR (cm)	60.3	82.7	89.3	81.7
MFLZLIP (cm)	130	125	130	135
MFLIP (cm)	67.3	66.3	64.3	66.5

Abbreviations: see page 2 and 3

There are lot of game situations in tennis when the speed is exceptionally important, especially when running at short balls, and also side balls. The explosive strength has great importance, for creating maximum force in the kinetic chain of basic tennis strokes, especially for the serve.

All other motor abilities are developed above-average when compared to the selected sample of elite junior tennis-players, except for the speed of repetitive movements of upper and lower limbs which are not at the satisfactory level. Referring to flexibility, the need for systematic work on the flexibility of all topological regions was observed.

Conclusion

The testing of an elite junior tennis player from age 13 to 16 showed heterogeneous results of his general and specific sports fitness. Some abilities were at an exceptionally high level during the period in which the measurements were performed (agility, explosive strength of the speed, jump and throwing type, repetitive relative strength and aerobic capacity). Inspite of average results in some tests (speed of repetitive movements and flexibility), the subject was able to achieve top results in junior tennis. The results indicate the dynamics of the development and the significance of particular general and specific fitness components in junior tennis, at age 12 to 16. The presented results are a contribution to the development and standardization of diagnostic procedures in tennis; there is a need for creation of a data base for the purpose of better selection, planning and control of the training process of young tennis players.

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RELATIONSHIP BETWEEN FATTY TISSUE AND STRENGTH ABILITIES IN RURAL BOYS FROM EASTERN POLAND

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Abstract

The objective of the research was to define relationships between the volume of body fat and strength abilities in rural boys. The boys were classified into categories of low- medium- and high- level of a fatty tissue on the grounds of centile values of fatty tissue expressed in percents. Strength abilities were assessed by tests being a part of the European Test of Physical Fitness. The relationships between the level of fatty tissue and the results obtained in strength tests were analyzed by ANOVA variation analysis, and the differences between the groups by the NIR test (the test suggested by Scheffe - the lowest statistically significant differences test – NIR in Polish). The findings indicate the occurrence of negative correlations between the percentage content of fatty tissue and the results obtained in sit-ups and standing broad jump. In case of static strength, no explicit relationships between the results and the level of fatty tissue were observed.

Key words: *body fat, strength abilities, children*

Introduction

Strength gives grounds for all physical efforts; it is an important factor of a healthy life style and of the development of motor abilities. It enables an individual to undertake everyday activities without the feeling of fatigue. Strength abilities define one's capacity to overcome the resistance of one's body in situations of either static conditions or slow but intense movements. Contemporary anthropometric studies apply many tests to assess strength. They are divided into those which require the use of special apparatus e.g. a hand dynamometer, and those which instead rely on various motor tests.

Muscle strength largely depends upon the muscle cross-section. Also it is influenced by the degree of fatigue, biochemical condition of muscles and emotional state. From practical point of view, development of muscle strength mainly depends on the body mass and the degree of the organism readiness to take an effort.

The aim of this research was to define relationships between the level of a fatty tissue and strength, measured according to the criteria of Eurofit Test (1988) in rural boys aged 10-19.

Methods

The research was conducted in the years 1998-2000 and included 963 boys aged 10-19. School youths were randomly selected from primary and secondary schools from the eastern regions of Poland. The following measurements were taken, among others: body mass and height, skinfold thickness of biceps, triceps, sub-scapula area, abdomen and the calf. Compiled data enabled us calculate percentage values of fatty tissue on the grounds of Slaughter's et. al. method (1988). International Biological Programme was used to calculate each participant's calendar age on the grounds of his birth date (Drozdowski 1998). In this way the boys were classified to appropriate age categories (tab. 1). In each age group centile values of fatty tissue in percents were obtained. Next, on the grounds of the centile values for different age categories, the boys were subdivided by centiles of body fat as follows into groups of low- medium- and high- level of a fatty tissue. The group comprising the boys of low level of fatty tissue presented the value of 15 centile and less. The range between 25-75 centile concerned the average values. The boys whose centile values crossed the level of 85 centile constitute the group of the high level of fatty tissue.

European Test of Physical Fitness (1988) was applied to assess strength. For our analysis the following tests were applied: trunk strength (sit-ups), explosive power (standing broad jump), static strength (hand grip). In the selected groups arithmetic means and standard deviations were calculated, separately for each age category. The relationships between the level of fatty tissue and the results of the tests were assessed by one-way ANOVA variation analysis.

Table 1. Number of surveyed boys in particular age categories

Age in years	10	11	12	13	14	15	16	17	18	19
Number	82	104	115	126	105	60	93	101	94	83

The test suggested by Scheffe (the lowest statistically significant differences test – NIR in Polish) was used to define relationships that were statistically significant between the groups of surveyed boys.

Results

Firstly, the relationships between the trunk strength of boys and the level of a fatty tissue in the total body mass in percentage values were analyzed. It was stated that a high level of fatty tissue had negative effect upon the results acquired in the test referred to. The boys' characteristic of a substantial content of fatty tissue obtained the lowest results. The differentiation of results between the two other groups was minimal. But in the older age categories, better results were acquired by the boys with medium level of fatty tissue. The biggest differences among the groups were observed at the age of 15. The difference between the high and medium level of fatty tissue amounted to 5.09 of the repetition, and between high and low level of fatty tissue it was 3,80. Statistically significant differences were observed in the following age categories: 11, 15 ,17. The NIR test revealed the significance of differences between the groups of high and low level of fatty tissue (figure 1, table 2).

Table 2. Relationship of fatty tissue in percentage and trunk strength of the examined boys.

Age in years	High adiposity (above 85 C)		Average adiposity (25-75 C)		Low adiposity (below 15 C)		Analysis of variance (one-way ANOVA)		Test NIR		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	F	p	H-A	A-L	H-L
10	21,50	3,06	21,60	4,21	22,58	4,98	0,285	0,753	-	-	-
11	19,94	4,96	23,88	5,13	23,00	4,95	3,694	0,029 *	**	-	-
12	23,31	4,32	22,90	3,53	24,41	4,32	1,034	0,360	-	-	-
13	21,84	4,57	24,26	3,85	23,45	3,63	2,746	0,069	*	-	-
14	24,12	4,41	24,73	4,69	26,18	4,63	0,908	0,407	-	-	-
15	20,60	3,89	25,69	5,35	24,40	4,53	3,945	0,026 *	**	-	-
16	23,77	4,25	27,68	5,30	26,86	5,82	2,804	0,068	*	-	-
17	23,86	2,93	26,91	3,27	25,50	3,78	4,789	0,011 *	**	-	-
18	27,00	2,65	28,39	3,67	27,67	3,20	0,931	0,399	-	-	-
19	27,14	2,91	27,30	3,85	28,11	3,74	0,457	0,635	-	-	-

High values of fatty tissue in the total body mass had negative effect upon explosive power. Persons characteristic of high level of the analyzed tissue reached the lowest values at standing broad jump. On the contrary, while comparing the results of the slim and average level of fatty tissue persons their results were approximate. The statistic significance of differences was present in majority of categories, excluding the ages of 13, 15, 16, 18. The NIR test results show that the differences among the groups were statistically significant mainly between the obese boys and two other groups (figure 2, table 3).

As far as the static strength is concerned, slight differences in results obtained by boys with various adiposity levels were noticed. Only at the age of 10, 11 and 12 the best results were obtained by the boys of the highest values of a fatty tissue. However, the differences between this group and two other groups were slight and not statistically important. Moreover, in the oldest age categories (18-19 years of age) the highest results in static strength (hand grip) were obtained by boys of average adiposity level. Statistically significant differences were denoted only in 19 year olds(figure 3, table 4).

Table 3. Relationship of fatty tissue in percentage and explosive strength of the examined boys.

Age in years	High adiposity (above 85 C)		Average adiposity (25-75 C)		Low adiposity (below 15 C)		Analysis of variance (one-way ANOVA)		Test NIR		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	F	P	H-A	A-L	H-L
10	123,33	23,46	142,08	16,51	138,25	25,77	4,124	0,021 *	**	-	-
11	130,13	23,56	152,35	21,11	152,88	20,09	7,080	0,001 **	**	-	**
12	155,63	27,46	165,00	23,35	183,71	20,27	6,330	0,003 **	-	**	**
13	165,47	17,10	174,02	20,50	175,45	17,40	1,672	0,193	-	-	-
14	167,94	24,03	184,85	22,97	186,94	25,18	3,617	0,031 *	*	-	*
15	205,90	25,68	196,07	24,57	198,00	13,78	0,676	0,514	-	-	-
16	207,08	16,94	204,32	24,86	209,71	20,20	0,319	0,728	-	-	-
17	191,29	33,99	218,04	24,03	214,93	19,87	5,964	0,004 **	**	-	*
18	213,62	16,39	226,06	20,27	220,87	15,51	2,351	0,102	*	-	-
19	212,14	19,28	228,28	17,45	232,88	25,16	4,857	0,010 **	**	-	**

Table 4. Relationship of fatty tissue in percentage and static strength of the examined boys.

Age in years	High adiposity (above 85 C)		Average adiposity (25-75 C)		Low adiposity (below 15 C)		Analysis of variance (one-way ANOVA)		Test NIR		
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	F	p	H-A	A-L	H-L
10	21,72	3,59	21,33	1,49	18,28	4,45	2,606	0,820	-	*	-
11	25,42	5,31	22,71	3,59	23,25	2,94	3,000	0,055	*	-	-
12	27,86	5,00	25,95	5,74	25,63	4,83	0,894	0,413	-	-	-
13	31,22	8,88	31,16	6,81	31,15	4,96	0,001	0,994	-	-	-
14	31,91	8,57	36,95	9,06	35,01	9,88	1,937	0,150	*	-	*
15	48,96	7,45	41,97	9,98	45,63	12,71	1,876	0,165	-	-	-
16	46,54	9,84	45,52	12,79	48,04	8,71	0,257	0,774	-	-	-
17	46,14	15,91	50,22	11,24	55,36	11,24	1,999	0,143	-	-	-
18	49,85	10,54	51,18	9,53	45,33	12,51	1,861	0,163	-	-	-
19	46,33	11,20	52,65	9,89	46,82	11,63	3,815	0,026 *	*	-	**

- a lack of statistically significant differences
* a statistically significant difference at $p \leq 0,05$
** a statistically significant difference at $p \leq 0,01$

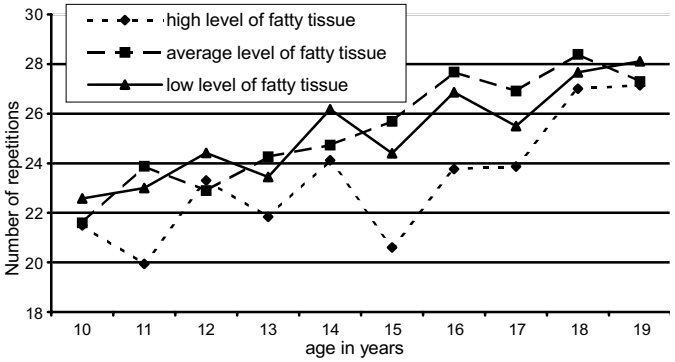

Figure 1. Relationship of fatty tissue in percentage and trunk strength of the examined boys.

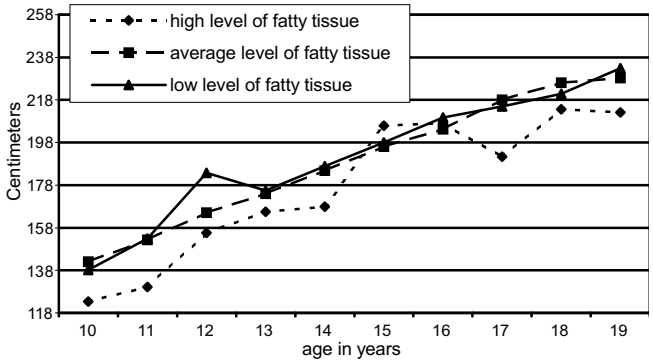

Figure 2. Relationship of fatty tissue in percentage and explosive strength of the examined boys.

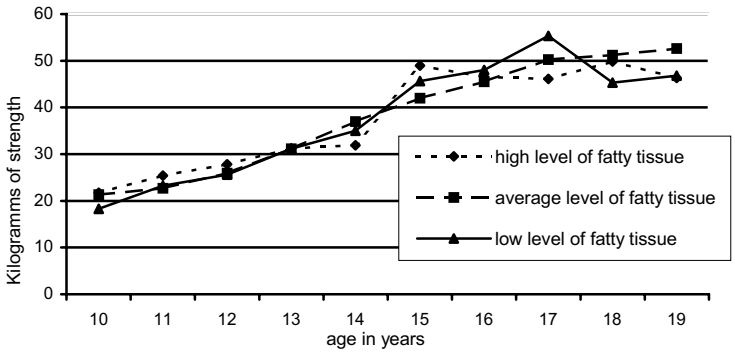

Figure 3. Relationship of fatty tissue in percentage and static strength of the examined boys.

Discussion

Relationships between physical agility and adiposity level in humans are a point of great scientific interest nowadays because adiposity consequently causes low agility level what tends to be more frequent in the present.

The findings presented in this work indicate the occurrence of negative dependences between the percentage content of a fatty tissue in the total body mass and the results obtained at tests such as sit-up, and standing broad jump. In case of the static strength, no explicit dependences between the level of a fatty tissue and results obtained in the hand grip test were observed.

The findings of our research confirm those of other authors. The negative relationships between the trunk strength and the level of a fatty tissue were observed by Maciaszek and Osiński (2001). In turn, a negative impact of too intense body fat upon the results in a standing broad jump was indicated by Osiński (1996).

Beuen at al (1983) reported negative relationship between high endomorphs assessed on the basis of skin folds thickness and trunk strength, running speed agility, high jump and bent arm hang. Boys of high endomorphs obtained low results in all the tests except in bent arm hang test. Slim people, with low adiposity level, were characterized by high physical agility.

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DIETARY HABITS AND NUTRITIVE STATUS IN STUDENTS OF FACULTY OF KINESIOLOGY ACCORDING TO GENDER

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Abstract

The purpose of this study was to assess the quality of nutrition and health related dietary habits of highly physically active student population. Two hundred and forty four (148 male and 76 female) second year students of the Faculty of Kinesiology (mean age 21 [1.35] years) were enrolled in the study. The survey was carried out in a form of specially designed self-administered questionnaire. The data show that according to BMI none of the students is obese but 15.2 % of them are overweight. However 37 % of them wanted to lose weight, more women than men ($p>0,01$). Both male and female students take too much sodium, while only male have high cholesterol intake. On the other hand the intake of fiber is below DRIs for both sexes. Male students lack water, while female lack potassium and iron. Smoking prevalence among the students is 25 %. There are more smokers among women than among men, 34 % and 20 %, respectively ($p<0,05$).

Key words: *dietary intake, nutrition, students, smoking*

Introduction

Nutrition in Croatia is characterised, among other things, by high intake of fat, cholesterol and sodium. While high fat and cholesterol intake is considered to be a risk factor for obesity, high sodium intake increases the risk for hypertension. Those two together with cigarette smoking lead to the deadliest diseases of today: myocardial infarction and stroke. We decided to investigate nutrient intakes and smoking habits in the student population. This is the part of population in which the prevalence of obesity and smoking rises every year. It is at this time when people leave their homes and start to take care of their diet by themselves. It is also a time when a lot of smokers commence with the unhealthy habit. That is why it is crucial to educate students in an effort to change their unhealthy dietary habits and health beliefs.

Methods and subjects

During the academic year 2003/2004 a total of 224 (148 male and 76 female) subjects was investigated for the purpose of this study. Subjects were second year kinesiology students, mean age 21 (1.35) years. Students at the faculty of Kinesiology exercise from 7 to 10.5 hours a week as a part of practical teaching. Most of the subjects (71%) were also engaged in additional sport or recreational activities. This leads us to the average physical activity of 5.5 (4.15) hours a week and 4.7 (5.8) h for male and female subjects, respectively. If we add the activity at the Faculty, we will find our subjects to be high above the average for student population in Croatia which is 4.4 h for male and 1.6 h for female students (Satalic, 2004.). Only 2 % of the subjects were vegetarians, and the percentage of the subjects who were dieting at the time was the same. The survey was carried out in the form of self-administered questionnaire. The UZPPN1 questionnaire vas developed and validated for the purpose of the study (Pedisic,2004). It consists of two parts. In the first part which contains 30 questions, a subject is asked about general information, physical activity and dietary habits. From height and weight obtained by this part of the questionnaire we calculated a body mass index (BMI) for each subject. The second part is a food frequency questionnaire containing 74 questions about dietary intakes. The data were processed with ViP 104 software and statistical analysis was carried out using Statistica 5.0. As most of the variables were not distributed normally, statistical analysis included only basic description and chi-square test.

Results

Results show that the mean values for BMI were 23.7 (1.7) and 21.9 (1.8) for men and women, respectively. As expected, because of their high physical activity only 21 % of male and 4 % of female students were overweight according to BMI. None of the students was categorised as obese. Nevertheless, only 61% of the students were satisfied with their weight, more men than women ($p<0,001$) (figure 1.). Among those who would like to lose weight there are more women ($p<0,001$), and among those who would like to gain weight men ($p<0,001$).

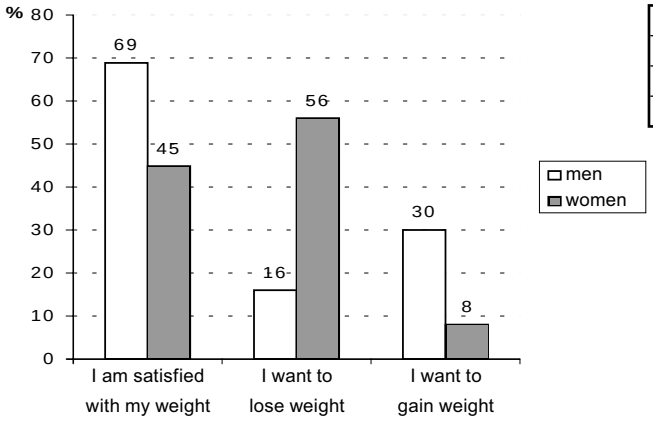

Figure 1. Weight concerns according to gender

	men	women	chi-square	p
satisfied	69	45	12,108	0,0005
lose	16	56	38,319	0
gain	30	8	13,337	0,0003

The data show that 46 % of the students eat in student restaurants, while 16 % cook by themselves. Male students eat more meals a day ($p<0,01$) than women. Most students eat 3 or 4 meals a day. Only one student eats once a day, and 3 of them reported as many as 6 meals a day (figure 2.).

Consummation of breakfast is also higher in men. Results show that 35 % of them eat breakfast every day compared to 24 % of women. On the other hand even 21 % of female students never eat breakfast compared to only 7 % of men (figure 3.).

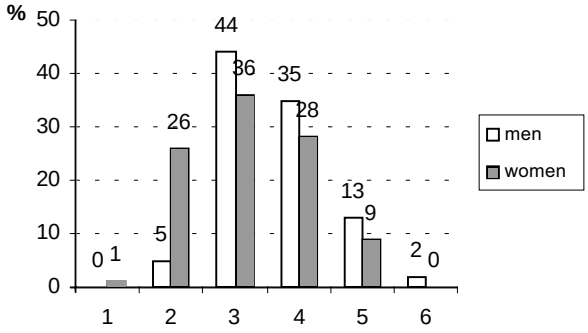

Figure 2. Number of meals a day

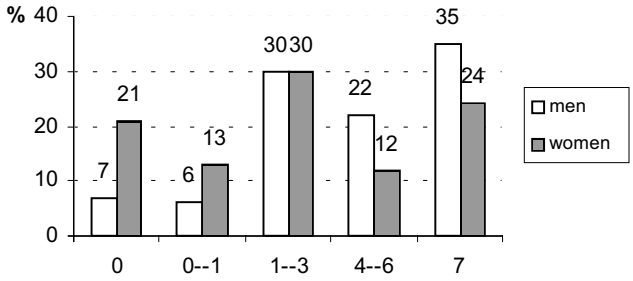

Figure 3. Number of breakfasts per week

The prevalence of smoking among students is 25 %. There are more smokers among women than among men, 34 and 20%, respectively ($p<0,05$). However, men and women do not differ in the intensity of smoking. Small number of students smokes more than one package of cigarettes a day (figure 4.). The percentage of students who drink alcohol is higher. Although 84 % of the students drink, only a few drinks more than one drink a day (6.25 %). Among men there are more drinkers than among women, 86,5 and 79 %, respectively ($p<0,001$). Men also drink more intensely than women (figure 5.).

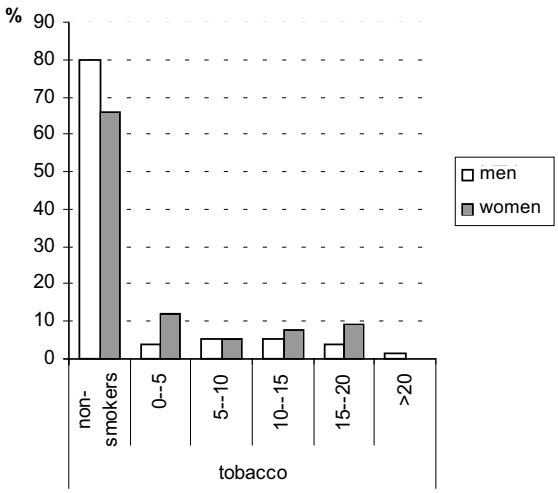

Figure 4. Consumption of tobacco

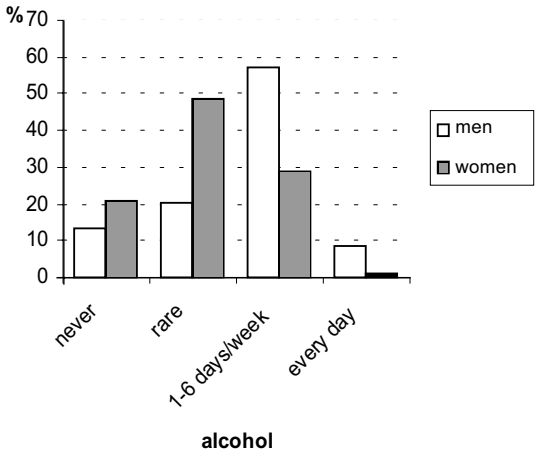

Figure 5. Consumption of alcohol

Regarding health concerns, 82 % of female students bares in mind the nutritional value of food when they choose a meal compared to only 64 % of male students (p=0,01). Students do not differ regarding concern about fluid intake during exercise (45 % of them take care), adding salt or oil, butter and other fats to their food, 57 and 44 %, respectively. Every fourth student takes vitamin and mineral supplements, 24.3 and 26.3 % men and women, respectively. From the second part of the questionnaire (table 1.) we can see that the intake of all nutrients is higher in male than in female students. That is not surprising considering that men are significantly heavier in comparison with women. Mean intakes of most nutrients are higher than Dietary Reference Intakes (DRIs). However, male students do not get enough water (Adequate intake-AI =3.7 L) and fiber (AI=38g), while they exceed the upper levels (UL) for cholesterol and sodium (UL=2.3g). Female students do not take enough fiber (AI=25g), potassium (Recommended Dietary Allowance-RDA =4.7g) and iron (RDA=18g), but their intake of sodium is too high.

Discussion

The primary aim of this study was to show the nutritive status of highly physically active student population. BMI in young people can predict obesity in adulthood. Because of that and high prevalence of obesity in Croatia it is important to educate young people about the risks of obesity. While 79.2 % men and 49.9 % women in our country exceed BMI value of 25 (Turek et al.., 2001.), the upper level of BMI for normal weight, in our study only 21% of male and 4 % of female students exceed that level. However, because BMI does not show the composition of the body and considering the level of subjects' activity, it is highly probable that most of the students with BMI>25 have a lot of lean mass and low % of body fat, as it was shown in the earlier studies (Misigoj-Durakovic and Gosnik-Oreb, 1995.). Therefore they should not be considered overweight. Concerning the distribution of BMI our students do not differ from their colleges in Slovakia (Baska et al., 2000). However, only 8 % of European students have BMI over 25 (Bellisle et al., 1995.). The mean value of students BMI is also higher compared to the one of European students (23.7 vs. 22 for men and 21.9 vs. 20.5 for women). This could be because of high activity levels of our students and consequently a higher amount of lean body mass. Although BMI values of our subjects are not high, a lot of them want to lose weight. It is especially marked among females, where 56 % of them want to lose weight even though only 7 % have BMI values above normal. In European student population 44 % of women expressed the desire to lose weight (Bellisle et al., 1995.). Range of the energy intake from macronutrients can be described as satisfying - 50 % from carbohydrates, 35% from fat and 15 % from protein. Although this is consistent with acceptable macronutrient distribution ranges, energy intake from fat is at the upper level. If we add it to a quite high cholesterol intake we come to a high risk for cardiovascular diseases. Although too high, the intake of cholesterol is markedly lower compared to the average student population in Croatia, 375 and 460 mg, respectively (Turek et al.., 2001.).

Table 1. Descriptive statistic concerning average daily intake of food, water, energy, macronutrients, vitamins and minerals.

	Men (n = 148)		Women (n = 76)	
	Mean	St.Dev.	Mean	St.Dev.
Total food intake (g)	4192,8	1400,4	3548,1	1337,3
Water (g)	3529,4	1190,3	3083,0	1221,3
Energy (kcal)	3084,3	1335,4	2042,7	877,4
Proteins (g)	113,4	52,2	74,9	34,5
Fat (g)	118,2	61,4	77,0	47,1
Cholesterol (mg)	438,8	291,1	251,1	151,8
Carbohydrates (g)	381,2	163,3	260,9	103,1
Fiber (g)	27,9	14,5	23,4	9,7
Ethanol (g)	11,0	15,0	4,8	12,4
Sodium (mg)	4708,0	1967,1	3493,6	1406,0
Potassium (mg)	5200,8	2213,7	4141,8	1820,6
Calcium (mg)	1601,6	784,5	1215,3	616,1
Magnesium (mg)	529,4	233,7	428,2	216,5
Phosphorus (mg)	2094,5	942,6	1457,5	658,6
Iron (mg)	23,3	20,2	17,6	10,6
Zink (mg)	19,3	11,1	15,2	11,1
Copper (mg)	2,9	1,5	2,4	1,3
Vitamin A (µg)	989,4	501,7	789,2	389,3
Thiamin (mg)	2,5	1,8	2,1	1,9
Riboflavin (mg)	3,4	2,4	2,8	2,3
Niacin (mg)	27,4	17,4	20,9	17,4
Vitamin B6 (mg)	6,9	3,5	6,4	3,3
Vitamin C (mg)	283,8	205,7	261,3	187,8

Intake of fat and cholesterol is dropping, but it is still insufficient. On the other hand, intake of fiber should increase to match DRIs, especially in male students. High intake of vitamins and minerals is due to high energy intake and the usage of supplements. A number of students use vitamin and mineral supplements, 24.3 and 26.3 % for male and female students, respectively. This is much less than the data of average Croatian students, 71.6 % of whom use those kinds of supplements (Satalic, 2004.). Data from Portugal, however, show that only 20% of male and 14 % of female students use vitamin supplements (Marques-Vidal, 2004.). The only mineral for which DRIs are not met is iron, but only in female students because of the considerably higher RDA for women. Their intake of iron is, however, a bit higher than in the average female student population in our country, 17.6 and 16.1 mg, respectively (Satalic, 2004.). The same problem has been spotted in Spanish female students (Soriano et al., 2000). Low iron intake combined with lose during exercise could pose a risk for iron deficiency and even anaemia. Regarding water intake, the fact that male students do not match AI is worrying because of their high activity and importance of taking fluids during exercise.

Female students' water intake is slightly higher than AI for women. The question of its sufficiency regarding high physical activity remains pending. Knowing the prevalence of hypertension in Croatia is high (27.7 %) (Turek et al.., 2001.) , the intake of sodium becomes very important. Our students exceed ULs for sodium by almost 100 %. Though a lot it is still lower than in average Croatian students, 4.3 and 5.8%, in women and men, respectively (Satalic, 2004.). However, we must emphasize their activity level once again. ULs do not apply to highly active people because of the excessive loss of sodium by sweat. The fact that 57 % of students salt food additionally at the table is, however, still perturbing. Because of its close connection to sodium excretion by kidneys, adequate potassium intake lowers the risk for hypertension. While male students ingest enough potassium, female students do not meet the RDA.

The second part of the study aimed to investigate dietary habits of highly physically active student population. Most of the students consume 3 or 4 meals a day. Those numbers suit the recommendations of at least 3 meals a day. Men eat more meals than women what corresponds to the data for students in Croatia (Satalic, 2004.). Even 55 % of male students eat breakfast at least four times a week. Less female students eat breakfast that often, only 36 %. This fact is in contradiction with the data for both croatian[10] and students from other European countries[9] where women eat breakfast more often than men. Even 21% of our female students and only 7 % of men skip breakfast. The prevalence of smoking in Croatia is 34.1% for men and 26.6 % for women (Turek et al.., 2001.). The difference used to be higher but because the number of smokers rapidly increases in females it is slowly disappearing. Consistent with this are also our data which show much higher percentage of female smokers in comparison with men, 34% and 20 %, respectively. Gender difference is marked in the average student population in Croatia, also. Data show that 33.1 % of Croatian female and 22 % of male students smoke (Satalic, 2004.). It is quite the opposite in Greece (Mammas et al., 2003.) where prevalence among students is similar, only the difference according to gender is opposite. In Slovakia male students also smoke more than female, but prevalence is lower, 19.6 % and 12.3 %, respectively (Baska et al., 2000). Closely linked with tobacco is the consumption of alcohol. Even 86.5 % of male and 79 % of female students drink alcohol, but only 8.8 % of men and 1.3 % of women drink more than one alcoholic drink a day. This data are similar to the ones in the average student population, where 88.9% of men and 84.8 % of women drink (Satalic, 2004.). This percentages are, however, higher than the ones in Greece, where 77 % of male and 58 % of female students drink alcohol (Mammas et al., 2003.).

In conclusion we can emphasize that although nutrition of this, highly physically active part of the student population, is somewhat healthier than the nutrition of an average student, number of things have to be improved. The intake of fat and cholesterol should be lower. Men should take more water, while women should increase their iron intake. Still, the biggest concern remains the high prevalence of smoking, especially in female students.

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CORRELATION BETWEEN RESULTS FROM 600 METERS RUN AND CONCONI TEST AND THE HEART RATE FREQUENCY OF TEENAGERS

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Abstract

The main aim of the research was to assess the endurance of the students of GLŠ. We have also been trying to estimate the correlation between the results of the 600 m run test and the Conconi's test regarding the average heart rate during running and the lowest heart rate measured three minutes after running. The sample included 82 males and 73 females from GLŠ high school and the testing was carried out in September 2004. All cooperating students were highly motivated. That explains average maximum heart rates which were all above 190 heart beats per minute. The highest correlations were identified between average heart rate during the test and the lowest heart rate measured 3 minutes after the test in both tests. The correlation coefficient was above .90 at Conconi's test and above .80 at 600 m running.

Key words: *students, heart beat, endurance, running,*

Introduction

Endurance is the motor skill that characterises the human ability of prolonged stable physical activity. Keeping the level of endurance high is especially important as we are getting older. It is also important because it stabilizes the level of physiological processes and is used as the main criteria in assessing acceptable medical condition (Karpljuk D., 1994; Berčič H., Tušak M., Karpljuk D., 1999).

Apart of endurance, running is an efficient tool for achieving steadiness, perseverance and will. At the same time running can help us to increase our mental and physical abilities and improve our self-confidence and self-perception.

The endurance of our students was assessed with the 600 m run test and with the Conconi test. It would be possible to assess it also with Other running tests such as 2400m run (Emberšič, Vincek, Voler, 1999). The most common test of endurance in high schools is the 600 m run which is measured annually as one of the test of the sports educational chart. The analysed data of the sports educational chart revealed (Strel J., 2003) that in the last decade the endurance in youth in stable or shows some moderate changing trends.

The data shows (Strel J., 2003) that the level of endurance of students from 15 to 19 years between 1990 and 2000 decreased for about 5 %. The decrease is more visible in male than in female population. If we take into consideration that contemporary life stile lacks activities that improve our endurance, the result of the analysis is expected. Some reasons may be hidden in the fact that popular sport activities do not develop endurance on the same scale as they do strength, speed, coordination, and other motor skills.

From the data it is possible to see that the results of males are improving while on the other hand the results or the females are decreasing. Both groups are about 15 years old. The reasons are probably hidden in the difference in their biological development. Other possible reason can lay in their relationship towards sports, and especially towards sports that require endurance. There is also a possibility that the results of female population were poorer because they were tested only in running, which is not necessarily activity they prefer. More and more people prefer others activities such as swimming or bicycling and that is why their muscle connections are not as adapted to running as to other sports. This, in other words means, that the choice of the inappropriate test batteries can result in inaccurate data because the motivational factors can negatively influence the results of endurance tests. In that case the results show poor level of endurance while some other test, adjusted to the tested students, could show a very different picture.

Aim

- assess the general endurance of male and female students and find the differences between them in 600 m run and Conconi's test
- estimate correlation between the results of the 600 m run test regarding the average heart rate during running and the lowest heart rate measured three minutes after running.
- estimate correlation between the Conconi's test regarding the average heart rate during running and the lowest heart ate measured three minutes after running

Subjects and methods

The sample included 82 male and 73 female students (in the frame of the project with the title "The analyse of evolutionary trends of motor and physical characteristics and connections between both with bio-psiho-social spread of Slovenian children and youth between 6th and 19th year in the period 1970-1983-1993/94 and 2003/04). They all ran the 600 m run and the Conconi test that was carried out on the 20 m track. The students followed the beeps, recorded on the tape and had to reach one or the other line that marked the 20 m track at the beep. The test was progressive which means that the tempo was constantly increasing. The maximal duration of the Conconi test was 15 min. All students were using the POLAR heart rate monitors that measured the average heart in 5 second intervals. After that all the data from the heart rate monitors was transmitted into computer and the values put into charts. The basic statistics were calculated for all variables. The coefficient of the following heart rate was calculated by deduction of the heart rate measured three minutes after running from the maximum heart rate. The values were calculated either from the result of the 600 m run or from the results of the Conconi test. The coefficient of average heart rate was calculated by deduction of heart rate measured three minutes after running from the average heart rate during the test. The values were again calculated either with the results of one or the other tests. All the values were calculated separately for male and female students.

Simbols

- MSTOP Conconi's gradual running
- MSTPO _ P average heart beat during the Conconi's gradual running
- M600M 600 m run
- M600M_PP average heart beat during 600 m run
- 500 male studants
- 505 female students
- Pearson's correlation
- N – number of students
- M600MPK2=(M600M_PP - M600M_PR) / M600M x 60
- MSTOPPK2=(MSTOP_P – MSTOP_R) / MSTOPx60

Results and discussion

The results showed that on the average our students showed better results in endurance tests than students of other schools. We have also diagnosed out considerable differences in results between our male and female students. The average results of males in the 600 m run were 20 % better than the average results of females. The even greater differences were diagnosed in the results of the Conconi's test. Males' results were on average better for even 40 %! We were satisfied that all the students were prepared to give their free time and to cooperate with us. This is the average heart rate that shows that all the participants exceeded the 190 heart beats per minute.

We have discovered (table 1) a very high statistic correlation (.000) between results of running on 600 m by male students (. 84) and female students (.97) and average heart rate coefficient during running and lowest heart rate 3 minutes after running. The higher coefficient of male students is a result of lower average heart rate during running, which was for half a minute shorter than the average run of the female students. It is obvious that male students have been accelerating more steadily and have reached high heart rate later than females. There are no considerable differences between sexes in the decrease of the heart rate after maximum effort. Females showed a higher average maximum heart beat than males.

Table 1. Correlatoin between 600 m run and average heart rate cofficient during running and the lowest heart rate 3 minutes after running

SEX			M600M	M600MPK2
500	M600M	Pearson Correlation	1	-,840(**)
		Sig. (2-tailed)	,	0
		N	82	66
	M600MPK2	Pearson Correlation	-,840(**)	1
		Sig. (2-tailed)	0	,
		N	66	66
505	M600M	Pearson Correlation	1	-,792(**)
		Sig. (2-tailed)	,	0
		N	73	48
	M600MPK2	Pearson Correlation	-,792(**)	1
		Sig. (2-tailed)	0	,
		N	48	48

** Correlation is significant at the 0.01 level (2-tailed).

We have discovered (table 2) a very high statistic correlation (.000) between results of Conconi's test by male students (.94) and female students (.88) and coefficient of average heart rate during the test and lowest heart rate 3 minutes after the test. The coefficient by male students is higher as a result of lower average heart rate during running. The average male run was 5 minutes longer than the average run by female students. The fact that male students have some biological advantages before

Table 2. Correlation between Conconi's test and average heart rate coefficient during testing and the lowest heart rate 3 minutes after testing

SEX			MSTOP	MSTOPPK2
500	MSTOP	Pearson Correlation	1	-,940(**)
		Sig. (2-tailed)	,	0
		N	80	62
	MSTOPPK2	Pearson Correlation	-,940(**)	1
		Sig. (2-tailed)	0	,
		N	62	62
505	MSTOP	Pearson Correlation	1	-,877(**)
		Sig. (2-tailed)	,	0
		N	73	36
	MSTOPPK2	Pearson Correlation	-,877(**)	1
		Sig. (2-tailed)	0	,
		N	36	36

** Correlation is significant at the 0.01 level (2-tailed).

female students is seen in results. Advantages are seen mostly in higher physical strength, which in necessary for fast direction changes and acceleration of the running. As expected, female students' heart rate decreases a bit faster because their run was shorter.

Conclusion

The results of the tested sample, which included 82 males and 73 females from GLŠ high school revealed that on average our students showed better results in endurance tests than students of other schools. We have also diagnosed considerable differences in results between our male and female students. The average results of males in the 600 m run were 20 % better than the average results of females. The even greater differences were diagnosed in the results of the Conconi test. Males showed on average 40 % better results than girls! Average heart rate shows that all the participants exceeded the 190 heart beats per minute.

The highest correlations in 600 m run and at Conconi test were established between average heart rate during the test and the lowest heart rate measured 3 minutes after the test. The correlation coefficient was above .90 at Conconi's test and above .80 at 600 m run.

One of the most important things that we have found out was that the results of the Conconi's test are considerably more predictable than the results of the 600 m run. The reasons might be that the Conconi's test lasts longer and has a defined tempo. The beeps signal us when we have to run faster.

All the results were taken on the sample of GLŠ high school students and should not be generalized for the whole population of Slovenian students.

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THE RELATIONSHIP BETWEEN HEART RATE DEFLECTION POINT AND THE VENTILATORY ANAEROBIC THRESHOLD IN BASKETBALL PLAYERS

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Abstract

The purpose of this study is to examine the relationship between the heart rate deflection point (HRDP) and the ventilatory anaerobic threshold (AT) and to determine whether changes in heart rate to workload linearity can be used to accurately estimate AT in elite basketball players. Forty-three professional male basketball players 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 HRDP was determined using the method of deflection of linearity by visual inspection There was no statistically significant difference between the. the running speed (RS) at the AT (12.9±1.0 km*h^{-1}) and HRDP (13.0±1.2km*h^{-1}) (p>.05). However, a small but significant difference between the heart rate (HR) at the AT (163.3±7.8 b*min^{-1}) and HRDP (166.3±8.6 b*min^{-1}) was found (p<0.05). We can conclude that the intensity at the HRDP is a potential tool for non-invasive detection of the intensity at the AT based on HR response during graded exercise in professional basketball players.

Key words: *Anaerobic threshold, heart rate deflection point, basketball*

Introduction

Several methods have been applied for detecting anaerobic threshold, based on blood lactate concentration as well as respiratory gas exchange parameters. The AT 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. Laboratory assessement of the AT by lactate or 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 unexpensive, but nevertheless valid and accurate tests to assess the AT. During progressive incremental exercise a deflection point from the linear heart rate-work relationship is evidenced (Brooke and Hamley, 1972; Conconi et al., 1982). The relationship between HRDP and AT is the subject of research in the last 2 decades with contradictory results (Bodner and Rhodes, 2000.). Conconi et al. (1982.) first suggested the use of a simple field test for determination of the HRDP as a valid measure of AT in runners.

The purpose of this study is to determine the relationship between the HRDP and the ventilatory anaerobic threshold in athletes with specific morphological characteristics, such as basketball players.

Methods

Fourty two male elite basketball players (22.7±4.7 yrs of age, 197.3±8.0 cm height, 95.7±9.8 kg weight) participated in this study. All subjects are members of professional basketball teams or their national teams.

The subjects performed an incremental maximal exercise test with one minute stages on a motor-driven trademill (Run race, Technogym, Italy), with 1.5% inclination. A “breath-by-breath” gas analisys 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 gas and ventilatory parameters were averaged for every thirty seconds. The maximal exercise test was terminated at volitional fatigue of the subject.

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). Heart rate and running speed at AT were determined by interpolation. 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 HRDP could not be indentified, were excluded from further analysis.

The paired t-test for dependent samples was used to evaluate the statistical significance of differences between the ventilatory AT and the HRDP method. The significance level was set at $p < 0.05$.

Table 1. Speed of running and heart rate at the AT and HRDP

	AT	HRDP	P
HR (bpm)	163.3±7.8	166.4±8.6	0.02
V (km/h)	12.9±1.0	13.0±1.2	0.71

Legend: see text

Results and discussion

The results of the study are presented in Table 1. The HRDP could not be identified in 5 (11.9%) subjects, and their results were not included in the analysis. All other subjects demonstrated a downward-like HRDP. Similar percentages in the ocurrance of the HRDP (80-90%) were also reported in other studies.

The mean running speed (V) at HRDP and AT are almost identical ($t=-0.36$, $p=0.71$). This finding is consistent with the work of several authors (Zacharogiannis et al., 1993; Bunc et al., 1995), which confirms the validity of workload at HRDP as a measure of intensity at the anaerobic threshold. However, the mean difference in heart rate between HRDP and AT (3.0 $b*min^{-1}$) although very small, is statistically significant ($t=2.39$, $p<0.02$). The explanation for this is not clear. Conconi and co-workers (1996) showed that heart rate adapts to each new work rate within 30 seconds; we can speculate that the adaptation of heart rate to each new work rate is slower than for the gas exchange parameters.

In conclusion, our data suggest that the intensity at the HRDP coincides with the intensity at the ventilatory anaerobic threshold during graded exercise in professional basketball players and in most cases can be used for the detection of the anaerobic threshold. More caution is necessary when using the heart rate at the deflection point as a measure of AT intensity, as it slightly, but significantly overestimates the heart rate at the AT. The simplicity and low-cost favors the use of noninvasive methods such as the HRDP method in diagnostics of sports performance, especially where the laboratory equipement for AT determination (lactate and gas analysers) is not available.

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INJURY RATE OF THE CROATIAN NATIONAL BASKETBALL PLAYERS

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Abstract

Although regular sports efforts are beneficial for the health of the human organism, they do not exclude the possibility of injuries or damages to the locomotor system in athletes. Sports injuries occur during the training process or during competition, and the knowledge of reasons of their occurrence, as well as the knowledge of specific mechanisms of injuries are of major importance for prevention. The knowledge of the preconditions and the incidence of injuries as regards the variables, such as the specific characteristics of a sports event, age and gender of athletes, are extremely important to plan the prevention-specific training in the best possible way. The goal of this paper was to determine the injury rate in Croatian national basketball female and male players, the conditions under which they happened, body regions commonly affected, and the position-specific distribution of the injuries.

Key words: *sports injury, basketball, injury prevention*

Introduction

Demands of every sport changes in consideration with the specific biomechanical structure of the activity, competition rank, intensity, and frequency of training. According to the specific biomechanics of every sport different parts of the body will be under greater training and competition stresses, which means that some injuries will occur more often in ones than in other sports. Basketball is a team sport in which physical contacts, sudden changes of direction and jumping dominates (Minkoff et all. 1994). The Basketball informatic, energetic and motoric complexity requires a great level of physical conditioning in the absence of which the injury risk gets very high (Jukić, Nakić, Milanović, 2003). Off-repeated actions like sprinting, jumping, pivoting, stopping, feinting, collisions with other players and footwork can, in less prepared or tired athletes, cause injury. Besides, anthropometrics characteristics of the basketball players, seems to contribute to the occurrence of their injuries (Minkoff et all. 1994). There are two kinds of sports trauma: acute and chronic or overuse injuries. According to previous investigations, the most common acute injuries in Basketball players are ankle sprain, knee sprain and finger injuries (Zelisko, Noble i Porter, 1982; DeBenedette, 1991), while the most frequent overuse injuries in basketball are patellofemoral problems, Achilles tendon peritendinitis and supraspinatus tendon inflammation (NBTA, 1990). The goal of this paper was to determine the injury rate in Croatian national basketball female and male players, the conditions under which they happened, body regions commonly affected, and the position-specific distribution of the injuries. Investigations like this are important because the collection of data like frequency and nature of sports injuries and environment in which they occur can be very useful for planning and programming injury prevention training. In order to avoid specific sports injury and alleviate their consequences, injury prevention training should aim at complete body development and especially development of those body regions, which are under greater training and competition stress in a certain sports for a determinate age and gender.

Methods

Croatian senior basketball team players, (men 11-players, women-9 players) filled up a questionnaire about injuries they suffered during their basketball career. Because of the method used for the data collection (a questionnaire) the registration of injury severity was not possible. Such registration could have been possible only by the examination of the players' medical chart. Because of the impossibility to determine the exact time of happening of an overuse injury, (Medved, 1979) only the registration of acute injuries was possible. The data were processed by the program STATISTIKA FOR WINDOWS VER. 5.0. Differences in frequency of injuries between male and female seniors basketball players were determined by Chi-square test for independent groups.

Results and Discussion

A total of 83 injuries were recorded on 20 Croatian senior basketball team players which results with an average of 4.15 (±1.7) injury per player during their basketball career till the survey. The basketball experience of the male national basketball players was in average 13 years (±1.3), while for female it was 12 years (±1.2). From the beginning of their

Table 1: Differences in frequency of injuries between male and female seniors basketball players, Chi-Square test (p<0,05).

Case	Chi-Square = 5,313253 df = 1 p < ,021164			
	observed FEMALE	expected MALE	O - E	(O-E)**2 /E
C: 1	31,00	41,50	-10,5	2,657
C: 2	52,00	41,50	10,5	2,657
Sum	83,00	83,00	0,0	5,313

career till the day of the survey, in average, every male player has suffer from 0.32 injury while every female from 0.37 injury per year, that is, every subject of the sample, in average has suffer from one injury every 3 years during his/her career.

During their basketball career men suffered from 31 injuries, while women suffered from 52 (Table 1) both injury exposed mostly while playing as seniors (42% for male and 48% for female) (Figure 1). A higher number of injuries in senior category is probably the result of a greater number of training sessions, greater number of competitions and more frequent travelling than in younger categories.

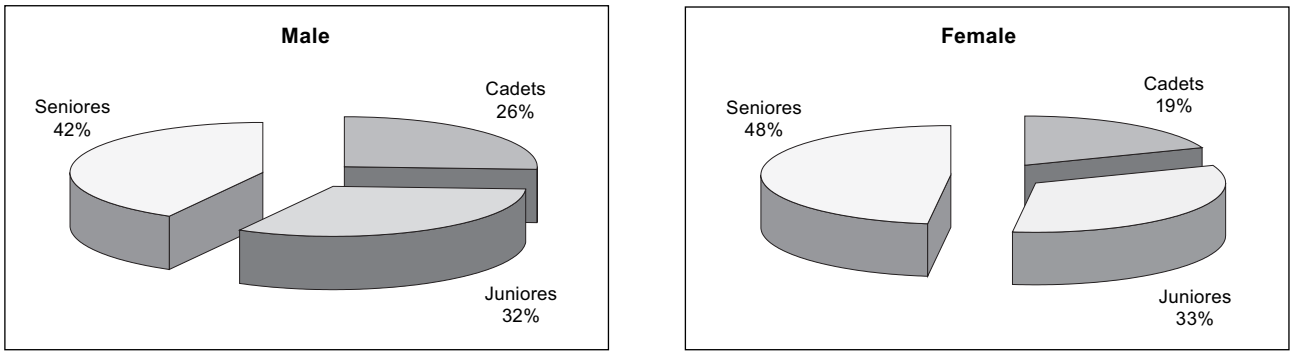

Figure 1. Injury rate of the Croatian national basketball players per category.

Results regarding the conditions in which injury happened shows that the majority of injuries occurred during competition (21 men, 28 women), then in training session (6 man, 23 women) and in leisure time (4 man, 1 women) (Figure 2).

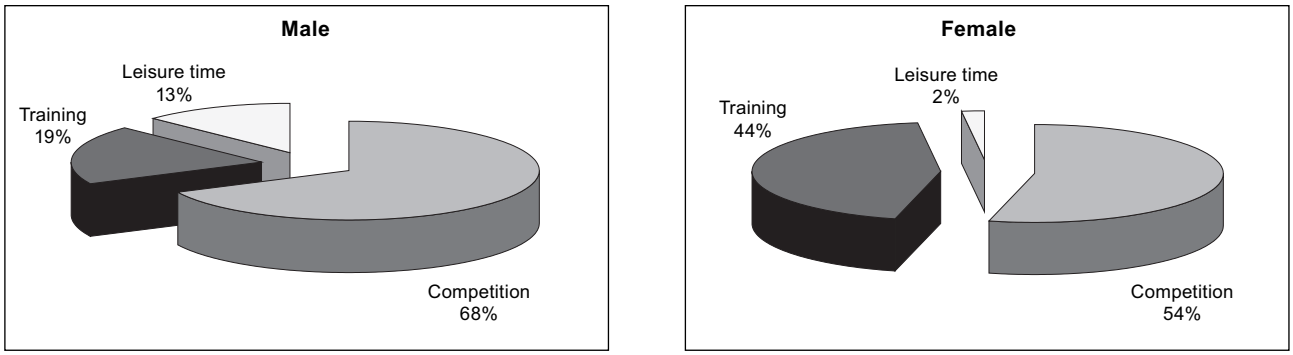

Figure 2. Conditions in which injury happened

The obtained results about the condition in which injury happened confirm the results of previous epidemiological studies about basketball players' injuries (NBTA 1990; Minkoff i sur. 1994). A high number of injuries during competition is explainable by the fact that the number of factors which players cannot influence is bigger during the game than in training session. One of the mentioned factors is undoubtedly the fatigue. In training conditions, if it is necessary, an athlete can take an involuntary or spontaneous pause during which the entire body rests. That allows him to restore the intramuscular coordination that could have been lost for a moment. In that way, during the pause between repetitions and sets, an athlete can prepare for the incoming stresses in the same training session. That allows him to properly develop his functional and motor abilities with a low injury risk. During the game that's not possible because, a player for instance, in an attack situation has to predict and solve various dangerous situations, react quickly, land safely etc. Statistics data of the American association of conditioning trainers show that the majority of basketball injuries happen during the last two periods of the game, that is, when players began to be tired. Further more, the injuries registered almost at the end of the game are more serious than the one that happens in the first two periods (NBTA, 1990). Besides fatigue, another risk factor for injuries during competition is the roughness of the opponent team players (Minkoff et all. 1994).

For planning and programming injury prevention training it is very important to have at disposition data about the severity, location and frequency of injuries, typical for a determined activity.

The most commonly injured areas in this study were: ankle (17 times), lumbar spine (5), groin (3), nose (2), foot, shoulder and wrist (1) for the men, while for women it wore: ankle (29), knee (7), foot (4), lumbar spine, elbow, wrist (3), upper leg and groin (1) (Figure 3).

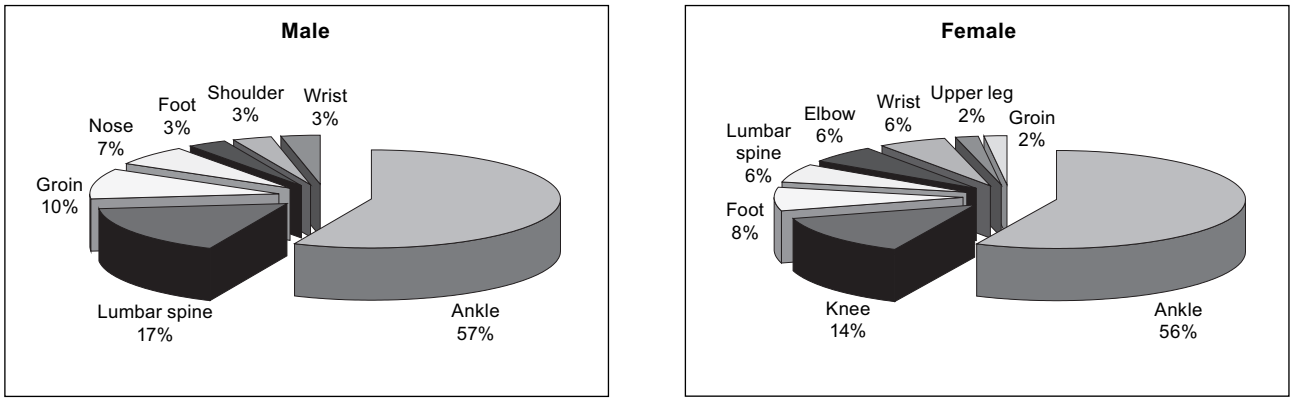

Figure 3. Locations of registered injuries in female and male Croatian national basketball players.

The outcome of this investigation confirms earlier results of epidemiological studies about injuries in basketball (NBTA, 1990; Minkoff et all. 1994). Off-repeated lower extremities injuries with a high number of ankle injuries show basketball specific technical and tactical demands. Such distribution of injuries in elite basketball players, with an overwhelming concentration in the ankle, is different than observed in other sports (Minkoff et all. 1994). One is left to ponder whether this peculiarity is due to the nature of the game or due to any predisposing structuring among its participants. As a group, basketball players are evidently anthropologically unique. It could be speculated that the size and structure of basketball players may play a critical role in the production of disabling lower extremity injuries. Cavanagh and Robinson (1989) have measured body dimensions and morphology of basketball players from five different teams. They found out that the basketball players had relatively smaller feet than extrapolations from the population of recreationally active males in relation to their body height. Namely, that means that basketball players sustain great loads on a relatively smaller lever which could be one of the reasons why they suffered from ankle injuries so often. Besides, basketball is a game of sprints,

Table 2: Differences in frequency of injuries between male and female seniors basketball players according to players positions

Playing position	Total number of injuries for female	Total number of injuries for male
Playmaker	18	4
Guard	12	16
Center	6	1
Forward	11	6
Power forward	5	4
Sum	**52**	**31**

Table 3: Differences in locations of injuries between male and female senior basketball players according to their playing positions.

Female	Injured area	Number of injuries
Playmaker	Ankle	7
	Lumbar spine	4
	Knee	3
	Upper leg	3
	Elbow	1
	Wrist	1
Forward	Ankle	6
	Groin	2
	Elbow	1
	Wrist	1
Power forward	Ankle	5
Guard	Ankle	6
	Knee	3
	Upper leg	1
	Elbow	1
Center	Ankle	5
	Knee	2

Male	Injured area	Number of injuries
Playmaker	Ankle	4
Forward	Ankle	3
	Groin	2
Power forward	Ankle	4
Guard	Ankle	6
	Lumbar spine	5
	Groin	2
Center	Nose	3
	Ankle	2
	Knee	1

sudden changes of direction, jumping, pivoting, feinting and sudden stopping which presents a great load for the lower extremities of a player. That shows the need of including injury prevention training with the intent to strengthen lower extremities muscles and develop the players' neuromuscular coordination in order to maximally prepare the athlete and diminish the risk of injuries in basketball.

As regards the position, in men, the most commonly injured areas of the body for the guards, the power forwards, the forwards and the playmakers is the ankle, and the nose in the centres. In Basketball, centers are frequently in collision with the opponent team players which can be the reason for their off-repeated nose injuries. In women, the most commonly injured area for all the positions was the ankle (Table 2 and 3). The more often injured players for the female were the playmakers, followed by the guards, while for the male it wore the guards, with only four registered injuries for the playmakers. One is left to ponder if that's because of their different way of playing. For detailed explanation, a game analysis is necessary.

In the end, it is important to point out how this is a retrospective investigation with several limitation (Auld, 1987). Therefore, there is a possibility that the players forgot to mention some injuries they suffered from during the very beginning of their career. For the same reason, as it has been told before, the registration of the mechanism and severity of injury was also not possible. However, we can conclude that the most commonly injured body region of the Croatian national basketball players is the ankle. Therefore, the need to introducing ankle injury prevention training is obvious. According to the available literature and previously published studies, we might presume that drills with the elastic ribbon, proprioception exercises, sprints with quick turns, quick stopping, changing of directions and plyometrics, as a part of a specific prevention training three times a week, could lower the risk of ankle injuries for the Croatian national basketball players.

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ANTHROPOMETRIC AND MORPHOLOGICAL CHARACTERISTICS OF RUNNERS

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Abstract

In this sudy we present the anthropometric and morphological characteristics of 46 national level track-and-field athletes. 20 morphological body measures were taken on a sample of 15 sprinters (S), 13 endurance sprinters (S4), 9 middle-distance runners (MD) and 9 long-distance runners (LD). Body fat percentage, body mass index and body constitution type were also calculated. Canonical discriminative analysis showed significant difference between the athletes of various running events, for the measures of body volume and body fat, and no significant difference in the variables of longitudinal and transversal dimensions of the skeleton. ANOVA and Student t-test for independent samples showed statistically significantly higher thigh and lower leg circumference in sprinters, as well as greater upper arm skinfold in middle-distance runners. The mesomorphic component is a dominant characteristic of body constitution of the runners in all events, whereas the ectomorphic component is the least marked.

Key words: *runners, track&field, anthropometrics, body composition, discriminative analysis*

Introduction

The measurement and apprehension of the basic morphological characteristics of the athlete is the foundation on which a training process may be built. Specific anthropometric characteristics are needed to be successful in certain sporting events, although, expert opinions often differ when it comes to this matter. Body composition analysis is also a standard procedure, that helps to improve and optimise the athlete's training process, as well as to determine health status and eventual osteoporosis or obesity.

There are number of papers dealing with anthropometrics and body type of athletes in various sports (Heath et al., 1967), as well as different playing positions in a specific sport (Matković et al., 2003, Jeličić et al, 2002). Rare, but very interesting are studies on the influence of morphological characteristics on top sport achievements, as the research carried out on javelin throwers (Čoh and co., 2002). Running events in track-and-field are marked by an exceptional variety of duration of a single event, energetic demands and the tempo of energy release. Considering the fact that runners need to carry their weight, which means they need to overcome the force of gravity on different distances, unlike, for example, rowers and swimmers, this stipulates a specific (lean) body composition as a prerequisite for more efficient and economic performance in a single event.

Although previous research has demonstrated that athletes in all running events have less body fat compared to most other disciplines (Martin et al., 1997; Jackson et al., 1985; Gore, 2000; Matković et al., 2003.; Medved, 1987; Hawes and Sovak, 1994), according to our knowledge, no sistematic research regarding the morphological characteristics of the athletes in various running events, has been conducted so far.

The aim of this study is to investigate morphological (volume and body composition) and anthropometric (longitudinal and transversal dimensions of the skeleton) characteristics and eventual differences between top national track-and-field athletes, in regard to specific events (sprinters, endurance sprinters, middle-distance and long-distance runners).

Subjects and methods

The sample consisted of 46 runners, divided in four groups: 15 sprinters (100 and 200m, S), 13 endurance sprinters (400m, S4), 9 middle-distance runners (MD) and 9 long-distance runners (LD). The average age of all runners was 21.2±4.9 yrs (S=20.9±4.9; S4=20.2±5.1; MD=18.8±2.4 and LD=25.4±4.3). All subjects are ranked in the top 15 on the Croatian Athletic Association rank-list for the specific event.

All measurements were conducted at the Sports Diagnostic centre at the Faculty of Kinesiology, University of Zagreb, according to the standards and instructions of the International Biological Program. 20 morphological body measures were taken: height, weight, leg length, arm length, arm span, shoulder width, elbow diameter, knee diameter, circumferences of upper arm, forearm, thigh, lower leg, chest and abdomen, skinfolds of the back, upper arm, chest, abdomen, thigh, lower leg and suprailliocristal. Body composition (percentage of lean body mass and body fat), body mass index and body somatotype (according to Heath-Carter, 1984) were calculated from anthropometric measures.

Body composition of the athletes was assesed by the skinfold method (Jackson et al, 1985), and the equation for the assessment of body density (BD). The value of body density was inserted into the equation for the estimation of body fat (% of the body fat = (495/BD - 450; Siri, 1956). New methods for assessment of body composition are developed, but it appears that the skinfold method is still the standard, when it comes to practical field and/or even laboratory testing.

The method of Heath and Carter, which is based on the Sheldon's somatotype classification, was applied to determine the somatotype characteristics. Somatotype is defined by three numbers which express the value of three components:

a) endomorph - a human physical type (somatotype) tending toward roundness, being calculated from the value of three skinfolds,
b) mesomorph - a human physical type (somatotype) that is marked by greater than average muscular development, being calculated from muscular-skeletal characteristics, height, circular dimensions of the limbs (upper arm and lower leg), and elbow and knee diameter,
c) ectomorph - a human physical type (somatotype) tending toward linearity, which expresses the longitudinal dimension of the body, regarding the height and weight.

Basic statistical descriptive parameters have been calculated - mean (AS), standard deviation (SD), range (R), for all subjects and for each group (S, S4, MD, LD) separately. The differences between the groups were analysed with the canonical discriminant analysis. The differences between all groups of runners in the manifested space have been analysed by ANOVA, whereas paired t-tests for independent variables were used to test the differences between particular variables between groups.

Results and discussion

The wide age span, from 17 to 36 years of age, confirms the fact that runners can maintain their sports career for very long, which is especially noticeable in sprint and long-distance events (especially half-marathon and marathon). In this sample, which comprised athletes of different running events who were, or still are a part of the junior or senior national team, the youngest athletes were middle-distance runners and the oldest, expectedly, were long-distance runners.

Basic descriptive parameters and the results of ANOVA for anthropometric and morphological characteristics of the subjects are shown in Table 1. The average height of all subjects, as well as for particular groups, is almost identical to the average height of the male population in Croatia (Mišigoj–Duraković, 1996). The lack of specific measures of longitudinal body dimensionality for any group of runners, implies that those measures cannot be used in the selection of children for specific running events.

The values of body fat percentage and the sum of all skinfolds indicate that runners, regardless the event, have prominently less body fat compared to other athletes of most sport disciplines (Martin et al., 1997; Jackson et al., 1985; Gore, 2000). The only statistically significant difference between groups is for the upper arm skinfold, which was higher in middle-distance runners compared to others. The lowest body mass index (the relation between weight and square height) was in distance runners, and the highest in sprinters. Considering similar body fat percentage in all groups, higher BMI indicates higher lean body mass, which is confirmed by the values of the mesomorph component, as well as by the values of the circumference parameters of the limbs (Table 1). Sprinters had the highest values in all body volume measures, 400 meter runners had slightly lower values, whereas middle and long-distance runners had about equal values. Sprinters have a significantly higher circumference of the lower leg, compared to all other groups of runners ($p<0,05$), while the circumference of the thigh differed only between sprinters and long-distance runners ($p<0.05$). The same trend is observed for other body volume parameters, and is open for debate what the results would be for a larger sample of subjects, tested during the competitive part of the season.

The somatotype of croatian runners is similar between groups. They have a moderate ectomorph constitution, which means a moderate muscularity and elongated shape, as the dominant features of the constitution. The endomorphic component is the least developed, as expected. The somatotype of croatian runners is comparable to the somatotype of the 1984 Olympics participants (Carter, 1984): sprinters 1,7 – 5,2 – 2,8, 400 meter runners 1,5 – 4,6 – 3,4, middle-distance runners 1,5 – 4,3 – 3,6, long-distance runners 1,4 – 4,2 – 3,7. The endomorphic component is somewhat more marked in our runners, while the mesomorphic, and even more the ectomorphic component are less marked. One might question the influence of the annual phase in the training cycle on the variation of anthropometric and morphologic features. This study was performed at the beginning of the annual training cycle, so we could assume a somewhat higher body fat percentage and endomorphic component.

The latent differences between the groups of runners have been analysed by the use of canonical discriminant analysis (Table 2). The hypothetical existence of morphological distinctions between the athletes of various running events has been confirmed (Canonical $R_1=0,85$; $p<0,05$). The centroid of the sprinters group has been polarised to one pole ($C_S = 2,13$), and the centroid of the long-distance runners and 400 meter runners has been polarised on the other pole of the first (and only statistically significant) discriminative function ($C_{LD} = -1,73$ i $C_{S4} = -1,15$). The centroid of the middle-distance runners took position in the middle of the discriminative function ($C_{MD} = 0,31$). No single measure contributed

Table 1. Average values and results of ANOVA for anthropometric and morphological characteristics of subjects

	AS ± SD (n=46)	S (n=15)	S4 (n=13)	MD (n=9)	LD (n=9)	F	p-level
Height (cm)	181.4±5.7	182.5	181.3	180.8	180.2	0.19	0.90
Leg length (cm)	102.6±3.4	103.1	102.5	102.3	102.2	0.15	0.93
Arm length (cm)	78.8±3.1	79.5	78.4	77.4	79.7	1.62	0.20
Arm span (cm)	182.7±6.9	183.9	182.1	179.8	184.1	0.98	0.41
Knee diameter (cm)	9.6±0.5	9.8	9.67	9.64	9.36	1.94	0.14
Elbow diameter (cm)	6.9±0.3	6.9	6.9	6.9	6.8	0.69	0.56
Shoulder width (cm)	40.8±1.7	41.1	40.3	40.6	41.3	0.59	0.63
Circ. of the upper leg(cm)	56.0±3.0	57.5	55.9	55.5	54.3	2.35	0.09
Circ. of the upper arm (cm)	28.5±2.3	28.9	28.9	27.6	27.8	1.08	0.37
Circ. of the forearm (cm)	26.3±1.4	26.4	27.1	25.6	26.0	2.39	0.08
Circ. of the lower leg (cm)	37.1±1.8	38.3	36.8	36.1	36.6	4.02	0.01
Circ. of the abdomen (cm)	78.3±3.7	79.1	78.3	78.5	77.4	0.56	0.64
Skinfold of the back (mm)	8.4±1.9	8.2	8.6	9.1	7.9	0.63	0.60
Skinfold of the upper arm(mm)	6.7±2.1	6.3	6.0	8.78	6.7	3.92	0.01
Skinfold of the thigh (mm)	8.7±3.6	7.8	7.7	10.4	9.6	1.31	0.29
Skinfold of the chest (mm)	4.7±1.3	4.6	4.5	5.3	4.8	0.84	0.48
Skin-fold of the shank (mm)	5.5±1.9	5.6	5.1	5.9	5.3	0.42	0.74
Skinfold suprailiocristal (mm)	7.0±3.7	5.9	7.2	9.7	6.0	2.52	0.07
Skinfold of the abdomen (mm)	8.2±3.9	8.4	7.5	10.0	7.5	1.02	0.39
Body weight (Kg)	72.4±6.6	75.1	72.6	70.2	70.2	1.37	0.27
Body fat percentage (%)	5.9±2.3	5.5	5.4	7.1	6.3	1.22	0.31
Body mass index	21.9±1.6	22.6	22.0	21.5	21.4	1.46	0.24
Sum of 7 skinfolds (mm)	49.2±14.9	46.9	46.6	59.3	46.8	1.79	0.16
S_I – endomorph com.	2.2±0.74	1.9	2.2	2.7	1.9	2.70	0.06
S_II– mesomorph com.	3.7±0.9	4.0	3.9	3.6	3.2	1.50	0.23
S_III- ectomorph com.	3.4±0.9	3.2	3.2	3.6	3.6	0.77	0.52

Legend: see page 2

to the factorial structure of the discriminative function, most probably because of the high correlation of anthropometric and morphological variables.

The results of a separate canonical discriminant analysis based only on the variables for body volume, mass and body composition measures are presented in Table 2. The first statistically significant discriminative function ($p<0.01$) clearly explained the difference between the groups of athletes of various running events. The position of the sprinters group centroid on the negative pole ($C_S = -1,24$), and the position of the long-distance, middle-distance and 400 meter runners centroid on the positive pole of the discriminative function ($C_{LD} = 1,01$, $C_{MD} = 0,38$ i $C_{S4} = 0,47$) confirmed previous statements that short-distance runners are more muscular (Table 2.). Namely, the factorial structure of the first discriminative function emphasises the influence of the volume and body mass variables, especially the musculature of the lower extremities (circumference of the thigh and lower leg). The musculature of the lower extremities generates strong, powerful movements starting from the reaction and pushing out of the starting block, through the acceleration, and maintainance of the maximal velocity on the running distance.

The centroid position on the discriminative function, voluminosity (body weight and circumferences of different body segments) and body fat, of the group of long-distance runners is determined primarily by lower circumferences of the thigh and lower leg. Namely, the weekly training volume of the long-distance runners often reaches 180 km or more. Considering the fact that such training regime is characterised by moderate intensity, higher muscular mass gives no advantage, and, as well as excessive body fat, would make an unnecessary extra load.

The centroid position of the 400m and middle-distance runners group placed in the middle between the sprinters and long-distance runners is logical and expected, regarding the energy demands of such events, as well as the volume and characteristics of the training process. Top performers in 400m, 800m and 1500m events demand highly developed aerobic and anaerobic systems (Janssen, 2001; Martin et al. 1997), although the share of particular energy sources varies in differing proportion from event to event – the shorter the track, the more dominant is the anaerobic energy supply, and *vice versa*, in long-distance events it is mostly aerobic.

Conclusion

Average values of the basic anthropometric measures (weight and height) of croatian nationally top-ranked runners in various running events are similar to those of the general population. In comparison to the general population, as well

Table 2. Results of canonical discriminant analysis for the variables of body volume, mass, and body fat of the subjects

	DF 1	DF 2	DF 3
Thigh circumference upper leg	-0.42	-0.14	-0.07
Upper arm circumfer. upper arm	-0.17	-0.20	-0.31
Forearm circumfer. forearm	-0.01	-0.27	-0.66
Lower leg circumfer. shank	-0.50	0.22	-0.39
Abdomen circumfer the abdomen	-0.13	-0.17	0.07
Body weight	-0.30	-0.01	-0.26
Body fat percentage	0.11	0.02	0.49
Body mass index	-0.31	-0.10	-0.22
Sum of 7 skinfolds ΣKN	0.08	-0.11	0.60
	DF 1	DF 2	DF 3
LD	1.01	1.06	-0.20
MD	0.38	-0.30	1.04
S	-1.24	0.21	-0.07
S4	0.47	-0.77	-0.50
Rc	0.68	0.56	0.49
p-level	0.01	0.07	0.15

Diskriminant functions (DF), canonical cirrelation (Rc), error size (p)

as to other sports disciplines, track-and-field athletes have lower body fat percentage, and statistically significantly higher values for circumferences of all body segments.

A mesomorphic component is dominant in runners of all events, the ectomorphic component is less dominant, whereas the endomorphic component is the least marked.

The canonical discriminant analysis showed that runners of various running events statistically differ in morphological measures, especially in dimensions of body volume and body fat. On the manifest level, only thigh and lower leg circumference statistically differ, being significantly higher in sprinters, as well as the upper arm skinfold, which is significantly higher in middle-distance runners.

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TYPES OF TRAINING AND HEALTH PROBLEMS IN GIRLS

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Abstract

On the sample of 64 girls aged 18 to 20 years who participate, or participated in near past in competitive sport activities, but not being elite athletes, discriminant analysis was done to establish differences in health problems in girls having different type of training. Subjects were divided in three groups. First group consisted of 27 athletes being in sports including physical contact with opponents (combat sports, handball, etc.), therefore being exposed to higher risk of injuries. Second group consisted of 16 athletes who competed in rhythmic gymnastics and had demanding trainings even not being elite competitors. Third group consisted of 21 girls competing in sports without direct contact with opponent (volleyball, swimming, tennis, etc.) supposedly having average risk of injuries and other health problems. The subjects answered the questionnaire consisted of questions about different health problems and using the methods to prevent or reduce those problems. One significant discriminant function was obtained, discriminating rhythmic gymnastics competitors from athletes from sports without direct contact. Rhythmic gymnastics competitor centroide is placed at the positive side of discriminant function defined by problems with the bilateral performance of exercises and exercises to strengthen the back muscles, were characterized by problems in the ankle and wrist joints. Centroide of group of competitors from sports without direct contact is placed at the negative side of discriminant function which is defined by pain after training, troubles with knees, trouble with ankle joints and compensatory training. Centroide of group of competitors from sports including physical contact with opponents is placed in the middle, being near zero point of discriminant function.

Introduction

Sports training is a process and form of regular sporting exercise aimed at achieving the best possible sporting results. In the widest sense, sports training is a form of educational process aimed at forming the knowledge, skills, abilities and habits of a sports person. As long ago as 1988 Legrange training was a process aimed at equipping a person for a certain task. Many writers have defined sports training in various ways (Harre, 1983, Roberts, Weider 1994) but it is undisputed that training is a form of physical but also mental work, and it causes changes to a person's organism. Training is performed regularly; it is therefore a planned and programmed process aimed at the specialization of a particular sport. It is carried out through the systematic increase of burden and is aimed at the maximum enhancement of the abilities, knowledge and sporting results, in line with the disposition and activities of each individual sports person. (Milanović, 1997.).

Training a sports person and his or her fitness is closely linked with the narrow sporting discipline involved. Depending on the type of sport or sporting discipline the results are conditioned by various requirements: speed, strength, coordination etc. that is aerobic or anaerobic abilities. From the point of view of a sportsperson's health, there are two conflicting opinions. The differences are in the positions determined by the sport, since these are greater if it is top class sport, or if it is only a case of sport for recreational purposes (some authorities does not consider top class sport to be healthy).

Research was conducted to analyze some health problems in various sports. The sports are divided into three groups: those where there is contact between the sportspeople and those where there is no contact in the sport and sportswomen involved in rhythmic gymnastics are a special category. An analysis of health problems was carried out by means of an anonymous questionnaire where the sportswomen could freely and with no pressure express the problems they had had during or after the training process. It is important to point out that the sample did not include any top class sportswomen, however the women involved were also not involved for merely recreational purposes, but were in systematic training in their sports without achieving top-level results.

Methods

The sample of this research consists of 64 young women aged 18 to 20 years who participate, or participated in near past in competitive sport activities, but not being elite athletes. The sample is divided in three groups. First group consists of 27 athletes being in sports including physical contact with opponents (combat sports, handball, etc.), therefore being exposed to higher risk of injuries. Second group consists of 16 athletes who competed in rhythmic gymnastics and had demanding training even not being elite competitors. Third group consists of 21 girls competing in sports without direct contact with opponent (volleyball, swimming, tennis, etc.) supposedly having average risk of injuries and other health problems. For assessment of health status the subjects fulfilled 28-item questionnaire. Seventeen questions regard to three aspects of the health status: pain after training, symmetrical bilateral training and compensatory training. The differences among three groups of athletes were defined by canonical discriminant analysis.

Results

In Table 1 there are descriptive statistics of variables of health status for three groups of athletes and for total sample. None of the three groups of subjects had significant problems during their sporting careers and they rarely missed training due to problems. The girls in rhythmic gymnastics and the girls in sports where there is body contact performed their exercises or sporting movements frequently or even constantly bilaterally, symmetrically, using the right or left arm or leg. Girls who did not have body contact in their sports only did this occasionally. Compensatory training was in general not satisfactory; relaxation exercises or massage were rarely used but exercises for strength were used intensively especially by the rhythmic gymnasts.

Table 1. Average (AS) and standard deviation (SD) of the variables Health Problems Caused by Training (PRO), Time off training due to health problems (MIS). Problems may be with: back of the head (BOH), shoulder (SHO), wrists (WR), upper back (UB) lower back (LB), knees (KN), ankles (AN) feet (FE), pain after training (PAI), pain that lasts longer than 48 hours following training (P48), symmetrical bilateral exercises (SY) and compensatory training at the end of the session (CO), relaxation exercises after training (REL), exercises to strengthen the back muscles (STR), massage after training (MA), in the group training rhythmic gymnastics (RG), the group of girls training for sports where there is body contact (CON), in the group of girls in sports where there is no body contact (WIT), on a total sample (N=64)

	N	PRO	MIS	BOH	SHO	WR	UB	LB	KN	AN	FE	PAI	P48	SY	CO	REL	STR	MA
		AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD	AS SD
RG	16	2,38 1,03	2,38 1,09	1,25 0,78	1,31 0,70	1,88 1,03	1,50 0,73	2,75 1,34	3,13 1,36	3,19 1,17	1,81 1,42	2,13 0,81	1,75 0,86	4,69 0,60	1,67 1,59	3,06 1,12	4,13 0,72	2,50 1,32
CON	27	2,22 0,97	2,11 0,80	1,26 0,66	1,67 0,96	1,56 0,90	1,93 1,17	2,56 1,42	2,11 1,31	2,70 1,30	1,89 1,28	1,89 0,89	1,56 0,85	4,04 1,16	2,96 1,51	3,22 1,42	3,56 0,93	2,37 1,08
WIT	21	2,05 1,02	2,19 0,93	1,43 0,68	2,05 1,24	1,52 0,75	1,81 1,33	2,38 1,20	2,42 1,25	2,14 1,20	1,81 0,93	2,29 0,85	1,86 0,91	3,43 1,33	2,86 1,42	3,05 1,36	3,81 1,17	2,67 1,20
TOT	64	2,20 1,00	2,20 0,91	1,31 0,6	1,70 1,03	1,63 0,88	1,78 1,13	2,55 1,32	2,47 1,35	2,64 1,28	1,84 1,20	2,08 0,86	1,70 0,87	4,00 1,20	2,59 1,58	3,13 1,32	3,78 0,98	2,50 1,17

In Table 2 the product-moment correlations of the variables are shown. The health problems of the sportswomen questioned were mainly linked to pain in the knee joints (0.60) and back (0.52) and slightly less in the ankles and feet. In some sports the shoulders and the lower back are also subject to pain. The greatest link (0.57) was noted between pain in the knee joint and feet. Some sportswomen feel pain after training, for longer than 48 hours. The fact that relaxation exercises after training are important is demonstrated by their link with the necessary compensatory training. Our subjects made little use of massage, which is clearly linked to the standard of their training in their sporting career.

The results of canonical discriminant analysis are in Tables 3 to 5. Only one statistically signifficant discriminant function was obtained. The greatest distance between groups (Table 5, Figure 1) was established for the group of rhythmic

Table 2. The matrix (lower triangle) of product-moment correlations of variables Health problems caused by training (PRO), missing the training because of health problems (MIS), back of the head (BOH), shoulder (SHO), wrists (WR), upper back (UB) lower back (LB), knees (KN), ankles (AN) feet (FE), pain after training (PAI), pain that lasts longer than 48 hours following training (P48), symmetrical bilateral exercises (SY) and compensatory training at the end of the session (CO), relaxation exercises after training (REL), exercises to strengthen the back muscles (STR), massage after training (MA), in the group training rhythmic gymnastics (RG), the group of girls training for sports where there is body contact (CON), in the group of girls in sports where there is no body contact (WIT), on a total sample (N=64)

	PRO	MIS	BOH	SHO	WR	UB	LB	KN	AN	FE	PAI	P48	SY	CO	REL	STR	MA
PRO	1,00																
MIS	,20	1,00															
BOH	,04	,05	1,00														
SHO	,23	,18	,04	1,00													
WR	,07	,33	,14	,28	1,00												
UB	-,00	,04	,23	,47	,31	1,00											
LB	,52	,02	,32	,13	,21	,23	1,00										
KN	,60	,26	,29	,09	,26	-,09	,58	1,00									
AN	,42	,01	,09	,12	,30	,13	,35	,52	1,00								
FE	,40	,04	,29	,28	,29	,07	,43	,57	,53	1,00							
PAI	,32	,34	,28	,03	,14	,20	,17	,24	,14	,29	1,00						
P48	,35	,26	,29	,31	,16	,18	,31	,38	,27	,28	,39	1,00					
SY	,28	,10	-,19	,05	-,03	-,07	,23	,29	,18	,08	-,03	-,08	1,00				
CO	-,04	-,25	,06	,07	-,19	-,02	,14	-,09	,10	,07	-,20	-,09	,13	1,00			
REL	,33	,10	-,13	-,01	,01	,02	,23	,07	,10	,01	,15	-,08	,34	,46	1,00		
STR	,13	,21	-,13	,08	-,02	-,04	,22	,27	,18	,05	-,02	-,10	,35	0,29	,38	1,00	
MA	,21	0,16	-,20	,30	,11	,24	,25	,15	,18	,10	,28	,13	,20	,09	,37	,30	1,00

gymnastic athletes and the group of subjects competing in sports without direct contact with opponent (WIT). The group of athletes in physical contact with opponent sports (CON) is placed in the middle, near the origin of discriminant function.

The statistical difference between the rhythmic gymnasts and the other two groups was mainly the result of the variables: problems with ankle joints and performing relaxation exercises, and slightly less problems with shoulder joints and compensatory training, which is shown in Table 4.

Table 3. The results of dicriminant analysis: eigenvalues (E), canonical correlations (R), Wilks' Lambda (λ), x-squared value, degrees of freedom (df), and level of significance (p)

Roots removed	E	R	λ	x^2	df	p
0	1,06	0,72	0,33	58,58	34	0,01
1	0,45	0,56	0,68	20,05	16	0,22

Table 4. Standardized coefficients for canonical variable (W) and correlations of variables with discriminant variable (discriminant factor structure F) of variables Health problems caused by training (PRO), missing the training because of health problems (MIS), back of the head (BOH), shoulder (SHO), wrists (WR), upper back (UB) lower back (LB), knees (KN), ankles (AN) feet (FE), pain after training (PAI), pain that lasts longer than 48 hours following training (P48), symmetrical bilateral exercises (SY) and compensatory training at the end of the session (CO), relaxation exercises after training (REL), exercises to strengthen the back muscles (STR) and massage after training (MA).

Variable	W	F
PRO	0,107809	0,121515
MIS	0,028367	0,076319
BOH	0,167092	-0,094957
SHO	-0,655169	-0,270709
WR	0,270756	0,149442
UB	-0,047289	-0,103333
LB	0,095497	0,103106
KN	-0,451382	0,203550
AN	0,699409	0,315564
FE	-0,069256	0,000359
PAI	-0,396758	-0,066760
P48	0,138994	-0,043394
SYM	0,778093	0,421654
COM	-0,820169	-0,310160
REL	0,026681	0,003075
STR	0,258702	0,124554
MA	-0,078541	-0,051060

Conclusion

On a sample of 64 sportswomen divided into three groups, research was conducted into their health and possible problems caused by training. Health problems could result from the sports they are involved in so we divided them into three groups as follows: sportswomen in sports without body contact, and sports where body contact is evident, and the third group was made up of rhythmic gymnasts, since it was assumed that they would differ from the others.

Table 5. Group centroids (D) on discriminant function for the group of rhythmic gymnastic athletes (RG), group of athletes in physical contact with opponents sports (CON), and the group of subjects competing in sports without direct contact with opponent (WIT)

Group	D
RG	1,53568
CON	-0,02082
WIT	-1,14327

This was also shown in the results. The rhythmic gymnasts, despite the bilateral performance of exercises and exercises to strengthen the back muscles, were characterized by problems in the ankle and wrist joints. On the other hand, the sportswomen regardless of whether they had body contact within their sports, do not perform sufficient compensatory training and they therefore feel pain after training, especially in the knees and shoulder joints. However much it is thought that undertaking training in different sports affects the health of the sportswomen, the research showed that for rhythmic gymnasts it is extremely important to practice all the elements of the sport bilaterally, which is also one of the demands of the Regulations, and for other sportswomen it is vital to perform compensatory exercises after each training session or at least after one cycle.

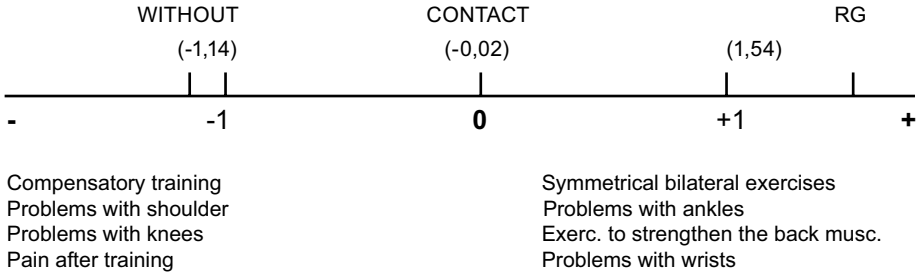

Figure 1. The position of group centroids on discriminant function for the group of subjects competing in sports without direct contact with opponent (WITHOUT), group of athletes in physical contact with opponents sports (CONTACT), and group of rhythmic gymnastic athletes (RG).

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Sport Psychology

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THE CAREER DEVELOPMENT OF ELITE ATHLETES: A SPORT PSYCHOLOGICAL PERSPECTIVE

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Abstract

To reach and to remain at the elite level in competitive sport requires athletes – and those around them – to "invest" at different levels (e.g., physical, social, financial) during a long period of time. Research reveals that the athletic career of successful athletes consists of succeeding normative stages, including the initiation, development, mastery and discontinuation stage. Athletes progress in their athletic development when they cope successfully not only with the characteristics of each stage, but also with the demands of the transition from one stage into another. Furthermore, athletes also need to cope with the demands of the stages and transitions that occur concurrently to those at athletic level in their psychological, psychosocial, academic and/or vocational development. Sport psychology support services, career intervention and lifestyle management programs are implemented to support athletes in optimizing and furthering their holistic development.

Key words: *sport psychology, athletic career, career transition, sport psychology support service, elite athlete, lifestyle management.*

Introduction

Empirical research into the career development of successful athletes emanates from studies conducted during the 1960s-1970s into the sport career termination among elite and professional athletes (Wylleman, Lavallee, & Theeboom, 2004). The earliest studies revealed that athletes retiring from elite sports experienced a wide range of psychological, interpersonal, social, and financial problems initiated by a range of negative or even traumatic experiences. These studies tended to emphasize almost exclusively on the dysfunctional issues such as depression and alcoholism experienced by retiring athletes, and on male professional athletes in specific (i.e., professional) sports. Research data gathered during the 1980s, however, challenged not only the widespread assumption that sports retirement is inherently stressful, but led researchers to suggest that the athletic career termination should be seen as a transitional process rather than as a singular event. The increased understanding of the career termination process also motivated sport psychologists during the 1990s to broaden their attention to the occurrence of other career transitions faced by athletes. This shift toward a career development perspective was also enhanced by the integration of conceptualizations emanating from research into youth sport participation and the development of talented and expert performers. Recently, research into the development of the athletic career has taken a life-span perspective by focusing not only athletes' development "beginning-to-end" or at athletic level, but also in other domains of their lives (e.g., academic, psychosocial, professional).

A lifespan perspective on the career development of elite athletes

A holistic, lifespan approach of the sports and the post-sports career of elite athletes was recently proposed by Wylleman and Lavallee (2004). Acknowledging the strong concurrent, interactive and reciprocal nature of transitions occurring in the athletic career and those transitions occurring in other domains of athletes' lives (e.g., academic, psychosocial, professional), Wylleman and Lavallee considered the dynamic interplay of key variables at various developmental periods. First, an athletic career is described in terms of succeeding normative stages. Athletes progress in their athletic development when they cope successfully with the tasks and challenges of each career stage, as well as with the demands of the transition from one stage into another. Second, as athletes develop at sports level, they also need to cope with the tasks and challenges of the stages and transitions in other domains of their development. In fact, concurrent to their athletic career, athletes also develop at psychological, psychosocial, academic and/or vocational level. Using research data on the career development of – active as well as former – talented athletes, professional and elite athletes, and Olympians, Wylleman and Lavallee proposed a life-span model (see Figure 1) which includes the normative stages and transitions faced by athletes at athletic, individual, psychosocial, and academic/vocational level.

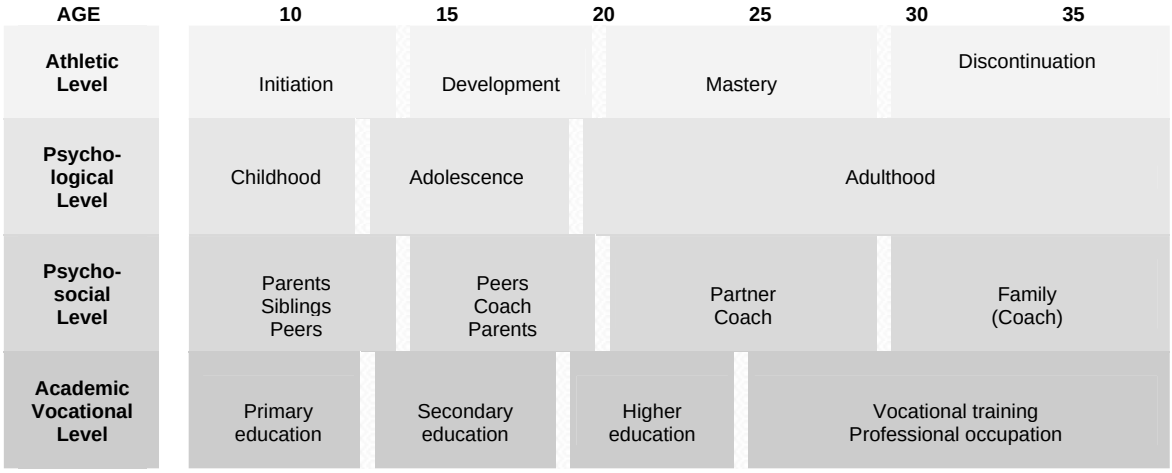
The top layer represents the stages and transitions athletes face in their athletic development and includes four stages which are tentatively linked to approximated ages:

(a) the "initiation" stage during which the young athletes is introduced into organized competitive sports (from about 6 to 7 years of age),

(b) the "development stage" during which the athlete is recognized as being "talented" and which entails an intensification of the level of training and participation in competitions (from about 12 to 13 years of age),

(c) the "mastery" stage which reflects the athlete's participation at the highest competitive level (from about 18 to 19 years of age),

(d) the "discontinuation" stage which describes the elite athlete's transition out of competitive sports (from 28 to 30 years of age).



Note. A dotted line indicates that the age at which the transition occurs is an approximation.
From "A developmental perspective on transitions faced by athletes" (p. 516) by P. Wylleman and D. Lavallee in Weiss, M.R. (2004), Developmental sport and exercise psychology: A lifespan perspective. Morgantown, WV: Fitness Information Technology, Inc. Reproduced with permission.

Figure 1. A developmental perspective on transitions faced by athletes at athletic, individual, psychosocial, and academic/ vocational level.

Although these stages are normative in nature, major differences may occur in-between sports: for example, at age 18 to 19, the mastery stage among female gymnasts may be coming to an end, while for male rowers it may actually be the start of their mastery stage.

The second layer represents the developmental stages and transitions occurring at psychological level and is based on the different conceptual frameworks on psychological development, such as Erikson's developmental stages, Piaget's stages of cognitive development, and Havighurt's developmental tasks over the life span. The stages of psychological development include childhood, adolescence, and (young) adulthood.

The third layer is representative of the changes that can occur in athletes' psychosocial context relative to her or his athletic involvement and which have been identified in earlier research. It situates those individuals who are perceived by athletes as being the most significant during that particular stage. These changing contexts include the athletic triangle (athlete-parents, athlete-coach, and coach-parents relationships) (e.g., Wylleman, 2000; Wylleman, Verdet, Leveque, De Knop, & Huts, 2004; Wylleman, De Knop, Sloore, Vanden Auweele, & Ewing, 2003; Wylleman, De Knop, Verdet, & Cecic-Erpic, in review), the athlete's relationships within the athletic family with siblings or grandparents, peer relationships, athlete-marital or life time partner relationships, and other interpersonal relationships significant to athletes.

Finally, as most countries have compulsory education up until the age of 16-17 years, athletes will be confronted with a major overlap between their academic and athletic development (De Knop, Wylleman, Van Hoecke, & Bollaert, 1999). For example, the normative transitions in the sport life-cycle of a basketball player in the United States will run parallel to transitions at academic levels – from youth sport to high school junior varsity to high school varsity to college and, finally professional level. In non-professional sports, 6 in 10 Canadian Olympians were students at the time of participating in the Olympic Games, whereas during the 2000 Olympic Games in Sydney, 1 Belgian athlete in 10 was a current or recently graduated university student-athlete (Wylleman & Lavallee, 2004). The final layer reflects therefore in first instance the stages and transitions at academic level, including the transition into primary education/elementary school, the stage of secondary education/high school, and the transition into higher education (college/university). However, as vocational training and the development of a professional occupation may also have a strong influence on a talented athlete's sport career (Wylleman, De Knop, Menkehorst, Theeboom, & Annerel, 1993), the final stage in this fourth layer represents the vocational training and/or a professional occupation.

As can be seen, this lifespan model already situates clearly the different transitions and stages athletes will face at different levels of development throughout their sports career. What role do significant others play in this development? What kind of support can be provided by sport psychologists in order to assist young talented and elite athletes to develop and progress at all levels?

In the next sections, this life-span model will first be used to illustrate why sport psychology support services should be focussed on specific transitions or stages in the career development of elite athletes. Secondly, based on this model, an overview will be provided of some of the career transition and lifestyle management programs currently available worldwide in general, and specifically in Europe, and which through sport psychology support services can assist athletes throughout their athletic career.

Parental involvement in the development of the elite athletic career

While parental involvement is clear during the initiation and development stages, its influence is less well-known during the mastery stage in the athletic career (Wylleman, De Knop, Ewing, & Cummings, 2000; Wylleman et al., in review). It is a stage during which athletes are required to perform at their highest level, in a consistent way, and for as long as possible, and which generally starts when the talented athlete moves from junior or senior category.

During this athletic stage, the family remains mainly a support system and an emotional refuge from the stress of competition. While parents are less involved at this moment, their emotional support and love remained high – in the best as well in the worst of times. They showed their, by now, adult-aged children that they were confident in their capability to succeed. A similar supportive parental involvement was found in Cecic Erpic's (2000; Cecic Erpic, Wylleman, & Zupancic, 2004) study where former elite athletes perceived their parents to remain positive, even when they experienced periods of lower levels of achievements during a competitive season in this athletic stage. Sometimes, parents may still be more actively involved, for example, by providing financial assistance, household organization, transportation, presence at games, and moral support. It should be noted however that parental involvement is not always similar for both parents. For example, in their study on 265 talented athletes, Wylleman and colleagues (Wylleman et al., 2003; Wylleman, Vanden Auweele, De Knop, Sloore, & De Martelaer, 1995) found that, in comparison with the developmental stage, athletes perceived the quality of their interactions with both parents to have changed during the mastery stage. More particularly, athletes perceived themselves to expect less emotional support from their mother, and at the same time more from their fathers. It was hypothesized that this differentiation in athletes' behaviors towards their parents was related to the fathers' surging interest for the athletic achievements of their children as they reached a higher level of athletic proficiency – an interest which made athletes shift their focus of attention away from their mothers who in general had been involved since their initiation into organized sport.

As the mastery stage runs parallel with the developmental stage of adulthood, parents are faced with the task of "launching" their children, so that they can establish independent living apart from the family, and develop partner relationships which may lead to the formation of the adult child's own family. The intense parental involvement and the (possible) dependence upon the family during the previous stage however may not only delay the onset of athletes' individuation and independence, but, may also affect parents themselves. It is worth nothing that 13% of the parents of competitive swimmers and track and field athletes still initiated a coaching relationship with their adult athlete child during the mastery stage (Wylleman & De Knop, 1998).

Finally, during this stage, parental involvement can also be linked to athletes' efforts in combining an athletic and an academic in higher education or vocational career. The importance awarded to higher education as a crucial step towards a professional occupation, is also reflected among parents of talented athletes: one parent in two of talented athletes who ended their secondary education, emphasized that they expected their athlete-child to continue into higher education. Furthermore, parents have been shown to "gently" pressure their children into continued formal education on the way to a professional future. The transition into the job market is often accompanied by an athlete's increased efforts to secure greater financial and personal security (e.g., by entering the job market). This is necessary for those athletes who cannot rely on a revenue-income via their athletic achievements. Here again, parents may be called upon for (financial, logistic) support.

It is clear that for parental involvement to be optimal to talent development it should include, amongst others, providing different types of support (e.g., emotional, financial, logistic) and avoiding specific types of interpersonal behaviours (e.g., pressure, disappointment, lack of parental recognition). Using this life-span model enables sport psychologists to assist not only the athletes with regard to parental involvement, but also and more specifically athletes' parents to optimize their behaviours to each of the four career stages.

The delivery of sport psychology support, career transition and lifestyle management

As research revealed that the development of their athletic career is influenced by their non-athletic development in the psychological, psychosocial, academic and vocational domains (Wylleman & Lavallee, 2004), sport governing

bodies and centres of sporting excellence have developed initiatives providing guidance and support services related to education, professional career development and lifestyle management.

The existing programs vary in format and often include workshops, seminars, educational modules and individual counseling (Wylleman, Lavallee, & Theeboom, 2004). The majority of programs focus on lifestyle management and the development of transferable skills that can assist individuals in making the transition from life in sport into a post-sport career. As such, these programs provide athletes with an introduction to career planning and development by focusing on values and interest exploration, career awareness and decision-making, resume preparation, interview techniques, and job search strategies. Career development programs for athletes are primarily managed by national sports governing bodies, national Olympic Committees, specific sport federations, universities and independent organizations linked to sport settings. While some programs address the needs of professional athletes, the majority have been developed for a much wider population.

One of the best known is the Athlete Career and Education (ACE) Program which was developed in Australia by the Victorian Institute of Sport in 1990. The overall objective of the ACE program is to assist athletes to balance the demands of their sporting careers whilst enhancing their opportunities to also develop their educational and vocational skills. A major component of the program is to assist individuals in developing a career plan that integrates both sporting and non-sporting components. The philosophy is to create an environment where athletes can be encouraged to be independent, self-reliant and have a capacity to meet the demands associated with elite sport. The following are services provided through the Australian ACE Program:

(a) Individual athlete assessments are used to provide a structured process in which to assess individual athletes' educational, vocational, financial and personal development needs;

(b) More than thirty personal development training courses, which are structured to assist athletes in meeting their sporting, educational, and career aspirations. Many of these courses provide individuals with nationally accredited competency-based education programs;

(c) A nationally consistent career and education planning process is employed to enable athletes to manage their own individual vocational requirements. Career development is provided in the form of direct assistance in finding employment through career advice, training paths, and vocational training. Secondary and tertiary education support is provided through networking with individuals in secondary schools, universities who can offer unit or course selection advice, as well as assistance in negotiating appropriate academic and residential arrangements for athletes (e.g., quiet halls of residence, appropriate and sufficient dietary provisions at appropriate times, distance and on-line learning opportunities);

(d) A transition program provides career and education guidance for elite athletes who are undergoing a transition to a post-sporting career;

(e) Training opportunities and supervised practice for ACE staff is provided through a Graduate Certificate in Athlete Career and Education Management that has recently been developed by Victoria University in Australia;

(f) Direct athlete needs-based assessments provide a structured process to assess athletes' eligibility for support.

ACE services are available to over 3,000 elite-level athletes throughout Australia. The United Kingdom Sports Institute has also recently initiated the ACE UK Program across England, Scotland, Wales and Northern Ireland.

Europe has also witnessed the development of interest in, and career transition and lifestyle programs for talented and elite young athletes (Wylleman, 2004a/b/c). Data provided on:

(a) support and services optimising the combination of education and elite sport,

(b) career development during and after the elite sports career,

(c) lifestyle support during and after the elite sports career

from 17 European countries attending the first European Forum on Lifestyle Management (Wylleman, & Parker, 2004) showed that with regard to the education of elite athletes, 9 (53%) countries developed at secondary level specialised sports schools ('topsportschools', 'elite sport schools', 'sport gymnasiums', 'vocational sport schools'). As the majority of initiatives provide support in a decentralised way – the number of schools ranged between 1 (Estonia) to 61 (Sweden) – young elite athletes generally attend boarding schools. Only four (23%) countries provide career counselling in a structured way (e.g., France) with the remaining countries offering some form of one to one counselling service. Five (29%) countries also make retirement support or pension schemes available for their former elite athletes.

Finally, a variety of lifestyle support initiatives were identified, including the wide use of workshops and seminars and the provision of web based support to current and former elite athletes. While most countries indicated that a variety of providers (sports federations, specialist advisers, private companies) were involved in lifestyle support services, only a couple of countries (e.g., UK) have developed support networks in which schools, excellence centres and counselling advisers co-operate.

It becomes evident that many European countries have engaged in developing support services, including sport psychology support, career transition and lifestyle management programs which enable their elite athletes to develop in a more holistic way – in elite sport, education, professional career and lifestyle. More specifically, sport psychologists are becoming more and more involved in structural initiatives aimed at providing career transition and lifestyle management services.

Conclusions

At the start of the 21st millennium, the field of sport psychology is witnessing different developments. While the role of sport psychologists has generally been related to providing mental support to athletes via mental techniques and sport psychology interventions, this role is steadily shifting towards a more holistic approach of sport psychology support delivery.

The use of this life-span model will assist sport psychologists in addressing those issues arising in the career development of talented and elite athletes which have a (in)direct influence on athletic performances, namely, athletes' developments in those domains which are related to their psychological, psychosocial, academic, and vocational level (Wylleman, Alfermann, & Lavallee, 2004; Wylleman & Lavallee, 2004). This will require sport psychologists to expand their knowledge and competencies to the field of lifestyle management (Wylleman, in review) and career management (Lavallee, Gorely, Lavallee, & Wylleman, 2001) and career and lifestyle interventions (for specific examples, see Lavallee & Wylleman, 2000). This shift in focus has not only been confirmed by European sport psychologists working with elite and Olympic athletes and teams, but has also led to the need of reviewing the education of sport psychologists and the delivery of sport psychology support services (Wylleman, in review). This includes, for example, the need for sport psychologists to be able to work within multidisciplinary support teams assisting elite athletes on different aspects of their athletic career (e.g., management, financial services, social services).

Conclusion, it can be stated that while the requirements for a future development of the field of sport psychology will include the need to take a holistic, lifespan approach to the delivery of sport psychology services – an approach in which the lifespan model presented here may be of assistance to sport psychologists.

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THE EFFECTS OF INTERNAL VERSUS EXTERNAL FOCUS OF ATTENTION ON THE LEARNING OF A BALANCE TASK AT THE PRESENCE OF AN AUDIENCE*

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Abstract

The aim of this study was to examine the effects of internal versus external focus of attention on learning with regard to presence Vs. non presence of an audience. 40 students ranging from 16 to 18 years were randomly assigned to two groups and practiced to maintain their balance on stabilometer on 2 consecutive days : one group of participants was instructed to either focus on their feet (internal focus) whereas other group focus on markers attached to the platform (external focus). Retention and transfer tests performed with assigned of participants by double transfer design to four groups in presence Vs. no presence of audience on day 3. The results showed no main effects of groups, however, the experimental groups showed an improvement in acquisition, retention and transfer.

Key words: *attentional focus, transfer, retention, balance task, stabilometer*

Introduction

Recent evidence suggests that instructions inducing an "external" focus of attention by directing learner's attention toward the effects of their movements enhance learning,when compared to instructions directing attention to the movements themselves "internal" focus (for a review, see Wulf, Höß, & Prinz, 1998; Shea & Wulf, 1999; Wulf, McNevin, Fuchs, Ritter, & Toole, 2000; Wulf & Prinz, 2001; Wulf, McConnel, Gärtner, & Schwarz, 2002; McNevin, Shea, & Wulf, 2003; Vance, Wulf, McNevin, & Mercer, in press).

The ability to transfer skills to novel situations is a concern for almost all training programs, as skills often have to be performed in situations that differ from those in which they were practiced, whether under increased social or time pressure, in environments that provide more distractions, or in situations that require modifications of the practiced skill. Totsika & Wulf (2003) demonstrated that performers can benefit from adopting an external attentional focus during practice when being assessed in situations that involve speed pressure, distractions, or even modifications of the practiced skill with use task of "ride a pedalo" (i.e., situations often encountered in real-life sports performance). They suggested that effects of the instructions examine outside the laboratory in a more naturalistic setting, such as, presence of an audience.

Contradictory findings are about effects of an audience on learning and performance of motor tasks. Audience have most mental-society effects on learning (Cox, 2000). Also, an audience would have no effect on learning of a new motor skill (Sawyer & Noel, 2000). The impact of the presence of others while working is not influence on performance in the tasks requiring combination of physical fitness and coordination (Straus, 2002).

In the present study, we examined the effects of the attentional focus on performance in situations that differ from those under which the skill was practiced. We used a dynamic balance task, that is, learning to keep balance on stabilometer, to examine this issue. Specifically, we were interested in two questions. First, we asked whether advantages of external relative to internal focus would be found at retention with use balance time (BT). If external focus advantages were found under (BT), this would demonstrate that the more effectiveness of this type of practice that can use for process of teaching.

Second, we wanted to examine the effects of these two types of instructions to a novel situation. This is because, in the most previous experiments comparing the effectiveness of internal versus external focus conditions (for a review, see Wulf & Prinz, 2001), retention tests were used. Thus, it has been almost impossible to determine whether group differences found in retention were, in fact, learning effects or whether they reflected more temporary effects present only when the specific attention focus was adopted. Therefore, we used transfer test in which participants were asked to keep balance on stabilometer at presence of an audience. The purpose of adding presence of an audience was to prevent participants from focusing on the motor task and, in particular, from adopting the attentional focus used during practice (for similar procedures, see Wulf & McNevin, 2002). If attentional focus effects could be demonstrated under these conditions, it would indicate that the influence of the focus of attention adopted during practice relatively permanent in nature.

** Young researcher award*

In summary, if the advantages of an external focus are restricted to specific task and performance conditions encountered during practice, no benefits of an external over internal focus condition should be seen in transfer. However, if the external focus advantages are generalizable to novel situations, one might expect external focus participants to be less affected by the presence of an audience.

Method

Participants. 40 students 16-18 ages (Mage = 16.7) served as participants in this experiment. None of the participants had prior experience and were not aware of the study purposes. Informed consent was obtained from each participant before beginning the experiment.

Apparatus and task. The task required participants to balance on a stabilometer. The stabilometer consists of a 60 x 120 cm wooden platform, with the maximum deviation of the platform to either side being 15 degree. The task was to remain in balance i.e., to keep the platform in a horizontal position, for as long as possible during each 60-s trial. Two yellow lines (16 x 2.5 cm) were placed on the platform, 9 cm from the front edge and 14 cm from the midline of the platform. Participants were instructed to place their feet behind these lines. To analysis skill development, we recorded balance time during each trial.

Procedure. All participants were informed that the task was to keep the platform in the horizontal position for as long as possible during 60-s trial. Each trial started with keep balance on stabilometer. Approximately 15-s before the start of a trial, the experimenter asked the participant to step on the platform and to keep their own balance until the start signal was given by the experimenter. At the start signal, the participant attempted to control move the platform, and data collection began as soon as the platform start signal. Participants were randomly assigned to one of two groups: the internal focus group, or external focus group. There was no control group without instructions, because our main interest was in determining the relative effectiveness of the different types of instructions. Participants in the internal focus group were instructed to think on their feet and to try to keep them at the same height, whereas the external focus group participants were instructed to think on the yellow lines and to try to keep the lines at the same height. There were seven 60-s trials on each of 2 consecutive days, with 60-s breaks between trials. Participant were reminded of the instruction before every other practice trial on 2 days, that is, before trials 3, 5, 7 (day 1) and before trials 8, 10, 12, 14 (day 2). Subjects were randomly assigned to 4 groups by double transfer design, on day 3. Internal focus assigned to 2 groups: at presence Vs non presence of an audience. External focus assigned to 2 groups: at presence Vs non presence of an audience. There was retention and transfer test without instructions (reminder) to assess the learning effects of the independent variables. All participants performed 7 trials. Audience in this research could be Supportive or hostile or neutral audience.

Depended variable and data analysis. Balance time is dependent variable in this research. The practice data were analyzed in a 2 (group) x 2 (day) x 7 (trial) analysis of variance (ANOVAs) with repeated measures on the last two factors. Retention and transfer data were analyzed in a 2 (group) x 2 (audience) x 7 (trial) ANOVA with repeated measures on trial. Greenhouse-Geisser epsilon values were used to adjust the degrees of freedom in all the ANOVAs to compensate for deviations from the assumption of sphericity.

Results

Practice

As can be seen from Fig. 1 (left and middle panels), Both groups showed considerable increase in BT across both days, with larger improvements on day 1 than on day 2. The main effects of both day, $F(1,38) = 28.163, P < 0.001$, and trial, $F(4.495,170.822) = 10.861, P < 0.001$, were significant. None of the other main or interaction effects were significant, all $Fs < 2, P > 0.05$.

Retention and Transfer

BT for the internal and external focus groups during retention and transfer can be seen in figure 1 (right panel). Both groups showed considerable increase in BT on day 3. The main effects of trial, $F(4.357,156.842) = 4.054, P < 0.01$, were significant. None of the other main or interaction effects were significant, all $Fs < 2, P > 0.05$.

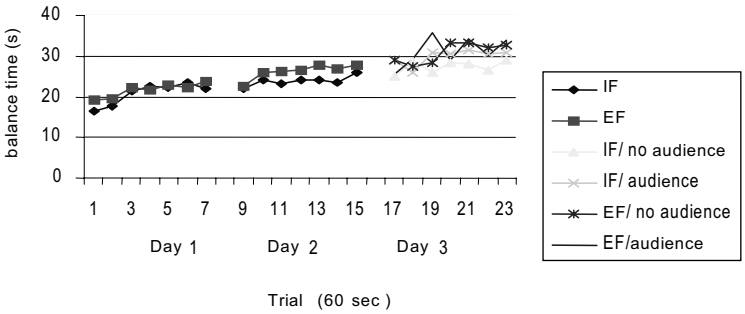

Figure 1. Average of balance time (BT) internal-focus (IF), and external-focus (EF) groups during practice (Day 1 and 2), and IF/no audience, EF/ no audience and IF/audience, EF/audience groups during retention and transfer (Day 3).

Discussion and conclusion

The goal of this study was to examine the generalizability of the advantage of an external attentional focus found in previous studies (e.g., Wulf et al, 1998; Wulf & Prinz, 2001; Totsika & Wulf, 2003), to learning a balance task under the presence of an audience. In previous findings the advantages of an external versus internal attentional focus was shown, however, in this study all groups improve in acquision, retention and transfer (in presence of an audience), and there were no any advantage of an external versus internal attentional focus. Several reason may cause for this results. First, in this study we used BT for examine of different between groups, whereas, in previus study on stabilometer used RMS error. RMS error is based deviation of subjects from goal in the time process. In fact, RMS error reveals the levels of subject's response distance from the goal. Thus, RMS error is measure from general error and it is sensitive to both bias and variability of performance (Shmidt, 1991). Another possible reason could have been argued, that is, the duration of used in previous studies (e.g., Wulf et al, 1998, Expreiment 2; Shea & Wulf, 1999), was 90-s in trial of practice and retention, whereas in this study we used 60-s in trial, thus, it can be argued that more error commited by the groups could be found in longer time stability of balance task. As a result, the findings of this study didn't support previous researches about the advantage of external relevant internal focus of attention in retention test.

Also, the findings of this study didn't show advantage of external versus internal focus of attention at the presence of audience. The external focus group in this study didn't benefit from adopting an external relevant internal focus of attention during distractions of practiced skill (for a review, see Totsika & Wulf, 2003).

On other hand, consistent with the findings of previous study (Sawyer & Noel, 2000), the results of this study showed that the presence of an audience is not influence on learning and performance a novel motor skill. Also, in line with previous study (Straus, 2002), the findings of this study showed the impact of the presence of an audience is not influence on performance in the tasks requiring combination of physical fitness and coordination.

In conclusion, the present study didn't show advantages of any one of these two types of instructions (external versus internal attentional focus of attention). The effects of attentional focus in naturalistic settings (presence of an audience) increased constancy in subjects, but more researches must perform about instructions with regard different elements (same subjects, type of task…). Future studies will be necessary to verify this conclusion.

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TOWARD A NEW, INTEGRATED MODEL OF DISPOSITIONAL AND SITUATIONAL DETERMINANTS OF MOTIVATION CLIMATE IN SPORT*

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Abstract

Achievement goal theory states that dispositional goal orientations and perceptions of the motivational climate are important components of motivation that interact to affect behaviour in achievement context. This study examined contribution of dispositional goal orientations, perceptions of motivational climate, and coach's leadership behaviour in explaining motivational climate in team sports (football, handball). Hierarchical regression analysis indicates that the situational factors (coach's leadership behaviour, instructiveness in particular) are more important for prediction of the mastery-oriented motivational climate than the dispositional factors (goal orientation of athletes), whereas quite the opposite is valid for prediction of the performance-oriented motivational climate (performance-oriented goal orientation had the highest prediction power). According to results obtained, the study proposed the new, original concept of Integrated Model of Motivational Climate in Sports.

Key words: *motivational climate, goal orientation, leadership, football, handball*

Introduction

Achievement goal theory (Nicholls, 1992) states that dispositional goal orientations and perceptions of the motivational climate are important components of motivation that interact to affect behaviour in achievement context. Motivational climate in sport context is a function of goals an athlete needs or wants to achieve, of evaluation of his/her effort exerted in accomplishing these goals, and of requests on particular interaction with other participants in sport setting, mainly his/her team-mates. Motivational climate determines a situational goal structure (Seifriz, Duda & Chi, 1992) and is understood as collective goal orientation of athletes in a particular sport context. It is a contextual variable (Duda, 1993, 2001) which depends of objective environmental signs (coach's leadership behaviour, parents' expectations) being the expectation message for athletes about their sport behaviour needed for successful performance. Athlete's subjective appraisal of the situation and the meaning of achievement experience has even greater impact on development of motivational climate. A perception of atmosphere (or perceived motivational climate) is composed of several dimensions such as the ways in which individuals are evaluated, the type of group interactions that are emphasized and the nature of the reward (Duda, 2001). According to these, motivational climate can be explained from two different perspectives - the objective and the subjective one. The objective perspective gives an insight into actual factors that determine the achievement context, are equal for all participants and can be recognised due to different environmental signs typical for a particular type of motivational climate (mastery or performance). The subjective perspective is a perception of a particular motivational climate that includes different ways of perceiving and explaining the same environmental signs, it can be related to different individual instructions, evaluations and feedback on one's sport behaviour.

Communication between a coach and athletes is a two-way process. Therefore, it can be assumed that each athlete may influence coach's behaviour and, indirectly, motivational climate within his/her team. Also, each athlete is in interaction with his/her team-mates who are his peer group. This impacts their common goals, values and builds a framework of social cognition in general. It was demonstrated that individual experience of each athlete could confirm active contribution of his/her dispositional characteristics on shaping the climate, in interaction with situational factors (Barić, 2004). The aim of this paper is to examine the relations between goal orientations, being the dispositional factor, and coaches' leadership behaviour, being the situational factor, on the one hand, and perceived motivational climate in two team sports - football and handball. Based on theoretical knowledge and empirical results obtained, integrated model of dispositional and situational determinants of motivation climate in sport will be proposed.

Methods

Participants and procedure. The sample consisted of 386 young Croatian athletes (aged 14-17 yrs) and 34 male coaches, 17 from each sport. The participants' selection criteria was training experience in the same club, whereas the clubs' selection criteria was a period of being coached by the same coach (for both minimum was 6 months). Clubs permitted the research, and all athletes participated voluntarily in it. Confidentiality of data was guarantied. The data were collected prior or after a training session in a group setting.

* *Young researcher award*

Measures. Three instruments were used to assess athletes' goal orientation - TEOSQ (Duda, Chi, Newton, Walling, & Catley,1995, 2 subscales: task and ego), perceived motivational climate - PMSCQ (Seifriz et al, 1992, 2 subscales: mastery and performance motivational climate) and coaches' leadership behavior – LSS (British version adapted for children, Lee, Williams, Cox & Terry, 1993, 4 subscales: instruction and explanation, democratic style, social support, positive feedback). Croatian version of all instruments demonstrated adequate reliability with alpha coefficients ranging from 0.75-0.86.

Results and Discussions

Simple correlation (Table 1) indicated that the motivational climate was significantly related to almost all facets of goal orientation and leadership behavior.

Table 1. Correlations between motivational climate, goal orientation and leadership behavior

	m. climate	mastery	instructions	positive feedback	social support	democratic style	task	ego
football (N=206)	performance	-.222**	-.238**	-.034	-.177*	-.145	-.174*	.517**
	mastery		.695**	.292**	.506**	.257**	.485**	-.152*
handball (N=182)	performance	-.047	-.169*	.014	-.112	-.074	.051	.521**
	mastery		.621**	.346**	.515**	.181**	.373**	-.043

* p<0.05, ** p<0.01

Results of hierarchical regression analysis (Table 2) revealed nearly the same pattern structure in both sports: the situational factors (coach's leadership behaviour, instructiveness in particular) were more important for prediction of the mastery-oriented motivational climate than the dispositional factors (goal orientation), whereas quite the opposite was valid for prediction of the performance-oriented motivational climate.

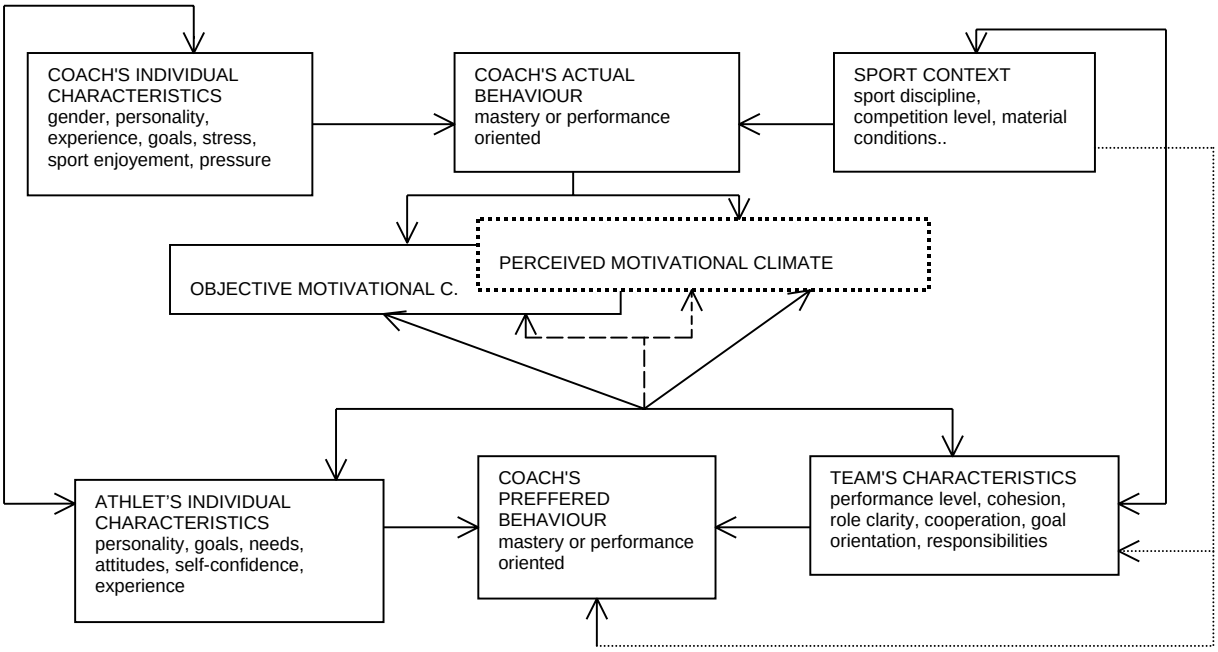
Table 2. Hierarhical regression analysis results

step	variables	BETA	R^2	BETA	R^2	BETA	R^2	BETA	R^2
		PERFORMANCE MOTIVATIONAL CLIMATE				MASTERY MOTIVATIONAL CLIMATE			
		handball		football		handball		football	
1	task ego	-.134* .507**	.286	.025 .520**	.272	.476** -.116	.248	.376** -.061	.142
2	task ego instruction positive feedback social support democratic style	-.095 .473** -.100 .093 -.053 -.058	.306	.077 .502** -.241** .100 .018 .061	.301	.228** -.011 .522** -.056 .203** -.037	.551	.166** .008 .502** -.027 .213** -.124*	.451
3	instruction positive feedback social support democratic style	-.281** .204* -.051 -.073	.094	-.257* .171* -.011 -.009	.048	.628** -.062 .209** -.056	.509	.544** -.027 .248* -.160**	.427

* p<0.05, ** p<0.01

According to the results, the ego goal orientation had the highest prediction power for the performance motivational climate, whereas coach's instruction and tendency to give social support to his/her athletes were negative predictors. Coach's feedback was also important for this motivational climate pattern, which was congruent with the theoretical presumptions (Duda & Balaguer, 1999), i.e. athletes who were dominantly ego oriented (as in this case) had a normative criteria for evaluation and needed to compare themselves to others all the time. On the other hand, if we want to build mastery motivational climate, we need an instructive and supportive coach and task oriented athletes. These results confirmed the coach's impact, although various, on modelling of both motivational climate patterns. The coach's impact seems even more important when the athletes' dispositional goal orientation is less favourable (as in all cases when ego oriented athlete fail to confirm his/her competence) because coach's leadership behaviour can have great repercussion on athlete's determination and attitudes toward sport. Based on these results, previous theoretical knowledge and author's sport and coaching experience, the idea about motivational climate structure was elaborated and proposed for the first time in the following model (Barić, 2004). The lower level represents dispositional and the higher level situational determinants of the motivational climate.

The model bellow is a combination of elements taken from the goal perspective theory (Duda, 2001;Nicholls, 1992), the leadership behavior models (Chelladurai & Reimer, 1998; Smith and Smoll, 1989) and from a different aspect of integrated model of antecedents and consequences of leadership (Duda & Balaguer, 1999). Motivational climate reflects conditional relations of dispositional and situational determinants that are shaped through interaction of coaches and athletes. Each athlete can partially modify his/her initial dispositional characteristics in relation to environment the latter being shaped through coach's leadership behavior, and this indirectly modifies characteristics of the whole team. Coach's leadership behavior shapes both the objective and subjective motivational climate. An athlete experiences his/her coach and perceives team climate individually through his/her preferences for coach's behavior as it happens in reality and depends on a wider sport context. Certain aspects of objective motivational climate can be also recognized in interaction between protagonists, because each participant modifies his/her behavior responsively. Congruence between athletes' preferences for and perceptions of coach's behavior, as well as between coach's demands and athletes' characteristics and goal orientation may impact athletes' motivation.



Picture 1. Integrated model of situational and dispositional determinants of motivational climate

Conclusions

More attention should be given to the motivational climate and athletes' goal orientation. Also, awareness of the impact coach's leadership behavior may have on athletes' motivation is very important. Athletes' behavioral, cognitive and affective responses may influence coach's behavior and change present motivational climate on both the individual level and within a sport team. If we succeed in overcoming common coaches' belief that you can't do much about athletes' motivational structure because the best athletes are 'survivors in the process of natural selection', and that they either have high motivation or not, we would open space for fostering communication process and education. In general, it seems that some motivational strategies commonly used in practice should be changed. Coaches would need continued support and resources available to help guide them in their attempts to create a mastery motivational climate, thus cooperation with sport psychologist seem to be the best choice.

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EVALUATION OF THE NEUROTIC SYMPTOMS EXTENSITY IN HIGH SCHOOL ATHLETES

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Abstract

By using the N-test on the sample of 186 athletes and non-athletes high school students, the neurotic symptoms incidency has been estimated. Carring out the T-test did not show any significantlly difference in the dimensions of the general neuroticism between the athletes and non-athletes, nor between male and female athletes. The obtained results show a low degree of the sport activity effect on the development of personality, which is possible to claim by series of other relevant factors in the process of forming conative space which either cancel or minimise the influence of sport.

Key words: *personality, conative dimensions, neuroticism, N-test, high school population*

Introduction

The analysis of the conative characteristics or the dimensions of personality in athletes has definitely a significnt place in the corps of the study in the area of sport psychology. That is to say, if we agree with the statement that the equation of sport efficiency is the function of sport situation and of all dimensions of athletes, it is clearly seen that the conative factors represent an important component in the subsystem of antropological dimensions of athletes (Figure 1).

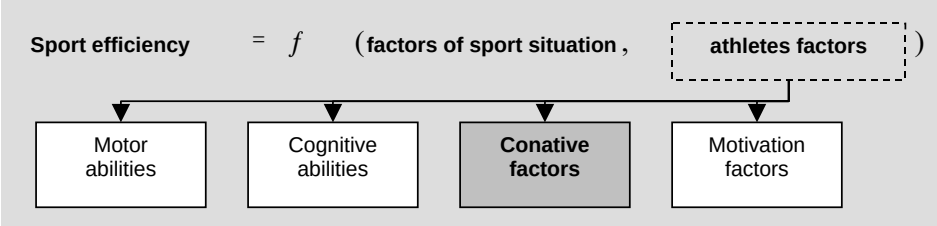

Figure 1. The equation of sport efficiency specification (modified according to Horga, 1993)

Since the structure of personality, defined as the group of features which ensure the adaptation of man on outside and inside conditions of environment (Horga, 1993), is extremely important for human functioning in all situations, as well as in sport, the necessity of analysis of previously mentioned dimensions also imposes in the case of athletes.

According to the Eysenck's theory, personality could be described by using three mutually independent dimensions of a wide range: neuroticism, extrversion, and psyhoticism (Horga, 1993). In this reasrch our attention will be focused on the dimension of neuroticism, defined as emotional instability, which is characterised in the behaviour inclined to worring all the time, being easily excited, having troubled sleep, loss of appetite, anxiety, etc.

The aim of this reasrch is the evaluation of neurotic dimensions in high school athletes, that is, to make tendency diagnosis of the participants according to, so called, general neuroticism (Bujas & Radošević, 1998).

Methods

The sample of participants was taken out, for the purpose of this study, from the population of students from the V. High school Vladimir Nazor, in Split, Croatia, school year 2004./2005. This school has in it's system sport classes, attended by young athletes who are active in their sport clubs. This reasrch has included all four sport classes, as well as four regular ones, that is, non-sport classes; two classes from each grade, 1st to 4th. The reasrch comprised the sample of 186 prticipants in total. The experimental group (N = 76 male + 29 female) consisted of sport classes students and students from regular classes who regularly take part in sport in sport clubs, while the control group (N = 31 male + 50 female) consisted of students who do not take part in any sport (Table 1).

Table 1. Sample of participants

Grade	Experimental group		Control group	
	Athletes		Non-Athletes	
	Male	Female	Male	Female
1	24	9	13	12
2	20	4	4	17
3	18	10	8	12
4	14	6	6	9

According to the aim of this reasrch, the participants were subjected to the N-test (Bujas & Radošević, 1998), composed for the tendency diagnosis according to general neuroticism which estimates the neurotic symptom extensity. The N-test is composed of 77 items/questiones to which the participants answers YES or NO, and which include different neurotic symptoms, such as excessive sensibility, irritability, neuro-vegetative disfunctions, phobias, obsessive and paranoid disorders, mild exhaustion, etc. The result of participants represent the sum of answers which point out at the tendency towards neurotic reactions (Bujas & Radošević, 1998).

The parameters of descriptive statistics were processed on the data: number of prticipants (N), mean ($\bar{x}$), and standard deviation (SD). The differences between the means of particular groups were tested by using the T-test. The statistical package Statistica for Windows, relese 6.0, was used for processing the data.

Results

The results of the carried out N-test (Table 2) does not imply on the increased neurotic symptoms extensity, neither in experimental, neither in control group of participants. If we compare the obtained results with the results of Bujas et al. (Bujas & Radošević, 1998), which established the value of means on the level M=36,9 for men and M=39,3 for women by testing manifest neurotics, we can see the positive quantitative deviation in participants of all ages.

Table 2. Deskriptive statistics and results of the T-test

Male							Female						
Grade	Athletes (Male)			T-test Male Athletes vs. Female Athletes			Athletes (Female)			t	df	p	
	N	M	SD				N	M	SD				
1	24	17,46	8,93				9	16,22	11,03	0,33	31	0,74	
2	20	16,80	6,83				4	16,75	5,12	0,01	22	0,99	
3	18	14,28	6,30				10	21,10	6,49	-2,72	26	0,01	
4	14	15,29	8,54				6	21,33	7,92	-1,48	18	0,16	
Grade	T-test Non-Athletes vs. Athletes (Male)						T-test Non-Athletes vs. Athletes (Female)						
	Non-Athletes			t	df	p	Non-Athletes			t	df	p	
	N	M	SD				N	M	SD				
1	13	19,92	14,65	-0,64	35	0,53	12	25,17	19,61	1,23	19	0,24	
2	4	10,00	5,29	-1,78	22	0,07	17	21,76	11,23	0,86	19	0,40	
3	8	12,00	7,46	-0,80	24	0,43	12	24,92	9,61	1,07	20	0,30	
4	6	12,83	6,91	-0,62	18	0,54	9	20,00	6,18	-0,37	13	0,72	

Legend: number of participants (N), mean (M), standard deviation (SD), T-test value (t), degree of freedom (df), level of significance

By using the T-test none of the statistically significant differences between the means of the N-test results have not been registered in athletes (both men and women), not even in one grade apart from 3rd grade where female students demonstrate the higher degree of neurotic symptom extensity on the level of significance $p=0,01$ (Table 2). The results comparison of 1st and 2nd grade female and male students demonstrate a statistically unsignificant, but quantitatively higher results in the case of male students, while in 3rd and 4th grade situation is reverse, that is, female students achieve higher results by which they demonstrate a higher extensity in the neurotic simptom incidence, in the conformity with reasrch of Bujas et al. (Bujas & Radošević, 1998), which imply on statistically significant higher neurotic symptoms extensity in women of all development stages; from elementary, over high school, to college.

Results of the carried out T-tests (Table 2) did not show statistical significance of the differences in the mean results of the N-test between athletes and non-athletes. The same results were obtained in the male and female subgroups in all four grades.

Disscusion and conclusion

The analysis of the obtained results did not show a significant difference in the neurotic symptoms extensity among the samples of male and female athletes, except in the 3rd grade. The reason could be explained by the fact that students involved in the reasrch participate in different sports and by different qualitative levels. If we agree with the assumption that among athletes exist important differences in the structure of personality according to sport they participate in, what is also proved in the reasrch of Horga et al. (Horga & Bujanović-Pastuović, 1987), than it is not surprising that the quantitative difference of the results obtained by the reasrch (Figure 2) is not statistically significant (Table 2).

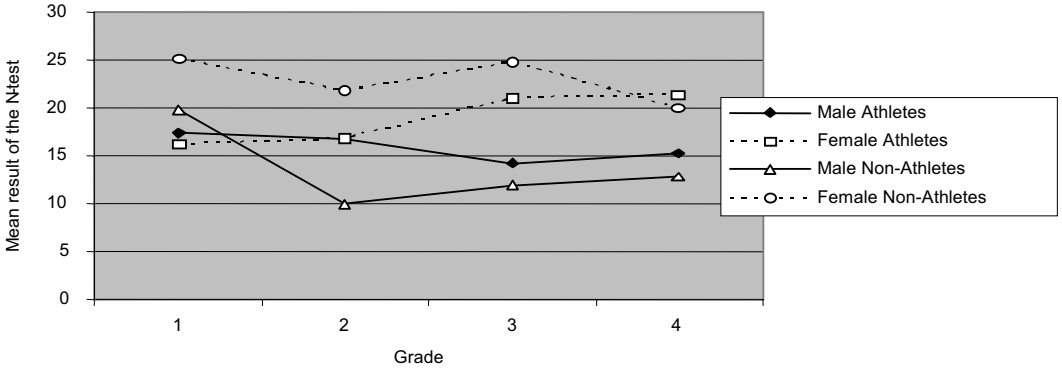

Figure 2. Results of the N-test according to sport and sex

It is also evident that athletes, comprised by this reasrch do not show more significant neurotic symptoms incidence than non-athlete population (Figure 2). The similarity of athletes and non-athletes participants could be explained, in the first place by methodology of athletes sample which did not enable the participants differentiation according to qualitative criteria, that is according to sport rank. The aforementioned corresponds to the results of the reasrch of Horga et al. (Horga & Bujanović-Pastuović, 1987), who by investigating the differences of athletes and non-athletes conative factors did not find statistically significant differences among participants, and the obtained results interpreted exctly as the impossibility of controlling the real involvment of participants in sport and with the fact that ahletes of the lower qualitative level are mostly similar to the population of non-athletes. We also have to take into consideration that the sample of participants comprised by this reasrch, consists of 14 to 19 years old students. Since we deal with the age of sensitive development of all human aspects, it is impossible to expect definitely formed space of conative dimensions, so therefore the unclear boundary in the area of the observed characteristics among the samples of athletes and non-athletes is not surprising.

So, the question which impones is how participating in sport globally influences on the development and the structure of personality, and especially on the development of the neurotic dimension. Three hypothesis are possible, and according to them participating in sport may have or ***positive*** or ***neutrale*** or ***negative*** effect on the development of the aforesaid characteristics (Horga, 1993).

Taking into consideration all relevant facts about forming the sample which did not allow the differentiation of athletes according to rank and type of sport, what definitely affects the structure of personality, it is possible to state that the results of this reasrch are the closest to the hypothesis about the neutral effect of sport activity on forming the personality structure as well as the dimensions of neuroticism. It is obvious that organisational level of sport activity, coverage of population, and competition of other activities might appear as factors which cancel or does not allow the appereance of sport activities conative effects. Also, sport activity represent only one among many possible effects on the dimension of personality. The other influences, such as familiy, school, and other activities, are so numerous and strong that they can mask, cancel, or not even leave any space for the sport activity influences on the structure of personality (Horga, 1993).

The problem of defining genetic determination of conative characteristics imposes in parallel with the previously mentioned. It is absolutely sure that in forming of the personality, a great role have genetic (inherited) and environmental factors, but the question is in which proportion. According to the recent scientific point of view genetic, that is inherited factors are more important (Petz, 2003). It is necessary, in this connection, to ask a question how big are possibilities of isolated sport activity impact on the development of conative dimensions in such a genetic highly predefined antropological space. If we take into consideration a whole series of other environmental factors which determine the development of personality within genetically defined boundaries, it is a logical conclusion that the influence of sport in forming conative dimensions can not have a dominant role. Thus, it is difficult to say whether a sport builds a personality. On the other hand, it is possible to assume that specific features of personality direct an individual in his choice of sport activity, and at the same time they are an important condition of persistence and success in that sport (Horga, 1993).

All in all, conative dimensions or features of personality represent a determinant of human behaviour in all situations, as well as in sport. Hence, it is, in the aim of defining a model of sport success along with studing other factors, necessary to define a conative space and the position of its subdimensions in the system of antropological characteristics.

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THE EFFECTS OF PHYSICAL ACTIVITY ON PERCEIVED SELF ESTEEM IN YOUNG ADOLESCENTS

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Abstract

The aim of this study was to research the relationship between quantity of physical activity, and levels of self esteem in a sample of Italian children. This was done through the administration of Fox's PSPP in conjunction with Bracken's MSEQ. 267 children were involved in the study. The children were all pupils from the region of Vicenza in the north-east of Italy. All participants were first split into six groups based on e physical activity experience in terms of years practiced, and secondly into six groups based on the weekly frequency of physical activity practiced. The first analysis highlighted significant differences between the sexes. Results showed differences in perceived body image, physical condition and global perception of Self.

Noteworthy differences in self esteem also emerged in the second analysis. Particularly noticeable were perceived strength, perceived physical condition, perceived involvement in sport, and perceived global self esteem.

Key words: *children, physical self, body image*

Introduction

As Soenstroem has demonstrated that physical activity is linked to esteem, so Fox and Corbin have contributed to a furthering in understanding of the link between esteem and attraction towards sporting activity.

Studies carried out in 1994 have put forward new conclusions as to how participation in physical exercise is associated with an increase in self esteem rating.

Together with Harter's work in the evolutionary field, these studies have helped direct much needed research into evaluation methods. Amongst instruments currently used to monitor perceived physical Self are Fox and Corbin's Questionnaire, Marsh's PSDQ and the CY-PSPP.

In the relationship between physical activity and self esteem Strauss has demonstrated that the perceived skill in physical activity provides a useful medium through which to strengthen self esteem.

Recent Canadian research echoes this assertion. In a study involving a mixed group of 10 and 14 year olds, Fox's PSPP questionnaire showed boys are more physically active and have a higher perception of their own sporting competence and strength.

Chinese research of a group of 10 to 13 year olds further highlighted differences determined by gender. Through the administering of Marsh's PSDQ specific differences were noted amongst the various age groups (regarding physical ability, reading, and scholastic ability), and according to gender (in interpersonal relationships).

To emphasise the value attributed to self esteem when practising physical activity it is necessary to refer back to the connection between self esteem and motivation shown by Weiss. A decrease in motivation and self esteem has been recorded in children and adolescents in cases of inappropriate physical education programmes. The type of programme followed (e.g finess training) and the choice of modality for the intervention (individual or collective) are two important variables that govern the quality of the expected results.

Using Harter's questionnaire in correlation with an instrument devised by Klint for perceived competence in cricket, Paterson has shown the relationship between self esteem and motivation in a study involving young cricketers.

When considering the lifestyle and habitual behaviours of children and adolescents, benefits of regular physical activity for the development and maintenance of good health are commonly recognised, as is the role of physical exercise in the prevention of chronic disease in high risk groups.

In relation to eating disorders in pre adolescence and adolescence it is clear that sedentariness plays a decisive role in continuing obesity. This has been shown through research using samples of both obese and non obese children, and it is also evident that a choice to increase physical activity levels encourages improved perceived sporting competence and perceived body image in obese children (Isarael et al., 2002).

It is necessary to emphasise that there is significant difference between results recorded for males , and for females, most noticeably in relation to negative attitudes towards eating patterns.

In Germany, in line with what has already been established, research has been carried out into the relationship between physical activity, general Self image, and problematic adolescent behaviours.

Results showed a highly positive relationship between regular physical activity and Self image, furthermore it would seem that adolescents who take part in physical exercise are psychologically more stable and therefore less vulnerable to risk behaviour (e.g drug addiction, alcoholism etc).

In pre adolescent and adolescent girls, physical activity intervention provided positive benefits for those with low self esteem.

As regards younger children, a study into the relationship between physical activity and self esteem has shown particularly beneficial for those with initially low self esteem.

In Italy research into health and lifestyle in 11 – 15 year olds showed a negative link between physical activity and watching TV. (L.Bertinato, M.Mirandola, L.Rampazzo & M.Santinello, 2005). So it can be seen that through physical activity it is possible to positively influence physical , and socio-emotional wellbeing. This in turn can encourage the acquisition of coping skills in the individual, and so the maintenance of a balanced dynamic relationship with their environment.

Conclusions that can be drawn from research show the high probability that physical skill, self perception and self esteem will benefit from the promotion of physical activity, as will interpersonal relationships (Fox ,1997).

Method

Participants. 267 children where involved in the study, 139 male and 128 female aged between 11 to 14 . (M 12,25; SD 0,91).The children were all pupils from the region of Vicenza in the north-east of Italy.

On the basis of data collected from information sheets completed by the pupils, all participants were first split into six groups in accordance with their experience of physical activity in terms of years practiced. The groups were as follows - No experience 29, 1 year 23, 2-3 years 42, 4-5 years 55, 6-7 years 72, and more than 8 years' experience 46. Secondly the sample were divided into six groups in accordance with the number of times per week physical activity was practiced: (No physical activity practiced 26, physical activity practiced occasionally or rarely 23, practiced once a week 25, twice a week 91, three times a week 70, and more than four times a week 32).

Procedure and instruments. Research subjects were selected by their P.E teachers. Teachers were trained how to administer the questionnaires, and were overseen by a tutor during this administration. The objectives of the research were explained to both students and parents, the latter were also asked to sign forms of consent regarding their children's participation. Each pupil was given an information sheet and the PSPP questionnaire (Guiccardi's Italian version - during the study the questionnaire was used in conjunction with Bracken's MSEQ test (Braken, 2003) for further validation.) All data was statistically analysed using Cronbach's Alfa for each scale. The internal consistency of scales for males and females ranged from 81 to 92. Analyses of the correlation between MSEQ and PSPP data was .050, which was considered acceptable. Inferential analyses were only carried out on the PSPP scales.

Results

Data collected from the five PSPP subscales were analysed for internal consistency (Chronbach's alpha range .081 .092), and were submitted to an analysis of correlation with the body subscale of Bracken's MSEQ (Pearson r.50).

In addition the data were analysed by Manova 6 (levels of quantity of physical activity experience) x 2 (sexes) and by Manova 6 (levels of times physical activity practiced per week) x 2 (sexes).

In particular the first analysis highlighted significant differences between the sexes F (1,267)=6.68.000 this was also the case for the second analysis F (5,267)= 3,92 p= .002. No differences between the sexes were shown for physical activity experience quantity levels, and for physical activity duration levels.

Interesting differences did emerge in the Unianova analysis of motor experience quantity levels. Of particular significance were the differences in perceived body image F=(5,267) 3,08 p.002, physical condition F(5,267)=4,24 p.001 (fig. 1) and global perception of Self F(5,267)=2,39 p.038 (fig.2).

There were also significant differences in weekly physical activity practiced in relation to self esteem. Particularly noticeable were perceived strength F(5,267)=4, 47 p.001, perceived physical condition F(5,267)=7.49 p.000, perceived involvement in sport F(5,267)=6.11 p.000, and perceived global self esteem F(5,267)3.23 p.007. For the latter category analysis was also carried out through Bonferroni's post hoc which provided values of significance heightened always in the same direction always between the first and the sixth groups in the following dimensions: Strength .023 condition .000 sport .016 global self .019 (fig.3).

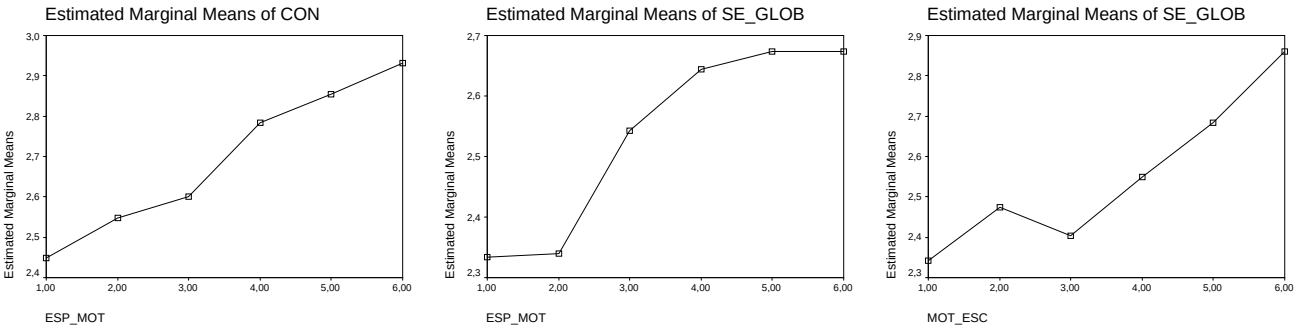

Figure 1, 2, 3. Relation between physical condition, global perception and global and motor experiences

Discussion and conclusion

The quantity of physical activity experience influences perceived body image, physical condition and global self esteem, while perceived physical condition is linked to the quantity of physical activity practiced weekly.

Similar results have been recorded in earlier research. In particular data from the HBSC study carried out in Veneto, north Italy showed that 52 % of a sample stated that they felt physically healthy if they practiced sport three times a week. In general males are more active than females, for the former the level of physical activity increases with age while for the latter the opposite is true. (Bertollo et al. 2001;Bertinato et al., 2005)

A possible future direction for research could involve the analysis of the link between the quantity of physical activity done in the past with the quantity of currently practiced weekly activity.

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ATTITUDES TOWARD DIETING IN NON-ATHLETES AND IN ATHLETES PARTICIPATING EITHER IN COMBAT SPORTS OR SPORTS WITH A MARKED AESTHETIC COMPONENT

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Abstract

General attitude toward dieting scale (Bosnar and Ambrosi-Randić, 2004.) was applied on the group of high school female students. From the total of 327 students, the sample was made including all girls not participating in any sport or exercise activity (n=51), all girls participating in combat sports (n=16) and all girls participating in sports with marked aesthetic component (n=40). Canonical discriminant analysis was done showing one function significant at the level $p<0.05$. The function is defined by eating whatever one wishes, healthy eating habits and diet as a part of healthy life-style at the positive side, and dieting for psychological benefit, buying healthy food, being able to diet easily, and repeated dieting at the negative side. First function discriminate combat sports group at the positive side from sports with marked aesthetic component group at the negative side. The group of subjects not participating in any sport is placed in the middle, being near zero point. It seams that athletes in combat sports developed more acceptable attitude toward dieting than athletes in sports with marked aesthetic component did.

Key words: *female high school students, female athletes*

Introduction

Many people in developed societies diet, and very often they do not do it for health reasons. The special regime of eating can improve health, as in metabolic diseases, but can also lead to very dangerous eating disorders (Bass, Turner, & Hunt, 2001; Halgin & Krauss Whitbourne, 1994). Dissatisfaction with one's body image often leads to weight reducing diets and eating disturbances (Tantleff-Dunn & Gokee, 2002). Specially endangered parts of population are young women and athletes. Although Lavallee, Kremer, Moran, & Williams (2004) warn on increasing incidence of different eating disorders in young male athletes, the incidence of eating disorders is still much higher in female than male population and is much higher in certain sports than in the general population (Schek, 2002). Cashmore (2002) states that prevalence of eating disorders in athletes varies from 4 to 22 per cent, and disorders are mainly in form of anorexia and bulimia nervosa. Weinberg and Gould (1999) consider that accurate assessment of the prevalence of eating disorders is difficult to achieve because athletes are hiding their eating problems. However, they consider that sports, which use classifications based on body weight, like combat sports and weight lifting, and sports where physical attractiveness is important, like rhythmic gymnastic, figure skating, etc., are having greatest prevalence of eating disorders. Plaisted (1995) says that aesthetic appeal of lean figure is crucial in some sports, making participants, mainly female, excessively weight preoccupied. To prevent eating disorders it is necessary to find predisposing factors which are controllable. The attitude toward dieting could be a factor of that kind. The aim of this paper is to analyse the differences in General attitude toward dieting scale items in two groups of young female athletes, from sports which use classifications based on body weight and sports where physical attractiveness is important, and group of girls from the same population not involved in any sport or exercise activity.

Methods

General attitude toward dieting scale (Bosnar and Ambrosi-Randić, 2004.) was applied on the sample of 327 finishing year nature science high school female students. From the total, three groups of subjects were pulled out. First group included all girls not participating in any sport or exercise activity (n=51). Second group included all girls participating in sports which use classifications based on body weight. All of them were combat sports: judo, taekwondo, karate, and kick-boxing, (n=16). Third group was formed including all girls participating in sports with marked aesthetic component (figure skating, rhythmic gymnastic, synchronised swimming, diving, aerobics and dance, n=40). The canonical discriminant analysis was done on the General attitude toward dieting scale items.

Results and discussion

Canonical discriminant analysis show one function statistically significant at the level $p<0.05$ (Table 1). It is defined by items describing eating whatever one wishes, healthy eating habits and diet as a part of healthy life-style at the positive side, and dieting for psychological benefit, buying healthy food, being able to diet easily, repeated dieting, opinion that dieting is healthy and judging one's character regarding eating habits, at the negative side (Table 2). Items describing dieting to reduce weight could be find at both sides of canonical function, and near the null value too. The means and standard deviations in groups and total sample are in Table 3.

Table 1. The results of dicriminant analysis: eigenvalues (E), canonical correlations (R), Wilks' Lambda (Λ), Chi squared value (χ^2), degrees of freedom (df), and level of significance (p)

Roots removed	E	R	Λ	χ^2	df	p
0	.874360	.682997	.323432	97.07383	74	.037537
1	.649543	.627512	.606228	43.04286	36	.195402

Table 2. Standardized coefficients for canonical variable (W) and discriminant factor structure (F) of 37 items

item	CONTENTS	W	F
1.	Repeated dieting for health	.184	-.051
2.	Repeated dieting	-.292	-.100
3.	Dieting to reduce weight	-.195	-.026
4.	Dieting to reduce weight	-.245	.038
5.	All life dieting - positive opinion	-.242	-.080
6.	Negative opinion about gourmands	-.075	.046
7.	Notable knowledge about dieting	-.072	.058
8.	Talking about diets with friends	-.284	-.008
9.	Opinion that media prove importance of dieting	.202	.032
10.	Healthy eating habits	.577	.236
11.	Eating whatever one wishes	.887	.412
12.	No intention to diet	-.252	.048
13.	Opinion that dieting is healthy	-.314	-.134
14.	Able to diet easily	-.352	-.141
15.	Dieting as a way to reduce body toxins	.080	.080
16.	Buying healthy food	-.391	-.095
17.	Reading about diets habit	.357	.125
18.	Negative opinion about number of diet topics in media	.105	.127
19.	Dieting to reduce weight	.140	.046
20.	Dieting for health	.357	.034
21.	Dieting for everybody	-.106	-.110
22.	Diet as a part of healthy life-style	-.340	.029
23.	Diet as a perilous factor during growth	-.219	.030
24.	Dieting to reduce weight	.004	.099
25.	Diet as a part of healthy life-style	.471	.113
26.	Dieting to reduce weight	.200	.122
27.	Dieting for health	.309	.096
28.	Dieting for health	-.194	-.053
29.	Diet as a part of healthy life-style	.370	-.017
30.	Dieting for psychological benefit	-.582	-.121
31.	Taking care of food ingredients	.244	.143
32.	Do not think about diet	.135	.013
33.	Negative opinion about dieting	-.034	-.008
34.	Enjoying the food	-.161	.007
35.	Do not stand overeating	.172	.123
36.	Eating healthy food	-.042	.127
37.	Judging one's character regarding eating habits	-.296	-.117

Dieting to reduce weight do not discriminate neither two groups of athletes nor non-athletes and athletes. Probably, it is due to the fact that dieting to reduce weight is a very common behavior among girls. Up to 80% diet at some point during adolescence (Schleimer, 1983).

Table 3. Means (M) and standard deviations (SD) of attitude toward diet item results in non-participants in sport, in group of participants in combat sports, and in group of participants in sports with marked aesthetic component

ITEM	NON-PARTICIPANTS		COMBAT SPORTS		AESTHETIC SPORTS		TOTAL SAMPLE	
	M	SD	M	SD	M	SD	M	SD
1	1.490	.857	1.375	.806	1.500	.784	1.477	.817
2	1.216	.673	1.250	.447	1.425	.903	1.299	.742
3	1.235	.839	1.250	1.000	1.300	.791	1.262	.839
4	1.961	1.264	2.188	1.276	2.025	1.291	2.019	1.266
5	3.235	1.305	2.938	1.289	3.250	1.296	3.196	1.292
6	2.216	1.154	2.000	1.095	1.925	.888	2.075	1.052
7	1.569	.781	2.188	1.167	1.925	1.141	1.794	1.007
8	1.412	.753	1.625	1.147	1.600	.982	1.514	.905
9	2.098	1.253	1.875	1.147	1.825	1.174	1.963	1.205
10	1.882	1.211	2.250	1.483	1.525	.816	1.804	1.145
11	1.843	1.120	3.125	1.408	1.725	1.037	1.991	1.225
12	2.824	1.381	3.625	1.586	3.300	1.400	3.121	1.439
13	2.824	1.212	2.813	1.377	3.225	1.250	2.972	1.255
14	2.490	1.433	2.375	1.360	2.875	1.324	2.617	1.385
15	2.882	1.107	3.063	1.181	2.800	1.203	2.879	1.147
16	1.725	.896	1.500	.730	1.750	.927	1.701	.882
17	2.569	1.473	2.938	1.289	2.425	1.430	2.570	1.428
18	1.882	1.143	2.313	1.493	1.875	.939	1.944	1.131
19	2.725	1.078	2.625	1.088	2.525	1.012	2.636	1.050
20	1.804	1.059	1.750	1.000	1.675	.971	1.748	1.010
21	3.490	1.155	3.313	1.138	3.650	1.075	3.523	1.119
22	2.392	1.115	2.313	1.078	2.250	1.056	2.327	1.080
23	1.941	1.207	2.063	1.389	1.950	1.154	1.963	1.205
24	2.902	1.136	3.250	1.342	2.900	1.128	2.953	1.161
25	2.706	.923	2.813	1.167	2.525	.933	2.654	.963
26	2.961	1.216	2.875	1.360	2.525	1.198	2.785	1.236
27	2.373	1.199	2.250	.931	2.025	.920	2.224	1.067
28	2.235	1.305	1.813	.981	2.050	1.085	2.103	1.181
29	2.176	.994	1.813	.911	1.925	.917	2.028	.956
30	2.647	.913	1.875	.885	2.300	.939	2.402	.950
31	1.882	1.321	2.000	1.461	1.550	.959	1.776	1.223
32	2.353	1.494	2.313	1.352	2.275	1.485	2.318	1.458
33	3.137	1.077	3.250	1.483	3.250	1.056	3.196	1.128
34	2.098	1.118	2.125	1.147	2.100	1.236	2.103	1.157
35	2.078	1.339	2.688	1.138	2.175	1.299	2.206	1.301
36	2.569	1.418	2.688	1.352	2.250	1.193	2.467	1.327
37	2.216	1.404	1.938	1.237	2.375	1.275	2.234	1.329
	n = 51		n = 16		n = 40		n = 107	

First discriminant function differ group of girls participating in sports which use classifications based on body weight (combat sports) at the positive side, from group of subjects participating in sports with marked aesthetic component, at the negative side. The group of girls not participating in any sport or exercise activity is placed in the middle, being near zero point (Table 4, Figure 1).

Table 4. Group centroides on discriminant functions (D) for the group of non-participants in sport, in group of participants in combat sports, and in group of participants in sports with marked aesthetic component

group	D
NON-PARTICIPANTS	.143906
COMBAT SPORTS	1.861288
AESTHETIC SPORTS	-.927995

The results are rather unexpected. Regarding literature (Cashmore, 2002; Plaisted, 1995; Weinberg and Gould, 1999) eating behavior of athletes is different from non-athletes. It could be expected that athletes should be more alike in attitudes toward dieting also, and differ from non-athletes at the first place. Perhaps the characteristics of sample can explain results. Proportion of weight preoccupied young females is great (Ambrosi-Randić, 2004) and that may be the reason why non-participants in sport are closer to girls practicing rhythmic gymnastic or synchronised swimming than combat sport female athletes are.

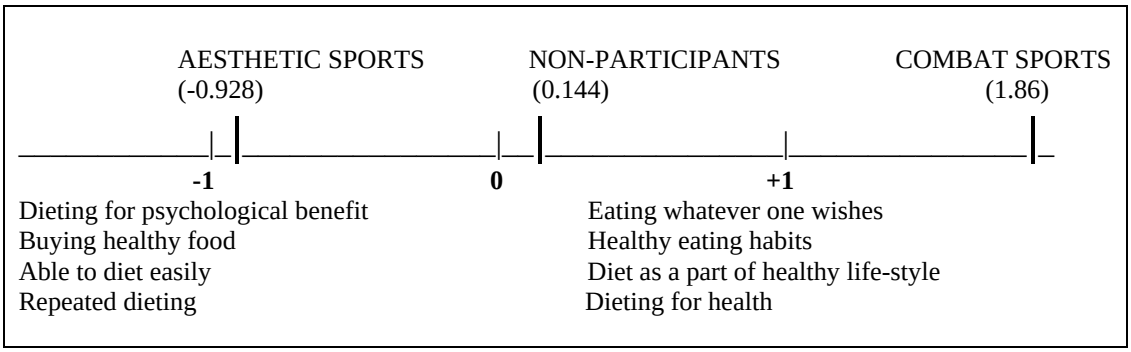

Figure 1. The position of group centroides on discriminant function for the group of non-participants in sport, in group of participants in sports which use classifications based on body weight (combat sports), and in group of participants in sports with marked aesthetic component.

The greatest coefficient value at positive side of discriminant function (Table 2) is for item 11 regarding eating whatever one wishes. The other visible values are for items regarding dieting for health and dieting as a part of a healthy life style. On the other side, the greater negative value is for item 30 regarding dubious dieting for psychological benefit. It seams that athletes in combat sports developed more acceptable attitude toward dieting than athletes in sports with marked aesthetic component did.

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RELATIONS OF THE HYPOTHETICAL DIMENSIONS OF THE PERSONALITY AND PERFORMANCE SUCCESS OF SITUATIONAL-MOBILITY TESTS OF BASKETBALL PLAYERS 14-16 YEARS OLD*

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Abstract

With fortification aim of relation and importance of conative dimensions of personality to performance of success of the situational-mobility tests exams at the basketball, there are analyzed results of 122 players samples. They can be accepted as selection samples.

At the area of conative regulators four scales for measurement of aggression, anxiety, inferiority and morality are applied. At the area of specific mobile basketball capability there are 12 exams applied. They intend to be measured in four segments of technical, basketball skills, actually to the estimation of four latent dimensions: precision of handing ball, leading ball, shooting accuracy and moving of the player without ball.

Key words: *Basketball, conative dimensions, situation mobility and regression*

Introduction

Institutionalization of sports mode of exercise, different approaches of selection and difference of successful and non successful, extremely big deposits and interest, inevitably led to more attention to the structure of athletes personality and it's relation to the sports. Complexity of functional relations between sports and personality is specially dominated when the subject is top sports where is the high level of equalization of competitions by all relevant measurement of sports readiness preparatory – physical, technical, tactical and psychological.

In that kind of situation psychological readiness in the sense of having potentials to overcome tasks of sports activities is essentially important.

Methods

Tested Sample

Research was conducted at the sample of 122-basketball players range, 14-16 years = M, of age old.

In research are included only those players who have certified registration from Basketball Federation of BH, Canton Sarajevo, according which they can participate into the system of competition provided for their ages.

Examined samples have health cards in their clubs, according which they could have adequate healthy status. These scales are applied:

1. CORAM – Scale for conformity rationalized no-morality
2. SCAT – Scale for measuring characteristics of sports anxiety
3. AG 30 – Scale for estimation of sports aggression (scales applied from collection item MK240)
4. COMPIN – Scale of complex inferiority

Based on results of so far researches in which tested instruments for examination of existence of anxiety, aggression, morality and inferiority constructs there has been chosen 4 measurable instruments and questionnaire of social status characteristics (Bajraktarevic, J , 2001).

Variables for Estimation of the Specific Mobile Basketball Abilities /Situational .Mobile Tests/

All tests are done in conditions of game 1:0, without opponent, but limited with time and space. So we have got important information about degree of some automatic uncontrolled elements of basketball techniques.

In the space of specific basketball abilities it is applied battery of tests that consists next segments of situational mobile skills (Blaskovic, M., Milanovic, D., Matkovic, B., 1982):

* *Young researcher award*

1. SMKOS30 – Movement in defense posture for 30 seconds
2. SMDEFM – Movement in defense
3. SMSKBT – Running forward – backward
4. SMPASS – Adding
5. SMSKEP 1 – Elevation precision of adding ball with one hand aside
6. SMSKHOR – Horizontal precision of adding ball with both hands from chest
7. SMD20 – Dribbling 20m
8. SMKAMSL – Kamikaze with ball
9. SMCD – Control of dribbling
10. SMH30 – Penetration (breach) to the basket …for 30 sec.
11. SMS5SP50 – Shooting from outside positions for 50 sec.
12. SMSSH60 – Fast combined shooting for 60 sec.

Interpretation of Results and Discusion

With aim to confirm influence of predictor system of variables for estimation of dimensions to the criteria of set variables that is defined by situational mobile tests – it has been done regression analysis on two levels (Radjo, I., & Wolf, B., 2002):

I level criteria: Complete set of variables for estimation of success performance of situational mobile tests

II level criteria: Isolated latent dimensions that define four areas of situational mobile variable area

Multiple coefficient co-relation is R = .88, and determination coefficient is .60, which explains summary of variable predictor system and criteria variables about 60% of total explained variables.

Aggression

Table 1. Isolated predictor variables of aggression with high co-relation coefficient

4.Predictor variables – aggression	p-level
6. From time to time I have strong need to do something harmful or unheard.	,027186
14. I easily infuriate and that passes quickly .	,037256
16. It happens that without thinking I did something that I regret later.	,054758

Aggression prediction to success performance of situational mobile tests is characterized by isolated variables with high co-relation coefficient in criteria sets of variables on a global and partial level. Aggression expresses most predictor value of the basketball performance of technical elements in case that it is present in optimal, constructive level. If it is present only on manifest level in form of mask hiding other negative dimensions it is contra-productive and has negative transfer to:

Precision of shooting to the basket, that belongs to the most important efficiency standard demonstration of basketball game

- Dribbling control in all phases of game;
- Defense tasks in game,
- Realization of assistance.

In theoretical sense connectivity of predicting variables for the estimation of aggression with set of variables that refers to the precision, adding ball is defined like fear at the latent level.

It is connected with responsibility for performance of this task (Horga S., 1993).

Result of possessing manifest aggression with fear at the latent level that represents accelerator of energy is evident through non-precise and non-timely adding of ball to a teammate, especially in stressful situations during training and match.

It is important to emphasize that aggressiveness of basketball players during performance of technical elements which is connected with player's movement without ball expresses in two ways:

- As positive aggressiveness with optimal intensity;
- As negative aggressiveness that is masked with other manifestations in most cases.

Example: In last and decisive attack with dribbling player has to start action but exactly on the quality of that dribbling performance depends further progress and issue of that action.

Anxiety

Table 2. Isolated predictor variables of anxiety with high co-relation coefficient

2. Predictor variables -Anxiety	p-level
5. While committing I am anxious about making mistake.	,016842
1. Competition against others is generally pleasure.	,043804

Isolated predictor variables that determine area of anxiety at the best way represent influence of this dimension of personality to the specific mobile ability. That influence is defined as:

Fear of responsibility in decision moments that manifests through wrong performance of some elements /i.e. "technically poor dribbling", wrong and non-timely assistance, hiding at the situation of movement without ball, non-precise and non-secure shoot, etc./

Anxiety represents one of the *main psychology inhibitors* of successful realization of technical elements in stressful situations at the court.

Concerning assistance influence is mostly reflected through decision-making in bit of the second. Importance of that influence approves at the best way fact that i.e. during the games often happens that at the bit of second late pass at the final moment is decisive factor. Game result of that team depends on that.

In case we look connection of those two sets through isolated variables of anxiety ("While competing I am anxious about making mistake!"), we could make general conclusion that quality and precision of adding ball depends on player's decision in a bit of second - to perform adding or not. From the other side that decision is connected with psychological moment of acting:

- Will the player release the ball as soon as possible because he is not self-confident and to be less responsible;
- Player will be late with assistance, because of fear to make fast decision.

Morality

Table 3. Isolated predictor variables of morality with high level of co-relation

1. Predictor variables -Morality	p-level
12. They tell me I can present myself to the people very well so they are always ready to help me.	,003675
18. It is very important in life to grab right moment for acquires, so that will release us from later constant boredom.	,016204
8. If I am trustable, sober, honest, it worth that others know that.	,029822
9. Real friendship rises only in childhood.	,035214
27.I did so much for my friend still now so I can expect from them to gat back all what I want.	0.44311

Predictor variables that are isolated with high coefficient of co-relation characterize influence of morality to the success of performance of situational mobile elements that we can interpret as:

Conscious of players is visible through steadiness for performance of individual elements techniques only at the theoretical level. It is not that case at the court. That is consequence of latent anxiety and little bit of presence of player's inferiority.

Ethical codex of player's behavior reflexes like relation to the performance of elements of basketball techniques at the trainings and competitions.

That relation is connected exactly with motivation energy that is necessary for big number of repetitions in the phase of complex mobile structures. Manifested form of connection is identifiable in game interruptions /i.e. during time-out at the game/, when coach could register this form of negative modality of behavior of player at the best way.

Through direct performance of some elements of situational mobility /i.e. player's movement without ball/, basketball players could skillfully camouflage manifest forms of expressing immorality that they have in form of hiding behind defender in a phase of attack at decision moment of the "fracture" result.

Inferiority

Table 4. Isolated predictor variables of anxiety with high co-relation coefficient

3. Predictor variables -Inferiority	p-level
13. I give up easily even when others think I am doing well.	,000340
23.When I have to show action I usually fail.	,002810
15. Even when they tell me it's good what I am doing I usually underestimate my work.	,010468
24.I often do not manage when something new happens because I don't know to give the best I can.	,055796

Interpretation of inferiority as a predictor through isolated variables with statistically important co-relation coefficients in connection to success of performing situational mobile elements reflects through further presented manifestations.

We can monitor influence of inferiority on four isolated variables of situational mobile area through synchronization effect with anxiousness and immorality that together represent main inhibitor of successful performance of technical elements in basketball. Those elements need timely steadiness, quickness of reaction and precision.

Very often players whose inferiority dominate in area of conative regulators and in specific situations do not invest maximum of energy into the movements without ball. That leaves negative transfer to:

- Attack actions where they don't come into the open position;
- Defense actions where they surrender quickly, in game 1:1.

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A CROSS-CULTURE ANALYSIS OF POSITIVE ILLUSIONS AND SPORT PERFORMANCE LEVELS IN AMERICAN, CROATIAN, AND NORWEGIAN BASKETBALL PLAYERS

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Abstract

The current study examined levels of positive illusion in relationship to basketball performance among 122 male players from the United States of America, 57 male players from Croatia, and 60 male players from Norway. Subjects signed an informed consent form and their scores were code-linked in order to protect anonymity. Performance of basketball players was measured by the Basketball Evaluation System (BES) (Swalgin, 1998), a computerized performance evaluation model that grades player performance in relationship to position-of-play and minutes-played The results of the present study indicate that the construct of positive illusion operates in a similar manner across the sampled cultures (i.e., there was no statistical difference in levels of positive illusion among the three different cultures of basketball players sampled). These findings support the robustness of the scale and the pervasiveness of positive illusion as a psychological construct. One striking feature in the data revealed a very strong connection across all the cultures sampled in the domain of "Illusion of Control". This particular cognitive characteristic was extremely prevalent in all teams across all cultures measured.

Key words: *positive illusion, basketball performance*

Introduction

The term positive illusion represents a multidimensional psychological dimension consisting of the following three sub-constructs: self-aggrandizement, illusion of control, and unrealistic optimism (Taylor & Brown, 1988). Self-aggrandizement is the perception of one's self, one's past behavior, and one's enduring attributes as more positive than is actually the case. Illusion of control is an exaggerated belief in one's personal control, involving the perception that one can bring about primarily positive but not negative outcomes. Unrealistic optimism is the perception that the future holds an unrealistically bountiful array of opportunities and an absence of adverse events. These positive illusions are common in mentally healthy individuals and become especially important in the athletic arena (Catina & Iso-Ahola, 2004).

The theory of positive illusion has been well established in the literature, but an assessment tool that measures positive illusion has only recently begun to be recognized. The implementation of a theory-based instrument assessing the factors that influence levels of success in sport is necessary to understand the role of positive illusion in sport-performance outcomes. Although a host of psychological factors examined in the literature such as anxiety, hardiness, locus of control and intrinsic motivation offers insight into explaining sport performance (Iso-Ahola, 1995), positive illusion has not been fully addressed as a variable influencing favorable outcomes in sport.

Other studies, of course, have shown differences in athletes and differences in cultures thus extending our knowledge about how cultures may, for example, influence perception and motivation. The current study has extended the universality of the Positive Illusion Sport Scale in important ways. Previous research using the scale with individual sports has revealed emerging patterns that are similar to those found in team sports. The current study brings to light a striking resemblance in the mental aspect of athletes from three different cultures. Namely, levels of positive illusion are consistent in basketball players from the USA, Croatia, and Norway. Additionally, the way in which positive illusion operates as a predictor variable for success is a common thread both within and between each of the cultures sampled.

In relation to fear of failure, there is an extreme sense of shame which is marked by personal inadequacy, diminished sense of control, and a sense of worthlessness. These negative feelings can be overcome by adopting positive illusions. This type of cognitive adaptation is based on fostering emotional adjustment by instilling a sense of optimism and regaining a perception of control over one's life. Since there is a sense of mastery which can be gained through the use of positive illusion, it stands to reason that there is a strong and positive relationship between the construct of positive illusion and the constructs of self-esteem and optimism.

For example, Taylor (1983) advances that the adjustment process of cancer patients is centered around three themes: a search for meaning in the experience, an attempt to regain mastery over the event, and an effort to restore self-esteem

through self-enhancing evaluations. Other researchers have found similar attributes. Helgeson and Cohen (1996) suggest the following five psychological mechanisms that facilitate emotional adjustment to having cancer: enhancement of self-esteem, restoration of perceived control, instilling of optimism about the future, provision of meaning for the experience, and fostering of emotional processing. A positive sense of self, a need for control, and an optimistic view of the future facilitate normal mental functioning (Taylor & Brown, 1988). This positive sense of self becomes especially important in the face of threatening social feedback (Taylor, 1983; Taylor & Brown, 1988; 1994; Taylor & Armor, 1996; Taylor & Aspinwall, 1996). Many of the cognitive mechanisms that are present in the minds of athletes are congruent with the research literature on positive illusion. For example, Taylor (1983), proposes that the diagnosis of cancer leads to a sense of personal inadequacy, diminished sense of control, increased feelings of vulnerability, and a sense of despondency and that these negative feelings can be overcome by adopting positive illusions. This can easily be seen within the realm of fear of failure in athletes and the consequences of such failure.

Concerning performance outcomes in sport, the construct of positive illusion provides a coping strategy for failure through a positive view of the self and an elevated belief in personal control. Current research is focused on whether or not these self-enhancing beliefs may increase the likelihood of success in sport (Catina & Iso-Ahola, 2004). The substantiation of the scale will provide empirical evidence to better understand the relationship between positive illusion and sport performance. Since the athlete's psychological mindset is widely regarded as influencing his or her behavior in sport, more assessment tools are needed in order to broaden the understanding of the mental components that facilitate success in sport. In regard to the present study, the researchers hypothesized that levels of positive illusion would be commensurate with levels of performance in basketball players across different cultures.

Research Methods and Materials

Sample of Subjects. The current study examined levels of positive illusion in relationship to basketball performance among 122 male players from the United States of America, 57 male players from Croatia, and 60 male players from Norway. Subjects signed an informed consent form and their scores were code-linked in order to protect anonymity. The total pool of subjects ranged in age (18-36). Ranges in age were noticeably different among the 3 countries since it is not as unusual to have players over the age of 25 in Croatia and Norway, as it is in the United States. Performance of basketball players was measured by the Basketball Evaluation System (BES) (Swalgin, 1998), a computerized performance evaluation model that grades player performance in relationship to position-of-play and minutes-played. Seasonal statistics were used for each player evaluated. Originally, a low number (15) of subjects had to be eliminated because they reported data for the Scale but did not report data for the BES due, in part, by not completing the season. The participation rate in this study was exceptionally high at (95%) indicating sound methodology in inventory distribution and data collection.

Instrumentation. The Positive Illusion Sport Scale is a 23-item, theory-based inventory that measures individual differences in positive illusion in an athletic population. Convergent and discriminant validities were assessed by correlating scores from the Positive Illusion Sport Scale with scores of self-esteem (Rosenberg, 1965), hopelessness (Beck & Steer, 1978), optimism (Sheier & Carver, 1985), and depression (Beck, Rial, & Rickels, 1974).

The Positive Illusion Sport Scale showed a moderate positive correlation with self-esteem and optimism and a moderate negative correlation with hopelessness and depression. The internal consistencies for the Self-Esteem, Optimism, Hopelessness, and Depression scales are high with alpha coefficients of .88, .89, .90, and .90 respectively. Cronbach's alpha indicated high internal consistency for the Positive Illusion Sport Scale at .84. These findings demonstrate considerable convergent and discriminant validity for the instrument and indicate that it is psychometrically accurate for research purposes.

Procedure. The Positive Illusion Sport Scale was administered to basketball players in the Untied States, Croatia, and Norway through their respective coaches. The protocols were such that a blind data collection method was established in order to prevent research bias. Namely, the researchers kept the scores from the psychological inventory separate from the basketball statistics until all data had been recorded. Scores from the Positive Illusion Sport Scale, a patented, internally consistent, 23-item psychological inventory (Catina, 2000) were correlated to scores from the Basketball Evaluation System, a standardized grading system for basketball performance based on position of play, time played, and game conditions (Swalgin,1998).

Table 1. Descriptive Statistics and Cronbach's Alphas for Convergent and Discriminant Validity Assessment of the Positive Illusion Sport Scale and Related Constructs

Scales	Mean	Standard Deviation	Cronbach's Alpha
Positive illusion	44.60	7.32	.84
Self-esteem	24.25	4.06	.86
Hopelessness	15.37	6.33	.86
Optimism	16.35	3.36	.83
Depression	5.07	6.49	.91

Results

A positive linear relationship was found between positive illusion scores and basketball evaluation system scores, which supported the directional hypothesis. Moderately positive Pearson Product-Moment Correlations (r) between positive illusion and basketball performance levels were as follows: USA (r)=.320, Croatia (r)=.532, Norway (r)=.403.

A subsequent analysis was conducted to see if there were cultural differences in levels of positive illusion. The Chi-Squares test was selected because sample size and level of measurement called for a distribution-free, non-parametric test to measure differences in positive illusion rank across the different cultures sampled. Multiple T-Tests were not appropriate due to sample size variation. A Chi-Square (X^2)=45.967 with 46 degrees of freedom (df) was calculated for USA. The critical value needed to reach statistical significance was 61.54 (Bordens & Abbot, 1998, appendix A-15). Calculations for Croatia were (X^2)=21.25 with (df)=30 against a critical value of 43.77. Calculations for Norway were (X^2)=24.10 with (df)=28 against a critical value of 41.33. Since none of the Chi-Square statistics even approached critical values, differences in positive illusion across the different cultures sampled were not statistically significant at p>. 05 (see Table 2). This indicates that the construct of positive illusion operates in a similar manner across the sampled cultures.

Table 2. Non-Parametric Test Statistics for Positive Illusion in USA, Croatia, and Norway

	USAPI	CROATPI	NORWAYPI
Chi-Square	45.967	21.250	24.100
Df	46	30	28
Asymp. Sig.	.474	.880	.676

A factor analysis was conducted to identify underlying variables, or factors, that could explain the pattern of correlations within the set of observed variables form USA, Croatia, and Norway. A Principal Components Analysis (EQS, Bentler, 2004, version 6.1,) using an orthogonal Varimax rotation identified the factor "Illusion of Control" that explained most of the variance observed in a much larger number of manifest variables. This technique is helpful in generating hypotheses regarding causal mechanisms within the multi-dimensional construct of positive illusion.

As outlined above, positive illusion has three sub-constructs that were reflected in three sub-scales during scale construction: The illusion of control sub-scale is a 9-item scale used to assess exaggerated beliefs of personal control. The self-aggrandizement sub-scale is a 5-item scale designed to assess overly positive self-perceptions, and the unrealistic optimism sub-scale is a 9-item scale measuring unrealistically optimistic views of the future. These measures were combined to form an aggregate score for positive illusion. The purpose of structure detection is to examine the underlying relationships between the variables.

Of particular interest is the consistency in which "Illusion of Control" accounted for most of the variance across all of the cultures sampled. There was also an exceptionally strong similarity between USA and Norway in the domain of "Illusion of Control" with the USA and Norway reaching Eigenvalues of 1.899 and 1.874 respectively. Each of these values in "Illusion of Control" accounted for 63.291% and 62.478% of the respective variance in the sample (see Tables 3, 4, & 5).

Table 3. Total Variance Explained USA Basketball

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.899	63.291	63.291	1.899	63.291	63.291
2	.641	21.370	84.660			
3	.460	15.340	100.000			

Extraction Method: Principal Component Analysis.

Table 4. Total Variance Explained Croatia Basketball

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.387	46.244	46.244	1.387	46.244	46.244
2	.934	31.121	77.365			
3	.679	22.635	100.000			

Extraction Method: Principal Component Analysis.

Table 5. Total Variance Explained Norway Basketball

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	1.874	62.478	62.478	1.874	62.478	62.478
2	.649	21.638	84.116			
3	.477	15.884	100.000			

Extraction Method: Principal Component Analysis.

Discussion

These results provide support for the reliability and validity of the Positive Illusion Sport Scale as a measure of positive illusion in competitive athletes. The current study increases the test-retest reliability for the Positive Illusion Sport Scale since it has been widely used in other sports. However, this is the first attempt at establishing cross-cultural validity, which makes this study particularly rich. Obviously, more research is needed to further validate the measure, especially if it is to be used for teaching and cultivating positive illusion in athletes who may have low levels in this cognitive dimension.

Further sequencing of these statistical procedures can be justified by the successful demonstration of the utility of the scale in a sport performance framework (Catina & Iso-Ahola, 2004). Given that no other scale of positive illusion exists, cultivating this new measure is necessary to create and employ predictive models for researchers to further assess its utility across a broader range of sport contexts. The Positive Illusion Sport Scale evolved from an empirical thrust specifically intended to create a scale with unique structural and construct validity qualities. Conceptually, the scale is based on the well-established theory of positive illusion which may have a high degree of relevance to researchers interested in understanding more about the role of this cognitive construct in human performance. This strongly suggests the potential value of refining the scale to capture the performance levels in other areas including but not limited to business, organizational psychology, drug rehabilitation, weight management, and relationship counseling.

Conclusion

Much of cross-cultural psychology focuses on describing the psychology of different groups of people without attempting to explain the cultural basis of these psychological differences. Therefore, it is either misunderstands the manner in which cultural factors shape psychology or fails to address those factors completely. For example, self-efficacy is widely noted in the research literature, however, little research has been done to examine it from a cross-cultural perspective. Self-efficacy is a powerful predictor for performance, especially sport performance. Self-efficacy expectations are beliefs that one can successfully execute behavior required to produce particular outcomes (Bandura, 1977). They derive from the relationship between one's perceptions of self-competence on a particular dimension and the relevance of the dimension to the task being confronted. Positive illusions enhance the self-concept indirectly through increasing self-efficacy. Consequently, this provides the athlete with the affirmative belief system needed to overcome the odds or to cope with extreme adversity which is inherent in athletic competition.

So many of the cultural variables examined by cross-cultural psychologists are abstract in that they are devoid of concrete content which reflect a specific domain. This type of abstraction results when a factor is confused as a variable with a singular fixed character. The development and use of psychological instruments are ways to reduce or eliminate this confusion. The Positive Illusion Sport Scale is a concrete measure which defines itself as a psychological factor that is qualitatively invariant and only varies quantitatively.

The results of the present study indicate that the construct of positive illusion operates in a similar manner across the sampled cultures (i.e., there was no statistical difference in levels of positive illusion among the three different cultures of basketball players sampled). These findings support the robustness of the scale and the pervasiveness of positive illusion as a psychological construct. One striking feature in the data revealed a very strong connection across all the cultures sampled in the domain of "Illusion of Control". This particular cognitive characteristic was extremely prevalent in all teams across all cultures measured.

Many analysts find obvious ways in which cultures are different. The present study has found one way in which cultures are similar. Thus, implicating to some extent, that athletes are similar, especially from a psychological perspective. The construct of positive illusion seems to have cross-cultural validity and is a universal personality dimension both from a theoretical perspective as well as a practical perspective.

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SOCIO-PSYCHOLOGICAL PERSPECTIVE ON TRAUMATIC RETIREMENT FROM SPORTS

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Abstract

Social support and interpersonal relationships play significant role in athlete's adaptation to sports career termination and adaptation to post-sports life. Although majority of athletes relatively easily adapt to retirement from sports, a small percentage of athletes is faced by severe and frequent difficulties on psychological, physical, psycho-social, and socio-economic level. The aim of the study was to qualitatively investigate the role of socio-emotional support and interpersonal relationships in the process of severely difficult retirement from elite competitive sports. Three participants who experienced traumatic sports career transition were interviewed. The content analysis showed that socio-emotional support and interpersonal relationships with significant others play, together with other factors, a significant role in the quality of their adaptation to post-sports life.

Key words: *sports career transition, traumatic, social relationship, support, elite sport, psychological difficulties*

Introduction

Sports career transition (SCT) and adaptation to post-sports life as the last stage of sports career is characterized by a set of specific demands requiring adjustment by athletes. Life-span perspective on the athletic career, proposed by Wylleman & Lavallee (2004) acknowledges the strong concurrent, interactive and reciprocal nature of normative transitions occurring in the athletic career and those transitions occurring in other domains of athletes' lives (e.g., academic, psychosocial, professional). According to the model of human adaptation to transition as proposed by Schlossberg and associates (Schlossberg, 1981; Schlossberg, Waters, & Goodman, 1995), a transition is "*an event or non-event which results in a change in assumptions about oneself and the world and thus requires a corresponding change in one's behavior and relationships*" (Schlossberg, 1981, p. 5). Although the onset of a transition may be linked to one identifiable event or non-event (i.e., an event that an individual had expected but which did not occur, thereby altering one's life), transitions are a process that are influenced by four major sets of factors referred to as situation, self, support, and strategies (Schlossberg, Waters, & Goodman, 1995).

The review of relevant literature reveals a notable dilemma regarding the difficultness of retirement from sports process. According to the older theoretical approaches, namely thanatological and socio-gerontological SCT is defined as an explicitly difficult and traumatic experience meaning that vast majority of athletes suffer from severe difficulties at adjusting to the post-sports life. More recent theoretical approaches (e.g., conceptual & transitional theories) comprehend SCT and adaptation to post-sports life as a natural and expected developmental stage of sports career. They describe SCT as a significant life event that influences former athletes' well-being and development (e.g., Wylleman, De Knop, Menkehorst, Theeboom, & Annerel, 1993). It can be followed by positive changes and not only by traumatic experiences (Alfermann, 2000).

Social support and interpersonal relationships play significant role in athlete's adaptation to SCT and post-sports life (Cecić Erpič, Wylleman, & Zupančič, 2004). There are several empirical evidence on the significance of socio-emotional support system during adaptation to retirement from sports (e.g., Coackley, 1983; Svoboda & Vanek, 1982, both in Cecić Erpič, 2002). Athletes who have more support from significant others adapt to post-sports life more smoothly and with less difficulties (for overview see Wylleman & Lavallee, 2004). Although majority of studies examined socio-emotional support from significant others, institutional support also has to be emphasized. It is of a great importance, that sport association, club, NOC or other sport-related institutions provide retiring athlete with support (Lavallee, 2000).

From the synthesis of SCT literature (Wylleman, 1995) it can be concluded that 85% of athletes experience relatively successful, smooth and non-traumatic transition out of elite competitive sports. Other 15% of athletes experience different and variously intensive difficulties at psychological, physical, psychosocial, and/or occupational level (for detailed description see Cecić Erpič, 2002; Lavallee, 2000). After retirement from sports, athletes may experience difficulties at psychological (e.g., identity crisis, loss of self-worth, decrease of self-esteem, decline of life satisfaction, emotional problems) and psychosocial (e.g. social and cultural loneliness, problems concerning engagement in new relationships outside of sports) level. SCT may be accompanied by physical difficulties (e.g., injuries, health problems) and difficulties

at occupational level (e.g. lack of an occupational career, less suitable professional career choices, decline in financial income).

The aim of the study was to qualitatively investigate the role of socio-emotional support and interpersonal relationships in the process of severely difficult retirement from elite competitive sports.

Method

Participants. The qualitative study included three participants who reached the highest scores on the Total scale of sports career transition difficulty of The Sports Career Termination Questionnaire (SCTQ; Cecić Erpič, 2000) among 85 elite former Slovenian athletes (M_{age}=29.02 yrs, SD_{age}=5.24 yrs; 63.5% males, 36.5% females; average SCT – 3 yrs ago).

Participant A: 23 years old female, former elite alpine skier with higher educational status. She ended her career 4 years ago; SCT was involuntary and abrupt.

Participant B: 35 years old male, former elite volleyball player with lower educational status. He ended his career abruptly and involuntary 3 years ago.

Participant C: 26 years old female former elite handball player with higher educational status. She ended her career voluntarily and abruptly 2 years ago.

Instruments and Procedure. A semi-structured in-depth interview schedule was designed to elicit qualitative characteristics of traumatic SCT. Interview about Traumatic Sports Career Termination (Cecić Erpič, 2000) investigates one's active sports career and life of an athlete, the termination of the sports career, factors influencing SCT, difficulties experienced during SCT, and organization of the post-sport life.

The interviews were conducted in athlete's homes and were recorded on tape and then transcribed in complete detail. Answers were analyzed using the Checklist for coding traumatic SCT (Cecić Erpič, 2000). Qualitative analysis of SCT was obtained by content analysis.

Results

The content analysis showed that socio-emotional support and other social-relationship issues significantly influence the characteristics of sport career termination. Social-relationship aspects affect all stages of SCT of all three respondents. Further analysis showed that two patterns of each SCT stage were found. The first one is characteristic for both female participants and the other one for a male former athlete. It has to be stressed out that the answers represent their subjective interpretations of SCT and therefore could not be considered as objective information.

Characteristics of active sports career.

1st pattern: Both female athletes attended school during their active sporting years and were university students at the peak of their careers. They were financially independent from sport as they were still living with their parents who provided financial resources during the sporting years. They both had very strong athletic identity. All other social roles and spheres of life (e.g., education, social life, family, & vocation) were subordinated to sports. Post-sports life was not explicitly planned during the active sports career

2nd pattern: It is characteristic for the male participant. He didn't educate himself during his lengthy career. He was financially dependent on sport as he was employed by the club with regular monthly salary. He identified himself exclusively as an athlete and was entirely committed to sport. Besides sport, he had no other social roles. During the active career, he didn't plan his post-sport life.

Sports career transition process.

1st pattern: Both female former athletes terminated their careers due to the combination of several antecedent factors. The lack of support from coach combined with injury led to not achieving the athletic goals, which resulted in the deselection from the team. Both participants had poor interpersonal relations with their coaches as they expected support during the injury rehabilitation process. SCT, which was voluntary, was also influenced by non-athletic transitions (i.e., decision to commit to education and vocational opportunities).

2nd pattern: The oldest among three respondents terminated his career entirely involuntarily. The process of deselection from the club was the only antecedent factor that influenced SCT. The end of competitive career was very abrupt and respondent did not have enough time to plan post-sports life. He had no support from coach and sport-related institutions. During SCT, he divorced his wife and she later got custody over their young daughter.

Difficulties during SCT.

Analysis of answers shows that respondents confronted themselves with numerous and relatively intense difficulties on different levels. Difficulties during SCT can not be linked together in a pattern, because respondents do not comprehend them in a mutual and interacting relation.

All three respondents experienced severe identity loss and problems with forming a new identity. While committing to the new social roles (related to family, vocation, education) they experienced difficulties because they didn't identify themselves as athletes anymore. All three respondents missed sports and athletic lifestyle. They felt competent only in the sports related areas, had financial difficulties and problems as had to start the new activities from the beginning. They had a little socio-emotional support from their families but none from the coaches or sport-related organizations. A male participant was divorced at the time, living with his parents who also had to cope with their adult son's moving back to their household and consequently with his adaptation to SCT. With no financial resources, he was dependent on parents' low pensions.

Organization of post-sport life.

All three respondents are relatively dissatisfied with post-sports life. They don't have any new significant social roles and still identify themselves with the role of an athlete although they are not competing for more than three years.

1st pattern: Both female participants engaged in sport non-related activities (study, vocation) shortly after SCT. They would like to be engaged in sport non-professionally but don't have the opportunity yet. They both have partners who are providing them socio-emotional support in organizing post-sports life.

2nd pattern: Male participant is significantly dissatisfied with current post-sports life. He is unemployed, without partner and wishes to find new professional opportunity in sports, which is relatively difficult to accomplish. He does not have any particular support system. Majority of his friends are still active athletes who have different problems than him and therefore not a very reliable support source. Participant's family is not very supportive. Parents see that he should focus his attention on something else than his already passed career, such as finding job and becoming independent of their financial resources.

Discussion

Respondents' subjective interpretations showed that traumatic SCT results from a combination of risk factors. The results showed that socio-emotional support and interpersonal relationship with significant others play an important role in the quality of adaptation to post-sports life. During the retirement process, all three respondents had little support from their families and friends. Although received support doses not guaranty the smooth transition, it plays an important role in athlete's adaptation to changes that occur during the retirement process (Schlossberg, 1981; Schlossberg, Waters, & Goodman, 1995). However, it has to be emphasized that none of three respondents have had any support from their long-time coaches and sport-related institutions. The other significant risk factor for difficult transition is strong athletic identity during and after active competitive career. Identity related problems during SCT process have been emphasized by several authors (for overview see Brewer, Van Raalte & Petitpas, 2002). Results of several studies show that explicit identification with one role is the risk factor for difficulties in adaptation to new social roles. The risk factors that have to be emphasized are the lack of post-sports life planning and dissatisfaction with current post-sports life. Analysis of their answers shows that dissatisfaction derives from lateness in establishing developmental tasks of early adulthood (Cecić Erpič, 2002).

Conclusions

A minor percentage of athletes experience severe psychological difficulties during the retirement from elite sports. Since socio-psychological aspects play a significant role in their adaptation process, development and retention of support network should be emphasized. Results of presented case study emphasize the necessity of psychological help during SCT. Such program should help retiring athletes with post-sports life planning already during active sports career as well with the identity development during SCT and adaptation to post-sports life. Since athletes expect the support from coaches and sport-related institutions but actually don't receive it, the emphasis should be put on the coaches' education and their expected role in the process of sports career termination.

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EFFECTS OF SPORT ACTIVITIES ON SELF-CONCEPT OF OPIATE ADDICTED PERSONS

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Abstract

The goal of the research was to determine possible differences in self-concept through involvement in physical exercise and sport between opiate addicts and non-addicts. A 13-item questionnaire was applied. The statsitically significant difference was established between the opiate addicts and non-adicts in self-concept improvement through sport. The addicts assessed the self-concept improvement effects of involvement in physical exercise and sport as more positive than the non-addicts.

Key words: *self-image, clinical patients, male, age 18-25 yrs, non-addicts, discriminant analysis, ANOVA,*

Introduction

Self-concept is defined as a "phenomenological organisation of an individual's experience and ideas of himself and all aspects of his life" (Combs, 1981, according to Lacković-Grgin, 1994). Engagement of children in sport has a strong impact on their health status and on general well-being, psychological in particular. Early persistence in moderate physical activities leads to habitual, regular physical activity in adult age, which reduce numerous risks of hypokinesia (Hagger, Ashford, & Stambulova, 1998). Many studies have demonstrated positive relation between physical/sporting activity and development of self-concept (Pongrazi, 1982, according to Hulya, Kosar, & Ayse, 2001; Taylor, 1996; Schlicht, 2002).

The research was started because experiences with clinical patients with opiate syndrome showed that a part of them were active in sports earlier. For that reason we wanted to investigate self-estimation of their involvement in sport activities in relation to self-concept. Therefore we tried to determine whether there were any differences in self-concept of those sport participants who were opiate addict types and those who were not.

Methods

The first group consisted of male opiate addicts (N=100), aged between 18 and 25 yrs, which were diagnosed as opiate addicts (primarily heroin) by a psychiatrist and were at the time of experiment under medical psychiatric treatment in the Psychiatric Clinic of the Clinical Institute "Sestre Milosrdnice" in Zagreb.

The second group of participants consisted of male non-addicts (N=108), citizens of Zagreb, aged between 18 and 25. The participants were surveyed on consumption of drugs and possible treatment prior to the experiment.

Both samples were surveyed by the questionnaire, consisiting of two parts. In the first part, containing one particle, the subjects were asked about their involvement in sports at the age of 10 to 17 years, and in the second, consisiting of 12 particles, the questions regarded self-concept through sport activities (Sarić, 1997). During the year 2001/2002 a more over-compassing research was conducted on opiate addicts, regarding their engagement in kinesiological activities. In this work a segment of that research will be displayed, the part related to the improvement of self-concept.

The variable showing the subjects' relation to sports in the period of preadolescence and adolescence is:

1. What were your relations to sports in the age between 10 i 17? **(R)**

The variables used to assess the state of self-concept through sport activities:

1. Sport activity involvement improved my physical appearance. (**R1**)
2. Sport activity involvement positively influenced my health. (**R2**)
3. Sport activity imnvolvement improved my persistence in other activities as well. **(R3)**
4. Good sport achievements helped me to gain confidence in myself. (**R4**)
5. Sport activity involvement helped me to concentrate better in work and study. (**R5)**
6. Through sport activity involvement I learned to control my behaviour. (**R6**)

7. Sport activity involvement helped me to start involvement in other activities as well. (**R7**)
8. Sport activity involvement helped me to feel more useful. (**R8**)
9. Through sport activity invlovement I associated with older pople more easily. (**R9**)
10. Sport activity involvement made it easier for me to associate with my peers. (**R10**)
11. I am certain that the habits of sport activity involvement will help me later in life (**R11**)
12. When I think of myself as "good", I compare the concept to my success in sport activities? (**R12**)

To determine the improvement of self-concept through sport activities a model of robust discriminant analysis was applied and univariate analysis of variance.

Results

In order to determine the improvement of subjects' self-concept through sport activities, it is necessary to see how much were the opiate addicts engaged in sports prior to their diagnosed addiction (Table 1). From the data displayed in Table 1, it is obvious that the observed opium addicts were in the earlier period of their life (between 10 and 17 yrs of age) often engaged in sport activities at different levels.

The goal of the research aims towards establishing the difference between the addicts and the non-addicts in improvement of self-concept through engagement in sports.

Table 1. Relative answer frequencies through categories for each variable

VARIABLE	ANSWER CATEGORIES	ADDICTS	NON-ADDICTS
What were your relations to sports in the age between 10 i 17? R	1. I have never been engaged in sports (unless it was required in school).	9 %	64,8%
	2. I was engaged in sports occassionally, as a recreation.	20%	18,5%
	3. I exercised regularly and competed in my club.	71 %	16,6 %

Table2. Self-concept through sport activities

VAR	% OF THE ANSWERS ASKED									
	ADDICTS					NON-ADDICTS				
	truly false	primarily false	correct/ false	primarily correct	truly correct	truly false	primarily false	correct/ false	primarily correct	truly correct
R1	2 %	3 %	8%	26 %	52 %	2,7 %	1,8 %	2,7 %	17,6 %	10,1 %
R2	-	-	-	20 %	71 %	-	2,7 %	7,4 %	12 %	12,7 %
R3	3 %	11 %	14 %	25 %	38 %	2,7 %	1,9 %	15,7 %	12 %	2,7 %
R4	5 %	13 %	23 %	29 %	21 %	3,7 %	3,7 %	7,4 %	12 %	17,6 %
R5	10 %	19 %	28 %	18 %	16 %	0,9 %	3,7 %	10,1 %	15,7 %	4,6 %
R6	12%	19 %	23 %	22 %	15 %	5,5 %	6,5 %	13,9 %	8,3 %	0,9 %
R7	9 %	10 %	25 %	33 %	14 %	4,6 %	4,6 %	16,6 %	8,3 %	0,9 %
R8	7 %	10 %	10 %	27 %	37 %	1,9 %	4,6 %	6,4 %	10,1 %	12 %
R9	22 %	15 %	19 %	17 %	18 %	3,7 %	7,4 %	18,5 %	5,5 %	-
R10	14 %	2 %	17 %	27 %	31 %	2,7 %	3,7 %	13,9 %	12 %	2,7 %
R11	7 %	9 %	5 %	21 %	49 %	1,8 %	2,7 %	11,1 %	13,9 %	5,5 %
R12	16 %	12 %	18 %	31 %	14 %	3,7 %	4,6 %	12 %	13 %	1,9 %

A descriptive analysis showed that most of the variables used got positive answers in both investigated samples, ranging from "primarily correct" to "truly correct".

A certain level of constraint can be noticed in the variable sports being helpful in improvement of work and study concentration, as well as in sport activities as a means of learning how to control their behaviour.

The addicts marked only one variable as "truly incorrect" - R9. With the non-addicts a level of constraint was most intensely apparent in the variables: R3, R6, R7, R9 and R10.

In order to answer to the most basic problem of this work, that is to establish if there were any changes in improvement of one's self-image through sport activities, robust discriminant analysis was used and only single statistically significant discriminative factor was isolated (table 3). It means that the first and theoretically the only one discriminative function is statistically significant.

Table 3. The Results of robust discriminant analysis

DISCRIMNATIVE FUNCTION	LAMBDA	CENTROIDS 1	CENTROIDS 2	ST. DEV. DF1 =1	ST. DEV. DF2 = 206	F	SIGNIFI CANCE
1	7.1083	1.96	-1.81	2.14	2.90	116.05	.000

Based on the value of Wilks's lambda it was determined that there was a statistically significant difference between centroids of the groups. From the position of the centroids, it is evident that the addicts occupy the positive pole on the discriminative function, meaning that they estimated the advantages of sport activity more successfully.

Considering that the discriminative function is statistically relevant at the level of $p<.01\%$, it is necessary to analyze the structure of the discriminative function as well as the results of the univariate analysis of variance in Table 4.

Table 4. Structure of the discriminative function and univariate analysis of variance

V A R	DISCRIMINATIVE COEFFICIENT	CORRELATION WITH DISCR. FUNCTION	ARITHMETIC MEAN 1	ARITHMETIC MEAN 2	STANDARD DEVIATION 1	STANDARD DEVIATION 2	F DF1=1 DF2=206	LEVEL OF SIGNIFICANCE
R1	.31	.94	.61	.70	.90	-.57	115.56	.000
R2	.34	.96	.67	.62	.87	-.62	152.94	.000
R3	.32	.94	.62	.78	.83	-.57	115.31	.000
R4	.27	.94	.53	.77	.94	-.49	75.22	.000
R5	.23	.91	.45	.81	.98	-.42	51.02	.000
R6	.28	.90	.55	.86	.84	-.51	79.60	.000
R7	.30	.92	.59	.81	.83	-.54	98.73	.000
R8	.28	.94	.54	.78	.92	-.50	79.52	.000
R9	.26	.86	.51	.93	.81	-.47	65.57	.000
R10	.29	.90	.57	.84	.83	-.53	89.57	.000
R11	.31	.93	.60	.80	.84	-.55	103.48	.000
R12	.26	.90	.51	.85	.89	-.47	65.97	.000

The variables mostly contributing to the definition of the discriminative function obtained were the variables related to the statements that sport activities had positively influenced their health, their persistence in other activities, physical appearance improvement, as well as those variables stating that sport activity habits would help them in life, and that it had already helped them to involve in other activities with more courage. The coefficients of discrimination for the variables range from .34 to .30 in the correlation with the discriminative function higher than .92. The other variables also participated in the discrimination of the groups, but in a somewhat lesser extent.

Also, the apparent differences were determined by the univariate analysis of variance between the groups. The results of the analysis conducted show the statistically significant differences between the groups of participants when speaking of improvement of self-concept through sport activities. The addicts have marked the effects of sport activities more positively than the non-addicts.

Discussion and conclusions

By analysing the space related to the improvement of one's self-image through sport activity in the analysed sample it becomes evident that the addicts were under a stronger influence of the effects of sport activities than the non-addicts. Based on the above stated, we can come to the conclusion that the difference exists in the improvement of one's self-image between the opiate addicts and the non-addicts. Such a finding can be probably attributed to the fact that the observed sample of addicts contained a larger number of subjects involved in sport activities than the sample of non-addicts. It is clear that in that case we can expect even better self.concept developed under the influence of accomplishments in sport activities which was more strongly expressed in the period of preadolescence and adolescence (Ćurković, 2002).

This work is in line with research studies that confirm positive relation between sport activities and positive self-concept (Schlicht, 2002; Taylor, 1996). Although the research was conducted on a specific sample, sport activity influenced positive self-concept. It should be emphasised that the non-addicts had a positive image of themselves, but self-concept was much more better expressed in the addicts.

It is hard to generalize these results due to the specifity of the sample of addicts and due to the lack of research on this kind of participants which would evaluate engagement of addicts in sport activities in the period prior to their addiction. The value of this work lies in the attempt to shed light on the area which the science of kinesiology has not yet researched enough.

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PERSONALITY, LEADERSHIP STYLES AND SOCIAL SKILLS OF TOP SLOVENE COACHES OF TEAM AND INDIVIDUAL SPORTS

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Abstract

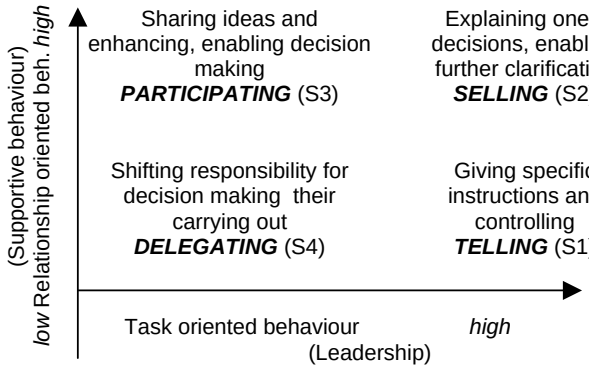
Many sport psychology studies emphasize differences between athletes, engaging in team and individual sports, but fewer of them focus on comparisons of coaches in those two groups of sports, which is what our study focused on. 168 top Slovene coaches - 58 of team and 110 coaches of individual sports were compared in leadership styles and social skills. The instruments used were LSS, LEAD and SSI and we found, that there are some significant differences in coaches - team sports coaches use leadership style of telling more often and are better in social control and social manipulation, while individual sports coaches use participation leadership style more often and are more democratic.

Key words: *coaches, leadership styles, social skills*

Introduction

Many studies have been carried out in order to establish the factors of top-level sport achievements. The majority of the studies were focused on the physiological and morphological views, motor function and the level of general and special physical condition. Studies in the field of sport psychology focus on athlete's personality, motivation, some special abilities and emotional states. Statements resulting from the comparison between athletes and non-athletes are very consistent. The athletes are usually more extroverted, emotionally stable and express stronger need for achievement and stimulation (Butt, 1987, in Tušak and Tušak, 2001 and Cratty, 1989). Eysenck, Nias and Cox (1982) established the need for classification within single groups of athletes, since differences of psychological profiles between male and female athletes and between athletes involved in group and individual sports existed. Eysenck, Nias and Cox (1982), as well as many other scientists, report about differences among the athletes involved in different sports. There are several researches, discussing these differences extending also to the coaches – Tušak and Tušak (2001), Šulc (2002), Martens (1990), Gilbert and Trudel (2004), Frederick and Morrison (1999) and Bennet and Maneval (1998) all stress the importance of coach's characteristics, such as personality, leadership styles, motivation…

Leadership is best described as "a process, that includes influencing the goals, tasks and strategies a group or an organization uses, influencing people within that organization in order to make them carry out strategies or reach certain goals and influencing the preservation of a group and identification with the organizational culture" (Yukl & Van Fleet, 1986). Hersey and Blanchard (2001) viewed leadership as a situational characteristic – they mention two dimensions of leadership, one is task oriented behaviour and the other person directed behaviour and four basic leadership styles within those dimensions, depicted in Figure 1. Those basic behaviour patterns represent leadership styles, but Hersey and Blanchard also point out the importance of one's flexibility in leadership – that is, how much a person is able to adapt their behaviour to specific situations, with respect to the characteristics of that situation (Hersey & Blanchard, 2001). Their model is also useful, because it stresses the importance of style effectiveness – authors also tell, why a certain style can be effective and /or ineffective, but they also emphasize, that these styles can be learned (Bass, 1990).



Picture 1. Leadership styles in the situational model (Hersey and Blanchard, 2001)

Authors have developed a LEAD questionnaire (Leadership Effectiveness and Adaptability Description), which can help us define the major styles we use and style flexibility, a leader with a large span of styles (being able to use many of them effectively) can adapt to many situations, top managers should use styles 3 and 4 most often (Hersey and Blanchard, 2001), and if we compare top coaches with top managers, characteristics of their work are fairly similar – so, also for top coaches, styles 3 and 4 should be most appropriate.

In sport situations, leadership is important when deciding about motivating, strategies, creating relationships, giving feedback, directing a team or a

group, a leader should also be familiar with the group's objectives and use appropriate instruments, that will enable reaching the group's goal (Weinberg & Gould, 1995). Early research, carried out by Lewin, Lippit and White (1939, in Tušak & Tušak, 2001) mentions two main leadership styles that represent two ends of a continuum, on which most coaches can be found. On one end, we can find autocratic leadership (it is characterized by orders, forbidding, demands for obedience, a leader decides on his own and takes nobody else's opinion into account) and democratic leadership on the other end (it is based on the group's cooperation in the decision process, a leader is a coordinator of activities). Few basic modifications have been made to this initial characterization of styles (Martens, 1990; Paranosić, 1982 and Steben & Bell, 1978, in Tušak & Tušak, 2001). Tušak and Tušak (2001) believe that autocratic style is more appropriate for the use in top sports, since sport seems to be more and more about winning, regardless the consequences. Chelladurai (1984) based his approach to leadership in sports on the effect leadership has on the athlete's motivation, starting from the path – goal theory (House & Dressler, 1974, in Yukl, 2002) - the coach's role as a motivator is creating a situation, in which the athlete's path towards their goal will be as clear as possible. His model (Chelladurai, 1990) includes three elements of behaviour (the situation, the coach and the athlete), which influence three types of leadership behaviour, demonstrated by the coach (as is required by the situation, as the athlete expects it and actual behaviour). The interconnections between these variables can have a positive or negative effect on athlete's performance and satisfaction. He mentions five predominant leadership styles – training and instructions, autocratic behaviour, democratic behaviour, social support and positive feedback (Chelladurai, 1990).

Researchers have often found differences in coaches of individual and team sports and in coaches and the rest of the population (Šulc, 2003; Jurčak, 2003; Bennet & Maneval, 1998).

Social skills are a poorly investigated area, the first attempts to point them out as an important factor of one's success and well being were made by Crossman (1960, in Hargie, 2003), Fitts and Posner (1967, in Hargie, 2003) and Argyle and Kendon (1967, in Hargie, 2003), who defined them as »an organized, coordinated activity, in relation to an object or a situation, that involves a chain of sensory, central and motor mechanisms….outcomes of these actions are …continuously matched against some criterion of achievement or degree of approach to a goal.« researchers have pointed out that social skills are a necessity in order to convey one's messages clearly, in order to obtain what we want without damaging others, they can be viewed as means of reaching our goals, when these goals include the cooperation or services of other people (Hargie, 2003). They involve processes, are goal directed, involve interrelated behaviour and have to be appropriate to the situation, can be learned and are under constant cognitive control, while they are being learned (Hargie, 2003). Since sport is an environment, where coaches as well as athletes »use« each other in order to achieve their goals, the importance of social skills in sport settings is evident.

The purpose of our research was to compare top Slovene coaches of individual and team sports in leadership styles and social skills.

Method

Participants

168 top Slovene coaches were used in the research, 58 of them were team sports coaches (basketball, handball, football, ice - hockey and water - polo) (mean age 38,56; SD = 10,06) and 110 of them were individual sports coaches (track and field, swimming, biathlon, shooting, archery, skiing, Nordic jumping, judo, boxing) (mean age 38,80; SD = 9,75). The differences in age were not significant (F = 0,02; p (F) = 0,88).

Instruments

Leadership styles were measured using the Leadership scale in sports by Chelladurai (1984), which measures 5 dimensions of leadership – training and instructions, democratic behaviour, autocratic behaviour, social support and positive feedback. Test – retest reliability (after four weeks) ranged between 0,71 and 0,82. Hersey and Blanchard's (2001) LEAD instrument was also used to assess leadership styles, it measures 5 dimensions – telling, selling, participating and delegating and style flexibility.

Social skills were measured using the Social skills inventory (SSI) – Riggio, Trockmorton (1986, in Lamovec, 1994), it is comprised from 7 dimensions – emotional expressiveness, emotional sensibility, emotional control, social expressiveness, social sensibility, social control and social manipulation. Both test – retest reliability (after two weeks) and internal consistency range between 0,81 and 0,96.

Procedure

All of the participants were tested individually in the years 2004 and 2005, the statistical package SPSS 12. 0 was used to determine the results.

Results and discussion

Leadership styles of top Slovene coaches of team and individual sports

Table 1. Descriptive statistics and One – way A-nova results for the leadership styles of top Slovene coaches of team and individual sports

Dimension	Individual		Team		F	p (F)
	M	SD	M	SD		
Training and instruction	4,34	0,38	4,35	0,32	0,02	0,86
Democratic behaviour	3,06	0,54	2,64	0,63	20,16	0,00
Autocratic behaviour	2,83	0,49	2,86	0,46	0,15	0,70
Social support	3,40	0,61	3,25	0,43	2,58	0,11
Positive feedback	4,52	0,47	4,39	0,53	2,89	0,09
Telling	2,75	1,90	4,11	2,74	13,53	0,00
Selling	5,32	1,83	4,89	2,23	1,71	0,19
Participating	2,89	1,48	2,24	1,50	6,77	0,01
Delegating	1,05	1,16	0,78	0,95	2,16	0,14
Style flexibility	6,93	10,57	4,56	10,24	1,85	0,18

Legend: Individual – coaches of individual sports; Team – coaches of team sports; M – mean; SD – standard deviation; p (F) – significance of F

Three significant differences are evident in leadership styles and dimensions, used by team and individual sports coaches – individual sports coaches are more democratic and use more participating in their decision making, whereas team sports coaches more often use the style of telling. This mans that team sports coaches are more directive, more often provide specific instructions and closely supervise performance of their athletes, which could be explained by the same reason as differences in personality – team sports practice is a situation, where much could go wrong, if leadership is not directive enough. There are a great many more people to be coordinated and it if far more effective to use a leadership style, which does not allow objections and pleasing individual requests by athletes, which is also why more democratic behaviour and participating is exhibited by individual sports coaches – athletes of individual sports are alone in practice and in competition and so often need more attention and have to have their needs fulfilled to the optimum – it is thus appropriate for coaches to include athletes in team sports in the process of decision making and also to include their suggestions into practice as much as possible.

Social skills of top Slovene coaches of team and individual sports

Table 2. Descriptive statistics and One – way A-nova results for the dimensions of social skills in top Slovene coaches of team and individual sports

Dimension	Individual		Team		F	p (F)
	M	SD	M	SD		
Emotional expressiveness	75,14	14,64	78,83	11,80	2,59	0,11
Emotional sensibility	92,56	13,72	96,04	13,06	2,38	0,12
Emotional control	78,71	15,56	78,03	18,24	0,06	0,81
Social expressiveness	84,17	18,21	89,96	17,50	3,69	0,06
Social sensibility	76,37	15,22	77,54	15,91	0,20	0,65
Social control	90,71	14,28	96,80	14,70	6,41	0,01
Social manipulation	71,45	10,02	75,37	13,55	4,32	0,04

Legend: Individual – coaches of individual sports; Team – coaches of team sports; M – mean; SD – standard deviation; p (F) – significance of F

Table 3 shows that there are significant differences in social skills between coaches of team and individual sports – team sport coaches are better in social control and social manipulation – team sports coaches seem to be more capable of using their social skills for controlling athletes and arranging the situation in such a manner, to be able to carry out the practice successfully, which is to be expected, since more people have to be controlled in the case of team sports practice – in individual sports, only one's own results depend on how well the practice is carried out, but in the case of team sports, the entire team depends on how well everybody performs in practice – much more is at stake than just one's own success.

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UNDERSTANDING OF ADOLESCENTS' EXERCISE BEHAVIOR BASED ON TRANSTHEORETICAL MODEL

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Abstract

This study was to examine the exercise behavior of Korean adolescents, reveal the differences in self-efficacy and decision balance by the stages of exercise behavior, and identify the relationship between the exercise behavior and psychological variables based on transtheoretical model. A total of 671 adolescents randomly selected from junior high and high schools in Seoul were surveyed. Three Korean-version questionnaires were used to identify the stage of exercise behavior and psychological attributes of adolescents. Data were analyzed by frequency analysis, χ^2 test, MANOVA, and correlation analysis. The exercise pattern of Korean adolescents was different by each stage of exercise behavior: precontemplation (17.5%), contemplation (16.6%), preparation (20.4%), action (28.3%), and maintenance (17.2%). Significant differences in exercise behavior distribution emerged as a function of gender and age. In addition, exercise efficacy, exercise benefits and exercise barriers differentiated across the stages of exercise behavior. Furthermore, the findings revealed that adolescents' exercise behavior was significantly correlated with the selected psychological variables. This study provides information about relatively unstudied Korean adolescents and has the potential to influence the development of better exercise interventions and health promotion programs for adolescents.

Key words: *Self-efficacy, Exercise benefits, Exercise barrier, Korean adolescents.*

Introduction

Physical activity in adolescence is an important public health issue, and regular participation in physical activity for adolescents can enhance their physical, psychological and social well-being. Nevertheless, there is an alarming trend of physical inactivity occurring in many countries including Korea (Centers for Disease Control and Prevention, 1997; Kim, 2001).

To improve our limited understanding of the physical activity behavior change, promotion and retention process, researchers have recently begun to examine participation in physical activity using theories from the behavioral sciences (Glanz, Lewis, & Rimer, 1997). One of the more promising of these theories is the Transtheoretical Model (TTM) in exercise (Prochaska & DiClemente, 1983).

The TTM accounts for the dynamic nature of health behavior change and recognizes that individuals often must make several attempts at behavior change before they are successful (Prochaska & DiClemente, 1983). The TTM consists of five stages of exercise behavior change: (1) Precontemplation (individuals are physically inactive and do not intend to initiate exercise within the next 6 months), (2) Contemplation (individuals are physically inactive and intend to begin regular exercise within the next 6 months), (3) Preparation (individuals are irregularly active below a criterion level-three or more times per week for at least 30 min. each time), (4) Action (individuals have been regularly active for less than 6 months), and (5) Maintenance (individuals have sustained regular exercise for more than 6 months after initial exercise) (Macus, Selby, Niaura, & Rossi, 1992).

Several psychological variables have been associated with exercise participation and can be imbedded with the TTM for exercise: decision balance (perceived benefits of exercise, perceived barriers to exercise) and self-efficacy. The decision balance construct is based on the conflict model of decision making (Janis & Mann, 1977), and focuses on the importance of perceived positive (pros) and negative (cons) outcomes of a behavior change. For exercise, examples of "pros" include health benefits (e.g., stress relief, improved sleep patterns and increased energy and stamina). Time constraints competing commitments and/or task (e.g., less time to spend with family and friends), and inclement weather are examples of "cons" (Prochaska & Marcus, 1993). Self-efficacy is one's perceived confidence in the ability to carry out a specific behavior successfully. According to the perspective of TTM, it is hypothesized that individuals in the different stages of exercise behavior have different perceived self-efficacy regarding benefits for exercise and barriers to exercise, and thus have different levels of confidence in their ability to maintain exercise benefits and to overcome exercise barriers.

With regard to such a possible association between exercise behavior change and psychological constructs, many studies have argued the existence of a significant relationship among those variables (Hellman, 1997; Nigg & Courneya, 1998).

Physical inactivity, especially, in Korea, is only now being considered a crucial factor in the health of adolescents. Moreover, data to predicting adolescents' physical activity on a basis of the TTM are limited. The purpose of the present study was to examine the proportion of Korean adolescents in each of the five exercise stages, to explore the differences in self-efficacy and decision balance by the stages of exercise behavior, and to identify the relationship between the exercise behavior and psychological variables.

Methods

Participants. After receiving permission from the principals and parents, a total of 671 students (male:353, female: 318) were participated in the study. The students were selected by a random sampling from six schools, geographically located in the northern areas of Seoul. All students in the age cohort were 13-18 years old (M=15.8 years).

Measures. For the exercise behavior of adolescents, the Korean version of Exercise Stage measure (Kim, 2002) was used in the study. In this questionnaire, stage of exercise behavior was assessed using 5-item, dichotomous scale ("yes"/ "no") related to regular exercise behavior and intentions. In this questionnaire students were categorized into one of five stages of exercise behavior change described previously. In addition, test-retest reliability measures were conducted as a measure of instrument stability, and obtained a reliability of .85.

To assess adolescents' confidence, beliefs, and intention relating to exercise behavior change, two revised questionnaires were used in this study. Decision Balance Scale for Exercise was revised by Kim (2002), and adopted in the study. The questionnaire consisted of the two sub-scales with 17 items: exercise benefits 9 items, exercise barriers 8 items. In this questionnaire, participants were asked to indicate, on a 5-point Likert-type scale (ranging from 1, "not at all important" to 5, "extremely important"), how important each statement was in regard to their decision to exercise or not. In addition, test-retest reliability measures were performed as a measure of instrument stability, and obtained a reliability of .89 for exercise benefits factor and .88 for exercise barriers factor.

Exercise Self-efficacy Scale, developed by Bandura (1997) was revised for the Korean version (Kim, 2002), and used in this study. The revised exercise self-efficacy scale consisted of 18 items with a 5-point scale ranging from 1 (cannot do) through intermediate degrees of assurance such as 3 (moderately certain can do) to complete assurance, 5 (certain can do). In addition, test-retest reliability measure was performed as a measure of instrument stability. The test-retest interval was 2 weeks, and *r* was .86.

Results

Exercise behavior for adolescents

Table 1 shows the result of the frequency analysis concerning the exercise behavior distribution in the adolescents.

Table 1. Stages of Exercise behavior Distribution

Stages of exercise behavior	Cases(n)	(%)
Precontemplation	117	17.5
Contemplation	112	16.6
Preparation	137	20.4
Action	189	28.3
Maintenance	116	17.2
Total	671	100.0

Table 2 demonstrates the stage of exercise behavior change distribution as a function of gender and age. A significant difference among male and female adolescents for exercise behavior stage distribution emerged ($\chi^2 = 113.14$, $df = 4$, $p<.001$). Similar differences in exercise behavior distribution emerged as a function of age group ($\chi^2 = 150.72$, $df = 4$, $p<.001$).

Table 2. Stages of Exercise behavior Distribution by Gender and Age

Variables		Stages of exercise behavior (%)				
		PC	C	P	A	M
Gender	Male	10.3	5.1	20.3	36.3	28.0
	Female	24.7	28.1	20.5	20.3	6.4
Age (years)	13-15	10.0	11.0	19.7	36.9	22.4
	16-18	25.0	22.2	21.1	19.7	12.0

PC=Precontemplation; C=Contemplation; P=Preparation; A=Action; M=Maintenance.

Differences in self-efficacy and decision balance by the stages of exercise behavior

Table 3 illustrates the results of MANOVA to identify the differences in self-efficacy and decision balance of the adolescents by the stages of exercise behavior. Overall, self-efficacy differentiated individuals at different stages of exercise behavior [$F(4, 657)$]=10.49, $p<.001$). Tukey's post hoc tests revealed significant increases in exercise self-efficacy from the

precontemplation to the maintenance stages. In addition, Table 3 shows that significant differences in both exercise benefits [F(4, 657)=4.99, p<.01] and exercise barriers [F(4.657)=2.68, p<.05] emerged across stages of exercise behavior.

Table 3. Means and Standard Deviations on Self-efficacy and Decision Balance in Relation to Exercise Behavior

Variables	Stages of Exercise Behavior						Pairwise comparison[1]
	PC	C	P	A	M	F	
Self-efficacy	28.78 (12.51)	31.63 (10.32)	37.46 (11.90)	49.72 (15.36)	52.73 (13.57)	10.49***	PC, C, P<M; PC, C<A
Exercise benefits	3.13 (1.03)	3.24 (.94)	3.36 (.75)	3.50 (.58)	3.62 (.74)	4.99**	PC, C<M; PC<A
Exercise barriers	2.62 (.79)	2.54 (.80)	2.40 (.83)	2.36 (.70)	2.34 (.81)	2.68*	M, A<PC

*P<.05; **P<.01; ***P<.001.
[1]Mean differences for the Tukey HSD pairwise comparisons.
PC=Precontemplation; C=Contemplation; P=Preparation; A=Action; M=Maintenance.
Standard deviations are in parentheses.

Correlation between exercise behavior and psychological variables

Table 4 illustrates the results of the correlation analysis to identify the relationships of psychological variables with exercise behavior. All of the psychological variables examined were statistically correlated with exercise behavior (r = .35, .27, -.19, p<.01, respectively). Specially, of the three psychological variables self-efficacy variable had the strongest correlation with exercise behavior.

Table 4. Correlation Among All Variables

Variable	Exercise behavior	Self-efficacy	Exercise benefits	Exercise barrier
Exercise behavior	1.00	.35**	.27**	-.19**
Self-efficacy		1.00	.38**	.06
Exercise benefits			1.00	-.15**
Exercise barrier				1.00
Mean	2.61	35.61	3.31	2.50
SD	1.45	10.31	.89	.80

**P<.01

Discussion

The findings concerning the high rates of physical inactivity among Korean adolescents agree with previous studies (Center for Disease Control and Prevention, 1997). This result might be extensively caused by the social and environmental limitations such as a lack of available facilities and times for exercise, a social context neglecting exercise and Physical Education, and excessive schoolwork owing to the dominance of an academic-centered curriculum.

The finding concerning gender difference was supported by one study (Wyse, Mercer, Ashford, Buxton, & Gleeson, 1995), demonstrating that males were significantly more likely to be in the “action” or “maintenance” stages compared with their female counterparts. In addition, it is not unexpected that older adolescents are less likely to engage in physical activity than younger adolescents. This finding can be explained from the societal viewpoint: older adolescents, in Korea, have little time to participating in physical activity owing to considerable stress about an entrance examination into university. There is a need for further study to see whether it is an aspect of Korean culture.

The present study indicated that exercise self-efficacy and exercise benefits scores were lower during the “precontemplation” and “contemplation” stages compared to the “action” and “maintenance” stages, and that exercise barriers scores were higher during the “precontemplation” and “contemplation” stages compared to the “action” and “maintenance” stages. The present data regarding exercise self-efficacy can be explained in that individuals with a high level of confidence to engage in physical activity, despite obstacles, can be seen as having high self-efficacy for exercise. In addition, with regard to exercise benefits this study argues that emphasizing the personal benefits of exercise may be beneficial for facilitating exercise adoption and suggest strategies that promote participation in a variety of activities to prevent boredom, a continued sense of mastery and competence, continued enjoyment, and injury avoidance, may be needed to promote continued exercise adherence.

Regarding a relationship of exercise behavior with psychological attributes, the previous findings have been in a line with those in this study. Hellman (1997) argued that self-efficacy, exercise benefits and exercise barriers were significant predictors of exercise behavior change. Moreover, one recent study by Kim (2002) also supported the link between exercise

behavior and psychological variables, and indicated that individual's intention and beliefs to exercise have a significant effect on exercise behavior change.

The findings of this study offer the first evidence suggesting the possibility of TTM to explaining Korean adolescents' exercise behavior. This study has the potential to influence the development of better exercise interventions and health promotion programs for adolescents. Furthermore, the present study provides starting points for interventions aimed at increasing physical activity levels, and a baseline level from which to evaluate these interventions.

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THE ASSESSMENT OF KNOWLEDGE OF TECHNICAL ENGLISH IN PHYSICAL EDUCATION STUDENTS

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Abstract

One hundred and sixty-one male and sixty-four female first- and second-year university students participated in this study. They took a test in technical English used in kinesiology. The aim of the study was to determine whether the number of years of learning a foreign language affects the results in technical English of kinesiology tests. Two sets of variables were subject to analysis – the first set was comprised of the variables *the number of years of learning English as a foreign language*, *the number of years of learning another foreign language* (excluding Latin) and *the number of years of learning Latin*, and the second of the variables: *Test 1*, consisting of 16 translation items, *Test 2*, comprised of three tense items, *Test 3*, consisting of five synonymous-term items, *Test 4*, consisted of 12 cloze-test items, and *Test 5*, consisting of four match-them items. To determine the correlation between these two sets of variables the canonical correlation analysis was used. The analysis showed one statistically significant canonical correlation (R=.333). As expected, *the number of years of learning English as a foreign language* had the greatest values of canonical coefficients in the first set of variables. But, the values on the canonical factor show that *the number of years of learning another foreign language*, as well as *the number of years of learning Latin* are included in forming the canonical correlation too. In the second set, *Test 4* and *Test 5* were the most important in forming the canonical variable. *Test 1* and *Test 3* had near zero canonical coefficients. The results showed that the number of years of learning English, Latin and other languages do help to some extent to understand the technical English of kinesiology, but only when the context is provided.

Key words: *learning outcome, tests, English, canonical correlation analysis*

Introduction

As it is well known, assessment of learning outcomes, as regards the performance of learners in foreign language learning, focuses on five skills – listening, speaking, reading, writing and culture. The assessment of outcomes in foreign language learning has always been one of the main foci of many professional and scientific papers (for example, Bakašun & Blažević, 2003; Hewitt, Ryan, & Kubs, 1993, etc.). The influence of learning Latin on the learning outcomes in learning English as a foreign language was, for example, investigated by Haag and Stern (2003) on fifty native German speakers, for whom English was the first foreign language. One half of them had learned French and the other half Latin at school. The students took a university Spanish course and the translation test at the end of the course showed that those students who had learned French at school made significantly fewer grammatical errors and slightly fewer vocabulary errors than the students who had learned Latin. The authors have, therefore, concluded that Latin is presumably not an optimal preparation for modern language learning. In their research into the successfulness of translating English kinesiological terms into Croatian Omrčen, Viskić-Štalec and Štalec (2002) found that the third-year physical education students of the Faculty of Kinesiology, University of Zagreb, achieved better results in translating the terms that did not have a Latin or a Greek root. Such results were somewhat surprising, because one would expect that the terms in the English language that are either of Latin or Greek origin are easier to translate because of the probability that similar terms, also of Latin or Greek origin, may be found as loan words in Croatian.

Methods

One hundred and sixty-one male (161) and sixty-four (64) female first- and second-year students (totalling 225, aged 18 to 27 years) of the Faculty of Kinesiology, University of Zagreb, participated in this study. They were asked to take a test in technical English of kinesiology. The majority of subjects (92%) have been learning English between one and fifteen years. Sixty-four subjects (28%) have never learned any other foreign language, and out of those who did two have learned Spanish, five have learned French, twenty-six (12%) have learned Italian and one hundred and twenty-six (56%) have learned German. The first set of variables was comprised of *the number of years of learning English as a foreign language*, *the number of years of learning another foreign language* (excluding Latin) and *the number of years of learning Latin*. The test consisted of five groups of items. These groups served as five variables in the second set. The first variable, *Test 1*, consisted of 16 translation items (Figure 1), the second variable, *Test 2*, was comprised of three tense items (Figure 2), and the third, *Test 3*, consisted of five synonymous-term items (Figure 3). The type of test for all three variables was the multiple-choice test. The fourth variable, *Test 4*, consisted of 12 cloze-test items (the omitted words

were listed at random below the text) (Figure 4), and the fifth variable, *Test 5*, of four match-them items (Figure 5). The goal of the study was to determine whether there is a correlation between the number of years of learning English as a foreign language, the number of years of learning another foreign language and the number of years of learning Latin on the one hand, and achievement in the technical English of kinesiology test on the other. To process the collected data the canonical correlation analysis was used, and the following hypothesis was set: *There exists a statistically significant canonical correlation between the set of values of the number of years of learning a foreign language and the set of results in the technical English of kinesiology tests.*

What is the correct translation of the following terms:

heart rate	1) otkucaj srca 2) frekvencija srca 3) srčana mana
tendon	1) ligament 2) tetiva 3) opna
lactic acid	1) limunska kiselina 2) oleinska kiselina 3) mlječna liselina
barbell	1) bučica 2) preča 3) dvoručni uteg
endurance	1) izdržljivost 2) umor 3) brzina
gymnasium	1) teretana 2) gimnazija 3) garderoba
push-up	1) zgib 2) čučanj 3) sklek
dexterity	1) izdržljivost 2) jakost 3) spretnost
long jump	1) skok u dalj 2) skok u vis 3) skok u dalj s mjesta
kick-off	1) uvođenje lopte u igru nakon što je preko poprečne linije izašla izvan igrališta 2) izvođenje kaznenog udarca u nogometu 3) početni udarac u nogometu
throw-in	1) uvođenje lopte u igru nakon što je preko poprečne linije izašla izvan igrališta 2) uvođenje lopte u igru nakon što je preko uzdužne linije izašla izvan igrališta 3) izvođenje kaznenog šuta u rukometu
breaststroke	1) leđno plivanje 2) prsno plivanje 3) način plivanja tipa leptir
medley	1) mješovito 2) štafeta mješovito 3) slobodnim stilom
shot put	1) streljaštvo 2) izbacivalje lopte izvan granica igrališta 3) bacanje kugle
double-dribble	1) dvostruko vođenje lopte (npr. u košarci) 2) koraci (npr. u košarci) 3) dvostruko dodavanje
sculling	1) veslanje jednim veslom 2) veslanje u kanuu ili kajaku 3) veslanje na pariće

Figure 1. The translation-items multiple-choice test.

Choose the correct tense:

He _____ his best in the match last evening.	1) does; 2) did; 3) is doing; 4) was doing
After he _____ in the competition, he received a reward.	1) have won; 2) has won; 3) won; 4) had won
People _____ tennis all over the world.	1) played; 2) playing; 3) play; 4) are playing

Figure 2. The tense-item multiple choice test.

What are the synonyms of the following terms (the verbs are denoted by to)?

speed	1) rhythm 2) velocity 3) endurance
to perform	1) to change 2) to develop 3) to execute
to leap	1) to jump 2) to run 3) to throw
to alter	1) to exercise 2) to apply 3) to change
horizontal bar	1) high bar 2) parallel bars 3) asymmetric bars

Figure 3. The synonymous-item multiple-choice test.

Fill in the blanks with the words listed at random below the text.

Skiing is all about balancing, turning and _____. In schussing and especially when turning, we balance by bending, _____ and turning our joints. Our _____ can be shifted forwards, backwards, right, left, up and down. In _____, which is the first real test of _____, the skis must be _____, and braking and accelerating forces have to be absorbed. To make a _____, you have to push the _____ of the skis apart. The skis then _____ on their inner edges. You can practise mobility in the snowplough position by varying the _____ of the skis and the width of the plough to improve control. If you put the weight on the _____ and edge it more, you will turn. If you weight and edge the skis _____, you will skid less and ski more on the edges.

1) alternately; 2)balance; 3) control; 4) edging; 5) schussing; 6) ski; 7) skid; 8)snowplough; 9) steered; 10) straightening; 11) tails; 12) weight

Figure 4. Cloze test.

Match the terms from the left column with their denotations/definitions in the right column.

1. Mechanical summation is …	a) … the length of a muscle remains constant and the tension changes.
2. Isometric contraction means that …	b) … both tension and length change simultaneously.
3. Isotonic contraction means that …	c) … a superposition of single twitches.
4. Auxotonic contraction means that …	e) … the length of a muscle changes and the tension remains constant.

Figure 5. The match-them test.

Results

Table 1. Means (M) and standard deviations (SD), modal values (Mod), minimum (Min) and maximum (Max) values of the number-of-years-of-learning variables, and the technical English of kinesiolgy test results.

Variables	M	SD	Mod	Min	Max
Years of learning English	7.578	3.077	8	0	15
Years of learning another foreign language	4.182	3.479	4	0	14
Years of learning Latin	1.258	1.059	2	0	4
Test 1	9.049	2.280	8	3	14
Test 2	1.480	.872	2	0	3
Test 3	2.018	1.485	2	0	5
Test 4	1.844	1.858	1	0	12
Test 5	1.471	1.343	0	0	4

The descriptive statistics data are to be found in Table 1, whereas in Table 2 the correlation matrix of the number-of-years-of-learning variables (denoted by Y) and the variables of the technical English of kinesiology test results (denoted by *TEST*) are presented. The data in the correlation matrix (Table 2) show that all five variables from the second set are positively correlated with the number of years of learning English as a foreign language – however, the correlations are very low.

Table 2. Correlation matrix of the number-of-years-of-learning variables (Y), and the technical English of kinesiology test results.

Variable	Y English	Y another	Y Latin	Test 1	Test 2	Test 3	Test 4	Test 5
Y English	1.00	-.21	.06	.13	.11	.06	.16	.18
Y another	-.21	1.00	.38	-.05	.10	.12	.12	.08
Y Latin	.06	.38	1.00	.02	.10	.02	.06	.18
Test 1	.13	-.05	.02	1.00	.12	.46	.25	.23
Test 2	.11	.10	.10	.12	1.00	.33	.20	.05
Test 3	.06	.12	.02	.46	.33	1.00	.29	.13
Test 4	.16	.12	.06	.25	.20	.29	1.00	.12
Test 5	.18	.08	.18	.23	.05	.13	.12	1.00

The analysis showed that the strongest correlation was between the variable *the number of years of learning English as a foreign language* and the variable *Test 5* that was comprised of match-them items. The correlation of the same strength was also found between the variable *the number of years of learning Latin* and the variable *Test 5.* The results of the canonical correlation analysis in which the significance of canonical correlations was tested between the two sets of variables showed one statistically significant correlation (R=.333).

Table 3. The results of the canonical correlation analysis: canonical correlation (R), squared canonical correlation (R^2), χ^2 tests with roots successively removed, degrees of freedom (df) and significance of χ^2 test (p).

Roots removed	R	R^2	χ^2	df	p
0	.332632	.110644	36.17146	15	.001677
1	.192874	.037200	10.43340	8	.235960
2	.097860	.009577	2.11220	3	.549457

Table 3 contains the results of the canonical correlation analysis in which the significance of canonical correlations was tested, and Table 4 the canonical weights and the first canonical factor structure of the number–of-years-of-learning English (denoted by Y) and the technical English of kinesiology test results (denoted by *TEST*).

Table 4. The results of canonical correlation analysis: canonical weights (W) and the first canonical factor structure (F) of the number-of-years-of-learning variables (Y), and the technical English of kinesiology test results.

Variable	W	F
Y English	-.810972	-.713183
Y another	-.547076	-.484272
Y Latin	-.286593	-.546751
Test 1	.073901	-.269606
Test 2	-.381035	-.518114
Test 3	-.049933	-.373730
Test 4	-.500638	-.652401
Test 5	-.657236	-.726111

Discussion

The data in the correlation matrix (Table 2) show that all five variables from the second set are positively correlated with the number of years of learning English as a foreign language – however, the correlations are very low. This was also the case with the number of years of learning Latin and the students' achievement in all five groups of items. These results prove that the knowledge of general (foreign) language, that the students have learned prior to their enrolment at the Faculty of Kinesiology, need not always imply the knowledge of technical language. On the contrary, sometimes it may even negatively affect the acquisition of new technical terms. For example, the number of students who have correctly marked, in the first groups of items, the translation of the English term *gymnasium*, a room designed and equipped for indoor sports, that is, physical exercise, was extremely low – only three students, out of 225, have marked the correct translation. The reason for this may be found in the

fact that the English word *gymnasium* and the Croatian word *gimnazija* are false friends, namely, the words that share the same root, but have different meanings in various languages. Thus the word *gimnazija* in Croatia denotes *a high school*. The interference of the meaning of the word *gimnazija* as acquired in Croatian with the acquisition of the term *gymnasium* in English is, therefore, exceptionally strong. As for the results in other items in the first variable, the students also performed poorly when marking the correct translation of the term *endurance*. Only four of them marked the correct translation, whereas as many as 192 marked the meaning *umor*, namely, *fatigue*. As it is well known, endurance denotes the ability to perform physical work for extended periods of time, that is, it implies the capacity to resist fatigue, which means that fatigue is the limiting factor of endurance. Still, it is surprising that the students confused the motor ability with the consequence of a prolonged physical activity. In the first group of items such a poor result was also noticed in the item *long jump* in which again only three students marked the correct answer.

Only six students knew that the term *double-dribble* denotes the ball-dribbling violation in basketball that is in Croatian termed as dvostruko vođenje, or, in slang, as *dupla lopta*. However, on the whole the analysis showed that the strongest correlation, although being very weak, was between the variable *the number of years of learning English as a foreign language* and the variable *Test 5*, namely, the variable relating to the group of match-them items. The correlation of the same strength was also found between the variable *the number of years of learning Latin* and the variable *Test 5*, i.e. the group of match-them items. The variable *Test 5* denoted a task consisting of four terms that the students had to match with their definitions. The variable *the number of years of learning another foreign language* from the first set was negatively correlated with one variable from the second set, namely, with the variable *Test 1* in which the students were asked to mark among the three terms offered the correct translation into Croatian of the given English technical terms.

Another interesting detail to discuss is the significant correlation obtained between the students' success in *Test 1* and in *Test 3* (.46), that is, between the students' efficiency in marking the correct translation of the terms given and their efficiency in the part of test in which they were asked to mark the synonyms of the given terms. Mental lexicon is organized by semantic relations (relations between meanings) and the most important semantic relation is similarity of meaning (Miller & Fellbaum, 1991), that is, synonymy. As Miller and Fellbaum emphasized (1991), synonymy is relative to a context. As for the previous example, namely, the correlation between *Test 1* and *Test 3* – translation and synonymy, the context can be understood in terms of the technical English of kinesiology that operates with a limited lexical matrix in contrast to the much broader one in general language. Within such a limited context and taking into account that synonymy is the most important semantic relation, the significant correlation between these two groups of tests is not surprising.

Table 3 contains the results of the canonical correlation analysis in which the significance of canonical correlations was tested between the two sets of variables. The analysis showed one statistically significant correlation (R=.333). The correlation between the first pair of canonical factors of two sets of variables denotes that this pair, describing what is significant for the correlation between the two sets, explains 11% of the variance of those sets of variables. Table 4 presents the canonical factor structure (F) of the number-of-years-of-learning-English variables and the canonical factor structure (F) of the knowledge of technical English of kinesiology tests. The results confirmed the previous discussion based on product-moment correlations. The variable *Test 5* had the highest impact of all the *Test* variables. In other words, the students achieved the best results in the match-them group of items, followed by the cloze test. This may be explained by the fact that both types of tests provide *a context*. To explain in more detail – the students' success in *Test 5* may, as already said, be attributed to the wide *context* of kinesiology, namely, all the sentences can be described as belonging to the field of physiology in which the students learn about muscular contractions on the one hand, and on the other, to the fact that, actually, the sentences provided a sufficient context for their understanding. Thus, the students could use both their knowledge of physiology as well as their knowledge of English to match the terms with their definitions. To have proven that the probability exists that the longer the students have learned English, the better results they would achieve in the technical English of kinesiology test may only seem as reinventing the wheel. The reasons why this is not so were already discussed in this paragraph. To support this argument let us quote Ebbinghaus (1885) who showed that the amount of learning is connected with the amount of material learned. The study conducted on the BBC advertising showed (Bekerian & Baddeley, 1980) that being exposed to certain contents does not suffice for their acquisition and that the time period of *learning* (exposure to certain information) is not the only factor that conditions the amount of learning material acquired. Additionally, a student may have had English language classes (both) in the primary and in the secondary school, but have acquired very little knowledge. However, the reasons for such a situation will not be discussed here. It can be concluded that the hypothesis has been confirmed and that, the number of years of learning English as a foreign language, the number of years of learning another foreign language, as well as the number of years of learning Latin are moderately but statistically significantly correlated with the results achieved by the students of the Faculty of Kinesiology in the context-based tests of technical English.

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GENDER DIFFERENCES IN MOTIVATION FOR PHYSICAL EDUCATION CLASSES*

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Abstract

In this paper gender differences between male and female secondary school students were studied for intrinsic motivation and orientation in classes of physical education (PE). Existence of total statistical significant difference between genders in motivation in class was found. Male students in comparison to female students are somewhat more intrinsically motivated, but much more ego oriented. In orientation of students towards performing tasks there are no significant differences between genders. Obtained results suggest the need of gender different approach in modelling the students motivation in physical education.

Key words: *intrinsic motivation, orientation in class, gender differences, PE classes*

Introduction

Motivation is something that moves us to a certain action or behaviour, as well as what our behaviour keeps (persistence). Motivation also determines the direction of our behaviour as well as its end (Deci, 1992, in Schaie & Willis 2001). In the context of teaching process the motives are the ones that move students to a certain activity, maintain and direct them in this activity but also condition the quality and quantity of the teaching process results. It does make a difference if the student studies for his/her own pleasure and an inner need for knowledge or mainly for the grade. The mentioned problem of intrinsic and extrinsic motivation of the student is surely not to be seen through the black and white logic. Namely, it is difficult to expect a complete and exclusively intrinsic motivation of the student, although it is the very pedagogic goal, or so to say, an ideal, to which should be striven because it very much determines the teaching process results.

According to the model for evaluation of intrinsic motivation applied in this paper, which is based on the theory of cognitive evaluation (Deci & Ryan, 1985 in Barić, 2002), the intrinsic motivation of a student depends on the feeling of self-competence, level of autonomy, importance that a student gives to the activities in class, and the feeling of pleasure or satisfaction in these activities. A desired intrinsic interest of the student and his/her activity will be expressed and encouraged in the amount that the mentioned conditions are provided. In the context of physical education this refers to the physical exercising in class, but more importantly in leisure time. Nicholls` motivation theory of target orientation is also based on cognitive evaluation theory, and it approaches the explanation of motivated behaviour from the aspect of goals that drive the person to activity or achievement. This approach is differed by two basic comparative starting points based on which a person evaluates his/her successfulness (Duda, 1993 in Barić, 2002). These are: focusing on the task (goal orientation) and focusing to the result (ego orientation). According to these, a task oriented student evaluates his/her success in relation to the efforts made and the level to which he/she has completed a task or improved a skill. On the other hand an ego oriented student compares himself/herself to the other students as a criteria of his successfulness and motivation, and feels successful only if better than the others, where the success is the consequence of his /her superiority, not efforts. A pedagogic goal is to develop goal orientation with students, the motivation towards the own improvement, and to decrease orientation to superiority to other students.

The goal of this research is to determine if there are differences in intrinsic motivation and goal orientation between male and female secondary school students.

Research methods

Sample of the examinees

Examinee sample contains total of 80 students, 42 female and 38 male students from four graduate classes of the secondary school "Fra Martin Nedić" from Orašje, Bosnia and Herzegovina. Students who were tested were all the students of the mentioned classes who assisted the class of physical education on the day of testing.

** Young researcher award*

Sample of the variables

Research was performed by application of two measuring instruments of as paper and pencil type:

a) For the needs of physical education ***Intrinsic Motivation Inventory*** (IMI; McAuley et al., 1989, was adapted according to Barić et al., 2002). It contains18 items and measures 4 factors of intrinsic motivation: interest / pleasure; efforts / importance, perceived competence, pressure / tension.

b) ***Task and Ego Orientation in Sport Questionnaire*** (TEOSQ, Duda et al., 1995) was also adapted for the needs of physical education according to Barić et al., 2002. It contains 13 particles 7 of which evaluate ego orientation of students in class, and 6 of them evaluate goal orientation.

In both tests a five-level scale of Likert type was used, with the offered answers from "*I completely disagree*" to "*I agree completely*", which were transformed additionally into a quantitative values from 1 to 5.

Process of data collecting

Testing of students` intrinsic motivation and target orientation in PE classes was performed according to the standardized procedure which is usually used with instruments such as paper and pencil. At the beginning of PE lesson, which took place in the classroom, students were given one set of questionnaire for target orientation (TEOSQ, Duda et al., 1995), and intrinsic motivation (IMI; McAuley et al., 1989). Students were explained that the evaluation was anonymous, and that they were not time limited.

Methods of data elaboration

Data obtained by testing were elaborated using the programme system STATISTICA 5.0 complemented by the "***RTT.stb***" and "***RTT-KON.stb***" programmes, which were written by Dizdar (1999, based on Momirović et al., 1999) and implemented into the programme language for multivariate data analysis, "***STATISTICA BASIC***".

For determining metrical characteristics of applied measuring instruments RTT.stb programme was used, where the following metrical characteristics were calculated:

ALFA – classic measure of reliability calculated based on the first eigenvalue of the particles correlation matrix (according to Crombach, Kaiser & Caffrey in Dizdar, 1999)

LAMBDA 6 – measure of test reliability by Guttman measuring model calculated based on the first eigenvalue of the matrix of variable transformed into the Harris co-variant metrics (according to Guttman & Nicewander in Momirović et al., 1999)

RHO1 and RHO2 – lower and upper reliability level (Momirović & Dobrić, 1977 in Momirović et al., 1999)

MSA – Kaiser-Rice coefficient of representative as a ratio of sum of square of anti-image correlation matrix variable and sum of square of correlation matrix

HOM1 – Momirović coefficient of homogeneity was calculated based on relative variability of the first eigenvalue of the matrix of variable covariance transformed into the image metrics (Momirović et al., 1999).

By using the RTT-KON.stb programme total examinee results in a single factor were determined by particle condensation to the first main matrix component of image covariance. Total results transformed in such a way into the partial image were obtained under the condition of maximum possible reliability and have features of the real results free from error variance, and they represent normally distributed quantity variables no matter what the type and distribution of the original variables. Due to the mentioned reasons this way of determining the total result in a test could be considered optimum (Momirović et al., 1999).

The total results of the examinees in a single latent dimension, obtained by transforming into the partial image, were used for determining the differences between attitudes between male and female students in intrinsic motivation and goal orientation. For this purpose canonical discriminative analysis was applied.

Results and discussion

By using the component model of factor analysis and varimax transformation of initial coordinate system of latent dimensions, factor validity of tests of intrinsic motivation and goal orientation in class was determined. As the results in tables 1 and 2 show factor validity is extremely good.

Table 1. Factor structure of the IMI test

Items	Effort/ importance	Interest/ pleasure	Competence	Pressure tension
UZIV1	0,10	0,78	0,01	0,25
PRITIS2	0,13	-0,21	-0,06	-0,78
TRUD3	0,72	0,25	0,25	-0,07
LAKIZAD4	0,09	0,42	0,59	0,12
NAPET5	-0,20	-0,19	-0,18	-0,79
DOBNTJ6	0,23	-0,03	0,81	0,08
DATSVE7	0,76	0,29	0,20	0,02
DOBIZV8	0,68	0,29	0,24	0,19
ZANIMZD9	0,36	0,68	0,02	0,02
VAZDOD11	0,76	0,32	0,09	0,05
NERVOZ12	-0,16	-0,37	-0,24	-0,62
NEDDOB13	0,26	0,09	0,65	0,37
IGTZSU14	0,30	0,75	0,09	0,25
ZABTJE16	0,12	0,83	0,16	0,17

Table 2. Factor structure of the TEOSQ test

Items	Task	Ego
JEDOBZ1	0,00	0,80
UCINVJ2	0,72	0,10
NAJBOLI3	0,02	0,79
OSTNKJ4	-0,06	0,84
NAPVJTR5	0,69	0,06
OSZAB6	0,07	0,85
VJEZBOL7	0,08	0,84
UCIMNO8	0,79	-0,02
DOBOSJ9	0,84	-0,05
NAJBOR10	0,11	0,77
UCZABS11	0,75	-0,05
TJJSVS12	0,80	0,05
SVEDSE13	0,72	0,15

Obtained reliability of intrinsic motivation and goal orientation tests (table 3) is somewhat higher than the so far researches (Barić et al., 2002), except for the factor pressure/tension, which has somewhat weaker reliability than expected. Upper and lower reliability limit, coefficient of representativity and homogenity are also at a very satisfactory level.

Table 3. Metrical characteristics of latent dimensions of intrinsic motivation and goal orientation tests

	effort/ importance	interest/ pleasure	competence	pressure – tension	motivation total	ego	task	goal orientation total
Alpha	0,78	0,87	0,79	0,75	0,91	0,88	0,89	0,85
Lambda6	0,81	0,85	0,79	0,69	0,95	0,87	0,90	0,92
Rho1	0,66	0,73	0,62	0,47	0,90	0,76	0,81	0,84
Rho2	0,96	0,98	0,96	0,90	1,00	0,98	0,99	0,99
MSA	0,93	0,96	0,88	0,79	0,97	0,96	0,97	0,97
Hom1	0,93	0,95	0,80	0,87	0,62	0,93	0,89	0,51

Table 4 shows correlation coefficients among factors of both tests. Effort / importance have the biggest link to the feeling of competence which implies to the conclusion that the students who feel more competent in PE class also give it more importance, make more effort, and so this reflects their interest and pleasure they feel during participating in class. Interest and pleasure are positively connected to the feeling of competence and goal orientation. Obviously, since the feeling of self competence is most connected to all the other factors of intrinsic motivation it leads to the possible conclusion of the crucial importance of this segment to the total intrinsic motivation of students. Pressure and tension have expected negative connection to all the other factors in both tests except ego orientation, which is obviously not significantly connected to neither of the motivation factors. Moderate to high correlation is visible (0,40-0,70) among all the intrinsic motivation factors.

Table 4. Matrix of inter-correlations between latent dimensions in intrinsic motivation and goal orientation in class tests

	Effort/ importance	Interest/ pleasure	Competence	Pressure– tension	Ego	Task
Eff./Import		0,52	0,69	- 0,40	0,20	0,43
Int./ Pleas.	0,52		0,65	- 0,64	0,20	0,55
Compet.	0,69	0,65		- 0,59	0,33	0,38
Press/Ten.	- 0,40	- 0,64	- 0,59		0,07	- 0,44
Ego	0,20	0,20	0,33	0,07		0,14
Task	0,43	0,55	0,38	- 0,44	0,14	

(bold values are statistically significant)

Results of discriminative analysis of differences between genders

In tables 5 and 6 results of canonical discriminative analysis of differences between genders were shown in all six factors of motivation. There was obtained a significant discriminative function (on the level of significance of p-0,04). Based on the orthogonal projection of the motivation factor to discriminative function it is possible to determine the

contribution of a single motivation factor in totally significant difference between male and female students. At this genders differ the most in ego orientation where male students are much more ego oriented than female ones. This tendency of higher motivation of male students is noticeable at all other motivation factors where it is somewhat higher at competence and interest / pleasure, while at other factors it is significantly lower.

Tables 5. and 6. – Structure of discriminative function and position of centroide groups

	Discriminative function
Effort / importance	0,25
Interest / pleasure	0,39
Competence	0,49
Pressure – tension	0,28
Ego	0,94
Task	0,34

	Discriminative function
Male	0,45
Female	-0,41

Conclusion

Performed research has shown the existence of a significant difference between male and female students in intrinsic motivation and orientation in class. Male students are more inclined to ego orientation than female ones, that is, to them it is much more important to defeat and win the other students. In connection to this is their higher feeling of competence which is the only thing that implies a significant correlation to the ego orientation. Obviously striving to victory and defeating others leads to higher level of feeling the own capability. Of course, this does not mean that this self-evaluation on own competence is accurate. Nevertheless, be it justified or not, higher feeling of competence leads to a positive connection with the increased importance that a student gives to the lessons, efforts he/she makes, and interest and pleasure in classes of physical education. Feeling of pressure and tension negatively reflects to all the other factors of intrinsic motivation and goal orientation, but has not significant connection with ego orientation.

Since intrinsic motivation is a pedagogic necessity for a long-term success of the teaching process, for the purpose of its encouragement with both male and female students the teachers should:

- support and increase students` feeling of successfulness in activities
- provide them with the environment where they would feel free and without pressure
- draw their attention to the importance of teaching contents to their present and future life
- provide them with a satisfaction and pleasure at participation in class

Unfortunately, according to our point of view, at all levels of Croatian schooling system – so too in the frames of physical education as an educational field – too little importance is given to the development of a desired type of student motivation (intrinsic motivation and motivation to ruling the knowledge, skills and capabilities), whereas too much stress is made to goals that encourage pedagogically undesired ego orientation of students. In big part of consequences many were proved as showing the wrong social system values that rule the contemporary world, and stress primarily importance of defeating others, not improving own capabilities and characteristics.

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EMOTIONAL INTELLIGENCE IN HIGH SCHOOL STUDENTS IN REGULAR AND SPORT GRAMAR SCHOOL

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Abstract

The aim of this study was to investigate differences in emotional intelligence in high school students in Regular and Sport Gymnasium. Emotional Regulation and Control Scale (ERCS) together with Emotional Skills and Competence Questionnaire (ESCQ-45) were administered to 213 Ss. One hundred twenty one (females and males) attend from Regular Gymnasium and 93 (females and males) attend Sport Gymnasium. The analysis of covariance with control of effect of gender was applied. The results show only one significant difference in Emotional expression and labeling. Students from Sport Gymnasium were better in expressing and labeling emotion compared with their peers in Regular Gymnasium.

Key words: *Emotional intelligence, ESCQ-45, high school students, sport Gymnasium*

Introduction

Emotional intelligence (EI) has been selected as "most useful" new word of 1995 by American Dialect Society. It refers to an ability to recognize the meaning of emotional patterns and to solve the problems that appear in emotional context. There are some definitions of EI and besides the most comprehensive is one that define EI as four-level set of ability, as follows: *Emotional intelligence involves the ability to perceive accurately, appraise, and express emotion; the ability to access and/or generate feelings when they facilitate thought; the ability to understand emotions and emotional knowledge; and the ability to regulate emotions to promote emotional and intellectual growth* (Mayer & Salovey, 1997).

The development of any construct in the science of psychology strongly depends on development of its measure. Emotional intelligence has been conceptualized (and measured) in three ways: a) self-concept approaches describe subject's self-reported beliefs about their abilities of EI, b) mixed conceptualization measures usually include self-concept, but also some kind of ability tasks, c) ability conception defines and measure EI in a manner of academic intelligence, and especially social intelligence. Ability concept of EI postulates four hierarchical dimensions: perception, assimilation, understanding and management of emotion. This model is based on the interaction of emotions and thought while the mixed models of EI conceptualize EI as a combination of cognitive, motivational, and affective constructs.

Higher emotional intelligence serves as protective factor for smoking risk factors in adolescents (Trinidad., Ungerb, Choub & Anderson Johnsonb, 2004), and risk behavior defined as use of alcohol, tobacco and marijuana (Takšić & Rafajac, 2002). Adolescents with higher emotional intelligence are also more likely to report positive relations with others, as well as perceived parental support and are less likely to report negative interactions with close friends (Lopes, Salovey & Straus, 2003). High EI people also are high in empathy (e.g., because they perceive others' emotions more clearly), life satisfaction, warmth of upbringing (Mayer, Caruso & Salovey, 1999), openness to feelings, and quality of relationships. They are higher in self-esteem and lower in neuroticism (e.g., because people high in neuroticism and/or low self-esteem do not manage their emotions as well as others) (Smith & Petty, 1995).

Emotional intelligence, as defined above, has wide range of useful implications for adolescents in high school. When faced with the struggles of adolescence, all four factors of emotional intelligence can contribute to the development of adolescent. Furthermore, these domains can assist in fostering a strong form of development in mind and in body, for each adolescent. One of the challenges in terms of emotional intelligence in schools is how, where, and when to foster it. It may be possible to develop it through organized sports. Research have shown that quality physical activity and participation in organized sport activities facilitate outcomes such as moral and social development, motor competence, positive self-perceptions, and positive affect (Smith, 2003).

Method

Subjects. From the total number of 213 Ss, hundred twenty one (females and males) were from Regular Gymnasium and 93 (females and males) from Sport Gymnasium.

Instruments. Emotional regulation and control scale (ERCS) consist of 20 items, and measure self-reported ability to regulate and control of negative emotions. The reliability of the Scale is high, and in different samples Cronbach Alphas are in range from 0.79 to 0.83 (Takšić, 2004).

Emotional skills and competence questionnaire (ESCQ-45; Takšić, 2002) consist of 45 items divided in three subscales that measure: a) ability of perceiving and understanding of emotions (ESCQ-PU), b) expressing and labeling emotions (ESCQ-EL), and c) managing emotions (ESCQ-M). The reliabilities of the Subscales are relatively high, and in different samples Cronbach Alphas are in range from 0.85 to 0.88 for ESCQ-PU, from 0.79 to 0.80 for ESCQ-EL, and from 0.71 to 0.74 for ESCQ-M (Takšić, 2004).

Results

Descriptive parameters together with Alpha coefficients of reliability are listed in Table 1.

Table 1. Descriptive parameters and reliability for dependent variable: number of subjects (N), means (M), standard deviations (SD), minimum (Min), maximum (Max) and reliability coefficients (Cronbach α)

SUBSCALE	N	M	Sd	Min.	Max.	Cronbach α
Emotional regulation and control (ERCS)	194	57,77	9,93	30	82	0,81
Emotional perception and understanding (ESCQ-PU)	204	53,03	7,88	33	74	0,88
Emotional expression and labeling (ESCQ-EL)	203	51,91	7,74	32	69	0,83
Emotional management (ESCQ-M)	199	55,26	6,37	39	69	0,74

In Sport Gymnasium were significantly less female students compared to Regular Gymnasium (chi=5,51 df=1 p=0,019). Well known finding that females are better in different kind of EI measures (Ciarrochi, Chan & Caputi, 2000; Mayer & Geher, 1996; Mayer, Caruso & Salovey, 1999; Takšić, 1998; Takšić & Rafajac, 2002; Van Rooy, Alonso & Viswesvaran, 2005) is also appeared in this study. The differences between females and males mean values in emotional regulation and control (t=3,19 df=192 p=0,002), emotional perception and understanding (t=3,44 df=202 p=0,001), emotional expression and labeling (t=2,59 df=201 p=0,010), and emotional management (t=3,00 df=197 p=0,003) were all significant. That is the reason why the analysis of covariance with control of effect of gender was applied in attempt to find out possible difference in EI variables between Gymnasia.

Table 2. Significance of differences between results of high students in Regular and Sport Gymnasium (ANCOVA): observed means (M obs)m adjusted means (M adj), degrees of freedom (df), F – value (F), and significance of F value (p).

SUBSCALE	Regular Gym.		Sports Gym.		df	F	p
	M (obs)	M (adj)	M (obs)	M (adj)			
Emotional regulation and control (ERC)	57,68	57,27	57,89	58,30	1/193	0,52	0,472
Emotional perception and undersanding (EPU)	52,85	52,55	53,28	53,57	1/203	0,87	0,352
Emotional expression and labeling (EEL)	51,01	50,76	53,07	53,32	1/202	5,59	0,019
Emotional management (EM)	54,86	54,60	55,78	56,04	1/198	2,57	0,110

The results show that adolescents in Sport Gymnasium have better emotional competence, but the only significant difference is found in Emotional expression and labeling ability. Students from Sport Gymnasium are better in expressing and labeling emotion compared with their peers in Regular Gymnasium.

Discussion

Physical activity contexts such as organized sport, physical education, and neighborhood games all provide opportunities to interact with peers and therefore may serve as important contexts for youth development, for example by providing opportunity for peer comparison and exposing youth to different points of view (Smith, 2003). Organized sport participation is an omnipresent form of physical activity involvement for children and young adolescents.

Participation in organized sport may also have some influence on development of emotional intelligence in adolescents, through peer interaction. Role of experience with others as well as learning, are key components of social perspective taking and development of emotional intelligence. Peer modeling may also be a mechanism by which youth learn moral attitudes and behaviors. Sport psychology research has shown this to be the case, with peer influence on moral attitudes and behaviors strengthening as youth progress through their sport careers. Participation in sport and greater sport competence is also related to higher social status. The findings for mood self-report data also provide some support for the hypothesis that high EI people are better than others at managing their moods (Ciarrochi et al, 2000).

A variety of inferences may be made to explain why students from Sport Gymnasium are higher in emotional intelligence (expressing and labeling emotion), compared with their peers in Regular Gymnasium. One explanation might be that students who are involved in organized sports have learned to understand both their emotions as well as the emotions of others. This puts them in a position whereby they will attract many positive peer relationships, as people know

this is a person they can talk to and trust. As a result of the positive socialization, students feel good about themselves and they are psychologically well off. Another explanation may be the idea of reciprocity in social interactions, whereby students who participate in sports activities are able to engage better in interaction with a wide range of individuals. They are able to give of themselves and receive from others in a variety of ways in return. This social reciprocity would help them to develop their emotional intelligence skills.

The effects of emotions upon sport performance and athletes have recently attracted the attention of researchers and practitioners. Though results remain far from conclusive, advancements have been made in the study of performance-related emotions in relation to whether they are facilitating or inhibiting positive or negative (Robazza, Bortoli, Nocini, Moser, & Arslan, 2000). Negative emotions seem to be perceived as benefiting performance when moderate in intensity, but this group-level finding does not generalize for all athletes since some competitors may perceive high levels of negative emotions associated with optimal performance. Nevertheless, emotions are important in sport performance, what could explain why students from Sport Gymnasium are better in their labeling and expression.

The concept of emotional intelligence has inspired numerous school-based programs of social and emotional learning, as well as management training programs. However, there has been much debates about how emotional intelligence should be defined and assessed, and what it may predict. Does emotional intelligence contribute to social and emotional adaptation over and above personality traits and traditional intelligence? To what extent is emotional skills domain or context-specific? These questions have implications both for our understanding of social and emotional adaptation, and for the design of school-based or work-based social and emotional training programs (Lopes et al, 2003). Regardless of the answers, school is an opportune environment to provide or teach life skills within each of the four domains of emotional intelligence. In addition, schools are the first place, and the place where the largest part of socialization takes place for children and adolescents.

This study has shown that student from Sport Gymnasium are better in labeling and expressing their emotions then their peers from Regular Gymnasium. Results can be explained by influence of participation in organized sports on development of EI. But some other factor, which might have influence on results weren't included in this study. Personality factors also have to be considered, because someone who is a prone to negative emotions may need to work harder to develop emotional control, thereby acquiring more sophisticated repertoire and understanding of emotional regulation strategies. This person might then obtain a high score on a test of emotional intelligence, regardless of participation in sports. Similarly, someone who is dispositional prone to experience more positive emotions may feel less need to pay attention to emotional regulation strategies and have lower score on EI test. Results from the study made by Gannon and Ranzijn, (2005) indicate that emotional intelligence makes a small contribution to life satisfaction beyond personality, as measured by a self-report scale. Further research is needed to understand more fully the nature of emotional intelligence, its relationship with personality and other factors. In order to identify the most appropriate methods of measuring EI, more extensive investigation of the relationships between actual abilities, self-reported abilities, observation and other-reports of abilities is required.

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PERSONALITY AND MOTIVATION OF FEMALE AND MALE SPORT DANCERS

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Abstract

We compared 14 male and 14 female top level sport dancers with 40 male and 40 female other athletes (gymnastics, swimming, track and field, Nordic skiing, biathlon and judo) between 17 and 30 years, in personal characteristics, motivation and self-motivation. One-way ANOVA was used to determine the differences between sport dancers of both genders on one side and other individual athletes of both genders on the other side. All sport dancers are in comparison with other athletes more energetic, dynamic, communicative, and more capable of self-presentation and they have bigger influence on others. Dancers seem to be braver, more extraverted, sociable, and open and relaxed people in comparison with other athletes of individual sport disciplines.

Key words: *Big Five Observer, Sport Orientation Questionnaire, Sport Attitudes Inventory, Self-motivation Inventory*

Introduction

One of the goals of every competition activity – same in sport dance – is result. Over and over again it represents a challenge for athlete, competitor, for trainer and all of those people who had participated their knowledge and qualities to create a successful result. Sport dancing in Slovenia has a long-standing tradition, as well as many great international successes in sport dancing competitions (Zaletel Černoš, 2002). Bigger national and international concurrence is demanding more precision, systematic and professional work with young dancers and also more holistic, interdisciplinary approach to this kind of sport branch.

The psychological researches indicate some specific personal characteristics for sport achievements, like emotional stability, extraversion, endurance, sociability and others (Tušak, Kos, Bednarik & Kos, 2002). It is very hard to find specific profile of top-athletes, because personality is very complicated dimension. Many studies established some differences between athletes and non-athletes, between athletes of individual and group sports and also between female and male top athletes. The athletes are usually more extroverted, emotionally stable and express stronger need for achievement and stimulation (Butt, 1987).

Athletes are usually extroverted and opened in their outward communication (Eysenck and others, 1981), have stronger achievement need (Davis & Mogk, 1994; Tušak, 1995), have stronger stimulation need (Cratty, 1989; in Tušak, & Tušak, 1997), more aggressive (Tušak, 1994), more psychologically stable (Hašek & others, 1976; Kane, 1978; in Tušak, 1998), have better emotional self-control (Ogilvie & Tutko, 1966) and are more emotionally stable (Butt, 1987; Tušak, 1998), less anxious (Martens & Gill, 1976; Highlem & Bennet, 1979; in Tušak, & Tušak, 1997), more self-confident (Ogilvie, 1968; & others), show higher degree of dominance (Thakur & Thakur, 1980), show higher degree of responsibility (Bruner, 1969).

The second group of investigations focused on personality differences between more and less successful athletes. The main findings concern stronger stimulation need among more successful athletes (Cratty, 1989), higher degree of extroversion shown by more successful athletes (due to constantly inherent lower level of stimulation, athletes need higher sensory; Eysenck, 1981), higher degree of frustration tolerance and tolerance for unpleasant stimulation and pain shown by the successful athletes (Lazarevič & Havelka, 1981), higher degree of self-confidence and positive self-view of the successful athletes (Ikegam, 1970; Ogilvie, 1968), lower degree of pre-contest anxiety and stress as well as effective techniques of dealing with these tensions shown by successful athletes (Martens & Gill, 1976; Tušak, 1998).

The third factor that influences the personality of an athlete is a sport branch. The athletes involved in individualistic sports show dominance, individualistic tendencies, sometimes on the margin of selfishness, endurance, high level of self-control, self-motivation and self-responsibility (Tušak, 1997). Nevertheless Tušak and Tušak (1997) showed that differences in many of psychological dimensions between top level athletes, based on sex or different disciplines, are disappearing.

Method

The goal of our research was to establish differences in personal characteristics, competitive motivation and self-motivation between female and male sport dancers on the one and other individual female and male athletes on the other side.

Subjects. Subjects were 14 male and 14 female sport dancers and 40 male and 40 female athletes of some other individual sports, which were available for this research (gymnastics, swimming, track and field, Nordic skiing, biathlon and judo). All subjects have world, international or perspective category class in Slovenia. Their age was between 17 and 30 years; average age of female and male sport dancers was 19,81, standard deviation was 4,45; average age of other male and female athletes was 22,97, standard deviation was 4,40.

Instruments. We used questionnaire Big Five Observer (BFO), which is composed by 40 pairs of bipolar adjectives, chosen for measuring of big five factors of personality. Each pair of adjectives is needed to be evaluated from 1 – one side of characteristics, to 7 – the opposite side. Scales are measuring five dimensions (Caprara, Barbaranelli, Borgogni, Bucik, & Boben, 1997; in Bucik, Boben, & Krajnc, 1997).

Next was Sport Orientation Questionnaire (Gill, & Deeter, 1988; in Tušak, Černohorski, Bednarik, & Tušak, 2002). SOQ includes 25 statements, which subjects are evaluating with 5-level scale.

Sport Attitudes Inventory (Willis, 1982; in Tušak, Černohorski, Bednarik, & Tušak, 2002) is composed by 40 statements and is measuring the main three motives for competition.

Self-motivation Inventory (Dishman, Ickes, & Morgan, 1980; in Tušak, Černohorski, Bednarik, & Tušak, 2002) includes 40 statements, which subjects are evaluating with 5-level scale.

Mentioned questionnaire was consisted by five dimensions: energy, extravertion, emotional stability, accessibility and scrupulousness.

Procedure. Beside methods of descriptive statistics one-way ANOVA was used to determine the differences mentioned above.

Results

Table 1. Differences in personal characteristics between female and male sport dancers on one side and female and male athletes of other individual sports on other side

	dancers		other athletes			
Dimension	**mean**	**SD**	**mean**	**SD**	**F**	**p(F)**
Energy	44,00	4,78	39,06	7,15	5,21	0,03*
Extravertion	45,62	4,17	43,69	3,70	2,33	0,13
Emotional stability	42,85	5,91	39,78	7,00	1,93	0,17
Accesibility	45,15	4,85	42,03	6,55	2,41	0,13
Scrupulousness	46,21	5,70	42,81	6,46	2,89	0,10t

Legend: F – F relations, * - p<0,05

Sport dancers (of both genders) are in comparison with other athletes more energetic, dynamic, communicative, and more capable of self-presentation and they have bigger influence on others. Dancers seem to be braver, more extraverted, sociable, open and relaxed people in comparison with other athletes of individual sport disciplines. Higher values in extraversion of sport dancers shows, that they feel more original, creative, innovating, open for novelties, bright and curious. Higher values in emotional stability are suggesting more stabile, patience, content, relaxed, calm, joy persons with high tolerance for stress. Persons with higher emotional stability are usually more optimistic, mature, calm and they have high tolerance on frustrations.

Sport dancers have probably higher need for impulses. Their extraversion and social expression are showing higher quality of specially aesthetics performance, which is not so much important for other athletes of different non-aesthetics sport disciplines (Zaletel Černoš, 2002).

Table 2. Differences in personal dimensions between female sport dancers and female athletes of other individual sport disciplines

	dancers		other athletes			
Dimension	**mean**	**SD**	**mean**	**SD**	**F**	**p(F)**
Energy	37,62	9,21	41,59	6,64	2,70	0,11
Extravertion	44,08	4,42	43,32	5,59	0,18	0,67
Emotional stability	41,54	7,17	39,88	7,13	0,51	0,48
Accesibility	44,08	6,98	43,32	4,96	0,17	0,68
Scrupulousness	46,77	3,37	45,88	4,46	0,42	0,52

Legend: F – F relations, * - p<0,05

There were no statistically important differences found in mentioned personal characteristics between female dancers and other female athletes.

Table 3. Differences in personal characteristics between whole group of sport dancers (both genders) and athletes of other individual sports (both genders

	dancers		other athletes			
Dimension	**mean**	**SD**	**mean**	**SD**	**F**	**p(F)**
Energy	40,81	7,89	40,36	6,96	0,07	0,79
Extravertion	44,88	4,28	43,50	4,73	1,62	0,21
Emotional stability	42,19	6,47	39,83	7,01	2,20	0,14
Accesibility	44,62	5,91	42,70	5,76	2,03	0,16
Scrupulousness	46,48	4,64	44,39	5,69	2,85	0,09t

Legend: F – F relations, * - p<0,05

All athletes think of themselves as very dynamic, energetic, talkative, communicative, dominant persons, with capability to influence on other people. Also there are some high values in dimension openness, which can be treated and understood as an additional proof that top-level sport requires original, intelligent and creative personality, open for novelties.

It seems that level of openness is connected also with level of self-confidence of individual (Tušak, Kos, Bednarik, & Kos, 2002). Sport dancers need a lot of self-confidence for dance appearance or show in front of public, audience and judges, who evaluate every move, gesture and smile they make.

Lower result in emotional stability shows, that other athletes of different individual sport disciplines are not as strong as dancers are confident in control of their emotions and impulses. Higher control of staying calm and balanced is typical for sport dancers of both genders, who have also absence of negative emotional states and worries. Sport dancers think of themselves as more reliable, precise, disciplined and hard working persons as other athletes.

Table 4. Differences in motivational dimensions between sport dancers and athletes of other individual sport disciplines of both genders

	Sport dancers		Other athletes			
motives	**Mean**	**SD**	**Mean**	**SD**	**F**	**p(F)**
Competition	55,79	2,64	55,16	0,99	0,04	0,83
Need to win	20,57	4,09	22,50	5,29	1,47	0,23
Achieving goals	27,93	1,59	26,22	4,90	0,61	0,21
Motive for strength	37,07	8,89	36,22	9,43	0,01	0,91
Reaching for success	52,71	17,38	53,28	15,43	0,01	0,91
Avoiding unsuccessfulness	33,64	6,67	32,66	8,65	0,14	0,71
Self-motivation	154,67	18,54	147,78	19,99	1,07	0,31

In sport orientation (competition, need to win, and achieving goals) sport dancers have little bit higher results from athletes of other individual sport. The biggest difference is in parameter of achieving goals. Dancers give a lot of attention reaching or striving to fulfil themselves as personalities, to “grow”. In top level sport the main goal is always success. Ways to get there are different and are depending on level of individual motivation, but goal still stays the same (Tušak, Černohorski, Bednarik, & Tušak, 2002).

Table 5. Differences in motivation of female dancers and other female athletes

	Female sport dancers		Female other athletes			
motives	**Mean**	**SD**	**Mean**	**SD**	**F**	**p(F)**
Competition	52,38	7,42	54,29	5,68	0,89	0,35
Need to win	22,15	4,38	22,24	4,55	0,00	0,96
Achieving goals	26,46	4,33	27,21	2,45	0,55	0,46
Motive for strength	43,15	5,00	39,52	6,44	3,34	0,70
Reaching for success	65,50	10,45	59,91	12,14	2,01	0,16
Avoiding unsuccessfulness	32,77	5,75	34,56	6,87	0,69	0,41
Self-motivation	155,33	20,16	152,42	16,10	0,25	0,62

There were higher results showing on almost all dimensions of motivation at female sport dancers, except at motive for strength and motive for success – typically competitive motives. Female dancers like to have influence on others, like to be in control with dance partner. Motive for success suggests connection between results from competitions and expectations of next results yet to come and emotions which follows those (Roberts, 1992).

Table 6. Differences in motivational structure of sport dancers and other athletes of both genders

	Sport dancers		Other athletes			
motives	**Mean**	**SD**	**Mean**	**SD**	**F**	**p(F)**
Competition	54,15	5,65	54,71	8,61	0,10	0,75
Need to win	21,33	4,22	22,36	4,88	0,92	0,34
Achieving goals	27,22	3,24	26,73	3,84	0,35	0,56
Motive for strength	40,00	7,90	38,15	8,11	1,01	0,32
Reaching for success	58,62	15,73	56,70	14,12	0,32	0,57
Avoiding unsuccessfulness	33,22	6,14	33,64	7,78	0,06	0,81
Self-motivation	155,00	18,95	150,14	18,13	1,23	0,27

In dimensions of motivational structure there are no significant differences between sport dancers and other athletes of both genders.

Conclusion

The goal of our research was to analyse personal characteristics, motivation and self-motivation of female and male sport dancers. Results showed no significant differences between both groups of athletes: sport dancers of both genders on one side and other individual athletes of both genders on the other side.

Statistically significant difference was established only between all dancers and other athletes in personal dimension energy. There was tendency towards significant difference in parameter scrupulousness. Results are consequence of learning very stereotypical roles of social environment, where boys are expected to be very active, energetic, extraverted, turned toward achievements, girls on the other hand should be more passive, retreated, turned inside toward emotions. In sport dance those roles are usually acted between female and male dance partner, but they differ when the nature of dance demands other way.

Area of motivation didn't show us any significant difference. Subjects are very similar in field of top level athletes and they can be treated likewise. From the viewpoint of analysed dimensions we can see them as one group of top level athletes. Dance is sport with artistic and aesthetical elements as well as other similar sports (artistic gymnastics, figure skating, synchronic swimming, and sport aerobics). We should treated our dancers same as the other top level individual athletes.

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Research Methodology

4th INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

"SCIENCE AND PROFESSION – CHALLENGE FOR THE FUTURE"

Editors:
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KINESIOLOGY*) AS A BRANCH OF BEHAVIORAL SCIENCE (CALL FOR A "REFORM", INCLUDING PHD STUDY)

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Captatio benevolentiae

This presentation is not supposed to be a standard research or theoretical paper but rather a subjective general consideration initiated by three personal views of the author. 1. A look back at the developments up to present (Blahuš 1993), 2. Certain critical deliberation about our scientific discipline in the light of more rigorous criteria of "genuine science" (Blahuš 1999, 2005), 3. View of formalistic methods used in different other disciplines of behavioral science (Blahuš 2004d). The contemplative approach does not make an obstacle to result into certain suggestions, maybe suggestions too revolutionary, nevertheless possibly initiating at least some small practical steps. In a self-critical reflection I have to admit that I am aware that the following text is not an attempt to present an exhausting and fully documented overview of the topic.

Some aspects of a "genuine" science in the behavioral science pool

However kinesiology is a scientific branch that bears the signs of interdisciplinarity, transdisciplinarity, and a use of wide spectrum of various empirical research methods, I would insist that its core and prevailing part tend to lay in the behavioral science (Blahuš 2000, 2004d, 2005). At present, we may witness certain signals of a departure from the post-modern philosophy of science (Ruse 1994, Gross etal. 1996, Constas 1998) toward a promising era that some call "After-postmodernism" (After-postmodernism, 1997). Let us hope that the clashes of quantitative vs. qualitative approaches and the related "methodolatry" (Schrag 1992) will be more or less peacefully transformed (Schutz 1989, Greene etal. 1989, Morse 1991, Brannen 1992, Hendl 1997) into serious movement for the new (and/or old ?) *Critical Methodology* (Gross etal. 1996, Slife & Gantt 1999, Yanchar etal. 2005), and rigorous scientific evidence. Then, it seems that behavioral science is again coming back to compare itself with respect to the ideal of "hard sciences". To transfer this tendency of comparative self-evaluation we may think about comparing Kinesiology with respect to the "best" / "hardest" (?) branches of behavioral science, whose prototype, perhaps an extreme one, may be psychophysics.

I do *not* think that a formal legal act or an institutional establishment could build recognition of science. Nevertheless, still, it may be interesting to notice what certain streams stimulated by contemporary problems in behavioral science as mirrored in the problematic of educational research in the USA have recently resulted in. As an example let us have a look at "Education Sciences Reform Act" (ESRA 2002) stating *scientifically based education research standards* whose nine features I quote a little abbreviated and modified:

- Objective methodology for reliable and valid knowledge relevant to education activities,
- Presentations and claims that are appropriate to and supported by the methods employed,
- Employing systematic empirical methods that draw on observation or experiment,
- Involving data analyses that are adequate to support general findings,

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*) Kinanthropology is the accredited science in Czech Republic, and in some other countries. Too: Human Kinetics, and other terminology in some universities. Et c., cf. Blahuš 2000, 1993.

- Relying on measurements or observation methods that provide reliable data,
- Making claims of causal relationships only in random assignment experiments - or other designs to the extent such designs substantially eliminate plausible competing explanations
- Ensuring that studies are presented in sufficient detail to allow for replications,
- Using research design and methods appropriate to the question posed,
- Be open to critique, acceptance by peer-reviewed journals or by a panel of independent experts.

As I cannot find some of my own points among these institutionally claimed criteria, and since I have a certain overall conception, let me paraphrase the nine features by mine, even if there is a certain overlap. Thus, in my view:

- An empirical research is to be *theory laden* (Schutz 1993, Blahuš 2004a). It must be hypotheses-falsification oriented (in the sense of the Popper´s philosophy of science), with the *hypotheses* pursuing one or a couple of theoretical paradigms, which they had been derived from. The confirmatory and exploratory approaches in the empirical research are to be balanced according to the area specificity, but mostly a blind exploratory one should be avoided.

- The *theoretical paradigms* (specifically focused theories) have to consist of a network of structured hierarchy of explanatory *theoretical concepts* (constructs), cf. Blahuš 1996b, 2000, which are interconnected with their *empirically observable* standardized research variables (indicators) by theoretically explicated *rules of correspondence* (they are "operationalized").
- For *observation* or data collection, the empirical research variables have to be standardized, i.e. their "diagnostic quality" is to be verified and known in advance. This is exhibited in the form of *standardization indices*, and characteristics, e.g. coefficients of *reliability*, different types of validities etc.
- In part, the problematic of standardization also covers appropriate logical construction of research variables, their categorization and appropriate way of *data coding* with respect to representation measurement theory and the theory of data (Coombs 1964, McDonald 1999, Blahuš 1996a).
- In experimentation, an *experimental d*esign must be based on the known basic *logic rul*es to allow for some possibility for supporting possibly *causal inference* about treatment - effect relationships in *controlled randomized experiments.*
- The methods of *data analysis* should be under preparation in advance, related to the corresponding research project in accordance with the expected hypotheses and relationships to be identified. (The adequacy with data scaling is perhaps *per se*, nowadays.) The complexity of methods of data analysis should be appropriate to the sophistication level of the problem. (For instance, a use of simplistic comparison of means of control vs. experimental group may be quite inadequate as well as a forced overcomplicated multivariate analysis.)
- If *statistical methods* of data analysis were applied, the blind use of statistical significance and null-hypothesis testing should be abandoned in favor of interpreting the *scientific content significance* (importance, practical significance) and *size of effect* that should be tentatively stated in advance as a part of the specific research hypothesis. The only two exceptions are inferential statistical projects: (i) representative survey study of randomized sample from a clearly defined population that is to be generalized on, and/or (ii) a controlled randomized experimental design. (Cf. Thompson 1993-97).
- Combination of different methods and general methodological approaches, say *triangulation*, (Hendl 1997, Morse 1991) quantitative and qualitative research approaches, should be everytime used.
- Formal methods, modeling approach, abstract symbolic systems, and other related approaches are one of the external signs exhibiting a level of development of a certain branch of empirical science, if they are not artificially, forcefully applied without assessing their contribution to solving a theoretically founded problem.

Formal methods applicable in the framework of the inquiry of Kinesiology

In a comparison, kinesiology exhibits its own certain specific problematic aspects in each of the above-mentioned areas if compared to other behavioral sciences and streams of research. That might be an interesting topic for carrying out an analysis of the methodological differences of kinesiology. Nevertheless, I would like to select just one of these areas and focus on the problems of application of formal methods, the area I have subsumed under my personal look-back no. 3 at the very introduction above.

Some of the formal methods that either are in use or may be used in behavioral science, and I think we should be aware that their use in Kinesiology is either in the stage of already made first steps, or we find their applications in another behavioral branch with a straightforward similarity to our research problems, or the theoretical and methodological character of a kinesiological problems suggests such a use. As an only tentative list, let me mention:

- Artificial Intelligence, the AI-methods
- General Systems Theory analysis
- Formal logic and formalized causal analyses with functional paradigms, computerized
- "Non-quantitative" mathematical methods
- Approaches that are of a general use but not too often or not in an enough sophisticated way used in kinesiology
- Stochastic methods
- Multivariate statistical and psychometric methods (those of extraordinary sophistication)
- Certain further specific, partial, ad hoc suitable formal methods

As regards the general Systems Theory analysis there are computerized systems of a kind of "ready-to-use" for application on any complicated area of realistic problems of control, management, or problem solving. However somewhat similar to expert systems they specifically serve to a team of specialist to analyze a problem area and suggest an optimization of the processes there (for instance Laušman 1993).

In the frame of Artificial Intelligence, for example:

- Pattern recognition
- Neural networks

- RES, the rare events simulation
- HAP, the hierarchy process analysis
- Chaos theory
- Expert systems, computerized
- Artificial machine-like learning
  Et c.

As a series of separate methods in the area of formal logic and formalized causal analyses let me put into the list, for instance:

- computerized formal-logic systems for logic inference, e.g. applicable to check consistency of propositions of theories in kinesiology, its definitions etc.
- fuzzy logic and fuzzy set theory and systems
- causal do-operator networks (Pearl 2000)
- Boolean algebra in logical qualitative analysis (Romme 1995)
  Et c.

Among the "non-quantitative" mathematical methods we may think of

- combinatorial methods
- graph theory
- algebraic structures (cf. similar applications in mathematical biology)
  Et c.

The stochastic methods that are i. a. used in social network analysis may cover for example:

- Bayesian networks
- stochastic processes, especially Markov-, and quasi-Markov chains, even with latent states
- Information Theory

Among the *general approaches* that are not too often or not in an enough sophisticated way used in kinesiology I would enlist:

- Meta-analysis
- Computerized systems of qualitative research (e.g. Weitzman etal. 1995)
- Evidence-based systemic approach, as analogy of "evidence-based medicine", for example Evidence-Based Educational Methods (Moran&Malott, 2004)

However it might seem that the area of *statistics* has been used extensively, and in the wide spectrum of the different statistical methods, it is not the case according to my opinion. There are at least the following groups of statistical methods that did not get enough attention in kinesiology. Those are:

- Structural Equation Modeling with latent variables (SEM, path analysis, latent covariance structures
- Multidimensional Scaling (MDS) and its use for constructing standardized expert scales
- Multilevel Analysis
- more complex regression analysis methods, as regression trees, hierarchical regression, and especially regression analysis of intermediating variables: mediators, moderators, suppressors

A similar situation can be found in the area of the so-called "psychometrics", which quite widely is being misunderstood as too narrowly related to psychology only (McDonald 1999). More appropriately, *psychometrics* should be accepted as a general methodology of interdisciplinary approaches, with statistics taken as just one among others, which primarily should become a general *theory of diagnostic quality* of the measuring and diagnostic methods in behavioral and social research in common. It also deals with the practical tasks like designing systems for assessment, prediction, and selection of persons. In kinesiology the following methods and approaches are either not used at all and/or they are applied only in their over simplistic and trivial forms:

- Multidimensional and multicriterion optimization of constructing test batteries (simultaneous optimization of many properties of test combined with optimum methods of operation research, e.g. linear programming etc.)
- Models of Item Response Theory (IRT) are quite rarely used, and their multidimensional forms perhaps have not been used at all
- Generalizability Theory based analysis of reliability and construct validity of diagnostic methods used in kinesiology
- Problems related to computerized test-item banks, using multi-sampling procedures, computer assisted testing - CAT, Taylorized Testing, test equating, et c. are almost unknown in kinesiology, while they could be efficiently used in admission testing of candidates for a study, for sport talent testing and for many other practical purposes
- Systems for prediction and persons selection, optimum construction of performance norms or selective norms, or continuous computerized modification of norms

Several questions on the capability of researchers, PhD students, and PhD curricula

Obviously, to understand at least the elementary principles of all the methods, and to keep a minimum clear view of the general sense of their possible use is quite difficult even for a researcher or scientist who has been specifically theoretically trained for such a purpose. Further, It is quite impossible to maintain all these areas and methods as deeply understood, and ready-to-use in research practice. Then, a more severe problem is to prepare our researchers - kinesiology specialists - for such an enormous task as concentrated in one person. On the other hand, any research team cannot contribute substantially to problem solving if the members of the team are not prepared at a sufficiently high level and quality for mutual understanding and cooperation. Moreover, social studies of scientific environment show that it is also necessary to have at disposal such scientists who are transdisciplinary prepared to overcome interdisciplinary borders in one-person-melting of two or more branches of science.

From that starting points of motivation allow me to pose couple of questions.

- Do we find research studies in our best journals that are mostly (*!*) of a quality comparable with other behavioral journals, especially as regards scientific evidence of hypotheses prove, elaboration of complex design (e.g. multifactorial experiments), standardization quality,
- Why don´t we find applications of more sophisticated methodology - including formal methods, say SEM, multilevel etc. - as frequently as it is usual in other behavioral science branches?
- Why many of those applications seem to be only ad hoc tentative pilot studies of a nature "just to show it is possible", without a more general scientific conception? Or sometimes even with the only motivation to constern the audience or dissertation committee by a self-purposeful demonstration of an unknown method?
- Isn´t it the case that in many research projects the partial methods of measurement and "data collection" are substituted for a scientifically targeted design of the methodological design, which would be focused on proving evidence for conceptually important hypotheses?
- What is the difference if we compare the situation say to quantitative behavioral science in top branches as mathematical biology, mathematical psychology, psychometrics?
- Is the overall preparation of research workers in kinesiology comparable to most behavioral sciences?
- Is the general methodology of scientific inquiry and specific methodologies of different research designs taught on appropriate level in PhD programs?
- Now, considering the formal methods only, how far the training of PhD students goes behind the simplest multivariate statistical methods as multiple regression, and other methods that are parts of standard statistical software?
- What kind of formal, mathematical, modeling, computerized, etc. methods are being taught in the frame of usual PhD curricula in Kinesiology?

  And, I think the questions may be continued.

Several examples of possible lines for a "reform"

It seems that a principal change and turn should be made to make an improvement of the contemporary state of affairs, especially with respect to the future development of kinesiology and its position and recognition among the other behavioral sciences. The prospect of the future should start with preparing a new generation of scientists - specialists in Kinesiology - should start with necessary changes of kinesiology curricula on all levels. The graduates in Kinesiology are mostly prepared as practical instructors, sport coaches, and physical education teachers. There should be more space for allowing some of the scientifically oriented to get an impulse for a turn from the practical aspects toward research background.

Bachelor level:

- Methodology of research should be a compulsory part of bachelor curricula, covering basic general methodology, research design, statistics, methods of logic, overview of principles of some selected formal and mathematical methods.
- A preliminary scientific stream of bachelor study, starting the end of the last-but-one year plus the last one (usually end of 2nd plus the 3rd), should allow a specialization in a research type program completed with a smaller research thesis even on this bachelor level.
- Thus, already on the bachelor level the preparation and selection of "scientific talents" would start.

Masters level:

- A separate master level program should be especially oriented as a scientific preparation, specifically focused on the further PhD continuation..

- The other ("standard") master programs should be coordinated with the above-mentioned and allow for some mobility of students, especially those who would exhibit the deep scientific interest and capability.
- A cooperation with other departments and colleges within the university as well as across international cooperation with other branches of scientific disciplines would be supposed to prepare the masters students in *specific interdisciplinary branches of kinesiology.*

PhD level:

- Any PhD program / curriculum should contain a compulsory, say two-year courses, of: (a) general methodology of research and research design, (b) overview modern formal methods used in behavioral sciences, (c) one or two specific formal methods training.
- Specific interdisciplinary programs of PhD study should especially promoted and supported, and carried out in bi-, trilateral cooperation with the other departments whose primary orientation is to formal methods (say artificial intelligence, information theory,...).
- Research program and the possible interdisciplinary formal method application should be interrelated and compared to the corresponding applications in the behavioral branches outside the kinesiology (say a scaling study compared to MDS studies in mathematical psychology etc.). Publishing in scientific journals outside kinesiology should be highly demanded.

Concluding remark on organizational aspects

It might be helpful, also in cooperation with other European bodies related to kinesiology as well as outside those, to establish a specifically focused *committee on the scientific preparation and PhD study in kinesiology in the frame of European Union* (too, with a wider international coordination), which would elaborate recommendations and suggest further organizational steps to ensure higher level of research in kinesiology and its related scientific recognition.

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ERRORS IN PARAMETER ESTIMATES USING EM ALGORITHM WITH SINGLE IMPUTATION AND DIFFERENT MISSINGNESS MECHANISMS

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Abstract

The paper is dealing with some parameter estimates (of μ, σ and Pearson r) in case of missing data. Performance of EM algorithm with different missingness mechanisms (MCAR, MAR, NMAR) is being analyzed, when one, two or three normally distributed correlated variables are included in the analysis. Results of simulation study in SPSS statistical package with both EM estimates of parameters, as well as parameters calculated from single imputed dataset are presented.

Key words: *missing data, missingness mechanisms, data imputation, parameter estimation, EM algorithm*

Introduction

A common problem in kinesiological research is missing data. For example, in survey research, a respondent may not know an answer, forget to give one or be unwilling to give an answer. Substantial missing values may threaten the validity of the research. In some cases, especially with multivariate data, it may be impossible to carry out an analysis because of the missing data.

The effect of missing values on parameter estimation depends not only on methods of their imputation (or elimination from the analysis) but also on the mechanism causing missing values. The least problematic, but probably also the most unrealistic situation, except when using data fusion (Rässler, 2004), is the one where data are missing completely at random (MCAR), i.e. the probability for the data to be missing is independent from the actual (observed) values of the variable itself and any other variable. With the missing at random (MAR) mechanism, the probability of the data being missed depends on other variables, but not on the variable itself (e.g. the elderly are less likely to answer questions compared to the younger generation). In the worst case, which, unfortunately, happens quite often, the not missing at random (NMAR) mechanism takes effect; in this case, the probability for missing value depends on the observed value itself (e.g. the respondents with higher income are more likely not to answer the question on income).

Dealing with the missing values is a serious problem with many different solutions. However, many methods routinely used by researchers may not be appropriate. Listwise deletion of the missing data is problematic when units with missing values are different from the ones with complete data. Pairwise deletion may cause "impossible" correlations, creating problems for further analysis (e.g. matrices not positive definite). Mean substitution decreases variance of the data and increases correlations among variables. Regression substitution decreases error variance and therefore increases multiple correlation of variables. Some other methods are known both for parameter estimation as for imputation of missing data.

When imputing missing data two approaches are possible. One is single imputation, which leads to only one complete dataset. The other is multiple imputation, which produces multiple datasets (usually 3-10 is enough for reasonably good estimates). The first approach is more practical because the researcher can carry out the analysis as if there were only one, complete dataset. The latter approach usually gives better estimates, especially with NMAR and high proportions of missing data, but the researcher must repeat the analysis on every dataset and then combine parameter estimates from different datasets, assuming some distribution of parameters, e.g. normal (Rubin, 1987) or t (Barnard & Rubin, 1999).

One of the most promising methods to deal with missing values today is the EM algorithm (Hartley, 1958). It is an iterative two-step procedure, the two steps being E and M. In the E (expectation) step, the expected value of (logarithmic) likelihood function is evaluated with observed data and parameter estimates from the previous step (Q'_{i-1}). In the M (maximization) step this function is maximized, giving new parameter estimates (Q'_i), which are used again in the E step. Each iteration is guaranteed to increase the loglikelihood:

$$Q(\theta^{(t+1)}|\theta^{(t)}) \geq Q(\theta^{(t)}|\theta^{(t+1)})$$

and the algorithm is guaranteed to converge to a local maximum of the likelihood function (see Dempster et al., 1977 for detail). Typically, just a few tens of iterations are enough for convergence. For EM to work properly, data distribution must be known in advance and the likelihood function must be a linear function of observed data or their sufficient statistics.

Parameter estimation and single or multiple imputation of missing data is available in most modern statistical programs (for a review see Scheffer, 2000); it is also included in leading software packages like SAS, S-plus or SPSS. The latter has a special add-on package MVA (Missing Value Analysis), which supports EM algorithm for multivariate normal and t distributed data. The performance of the implementation of this algorithm in SPSS is analyzed in the present paper.

Methods

EM algorithm was evaluated with the following simulation:

1. From 3-dimensional multivariate normal distributed variables Z, X and Y, randomly select n=10000 units with the following correlations (covariances):

	Z	X	Y
Z	1.000	0.763	0.400
X	0.763	1.000	0.488
Y	0.400	0.488	1.000

These are actual correlations between three motor tests of PE students (Z=100 m dash, X=2400 m run – "Cooper test" and Y=100 m swimming free style).

2. (1 variable) Delete 50% of values of Y with MCAR (randomly), MAR (Z<0) and NMAR (Y<0) method and compare parameters of complete data with EM estimated parameters and parameters computed on EM imputed data. Only Y variable is included in the analysis. Parameters μ and σ are compared.
3. (2 variables) Repeat the previous step, but include completely observed (no missing values) variable Z. Besides μ and σ, compare also the correlation (r) between Y in Z.
4. (3 variables – data fusion with no simultaneously observed X and Y values). Delete one half of randomly selected values of Y and the other half of X values. Include all 3 variables (Z with no missing values) in analysis. Compare μ, σ and r_{XY}.
5. (3 variables – data fusion with 5% of simultaneously observed X and Y values). Repeat the previous step, but this time only 45% instead of 50% of X values are deleted (so that 5% of units have no missing data in any of the variables).

SPSS 11.0 for Windows was used in the simulation.

Results

One variable

Table 1: Observed and estimated parameters of Y variable, of which 50% of values are missing

	Observed data			EM estimate		Imputed data	
Mechanism	N	μ	σ	μ	σ	μ	σ
(No)	10000	0	1				
MCAR	5000	0,011	0,998	0,011	0,998	0,011	**0,706**
MAR (Z<0)	5000	0,315	0,951	**0,313**	0,944	0,315	**0,672**
NMAR (Y<0)	5011	0,794	0,610	**0,790**	**0,610**	0,794	**0,432**

When parameters of only one variable are being analyzed (Table 1), EM estimates are very similar to the actual (non-missing) values. The same is also true of estimates of μ, calculated with imputed dataset. σ computed on imputed data is much more underestimated then EM estimates itself. This is not surprising, as all imputed data are equal to the μ of non-missing data.

Two variables

Table 2: Observed and estimated parameters of Y variable, of which 50% of values are missing, when another variable, Z, is completely observed

	Observed data			EM estimate				Imputed data		
Mechanism	N	μ	σ	r_{YZ}	μ	σ	r_{YZ}	μ	σ	r_{YZ}
(No)	10000	0	1	0,4						
MCAR	5000	0,011	0,998	0,408	0,004	0,997	0,406	0,004	0,761	**0,532**
MAR (Z<0)	5000	0,315	0,951	0,405	-0,002	1,001	0,402	-0,004	0,764	**0,530**
NMAR (Y<0)	5011	0,794	0,610	0,272	**0,741**	**0,612**	0,284	**0,741**	**0,450**	0,387

When 50% of Y variable are missing, but there is another, completely observed variable Z with r_{YZ}=0.4, EM estimates are excellent under MCAR and MAR missingness mechanisms (Table 2). When imputing data, missing under those mechanisms, variances are underestimated and correlation r_{YZ} is overestimated. These results are expected, as missing values are imputed under regression principles (linear regression with β *c*oefficients calculated from EM estimates of covariance matrix).

With NMAR missingness mechanism, EM estimates are almost the same as values calculated from observed data. This is true also of μ of imputed data, where σ is strongly underestimated. It is interesting that r_{YZ} is almost correct, which is probably the result of two opposite effects, i.e. the underestimation of this parameter with observed data and the overestimation of EM algorithm with imputed data (no matter of missingness mechanism).

Three variables

Table 3: Observed and estimated parameters of Y variable and its correlation with X, when 0% and 5% of X and Y values respectively are simuntaneusly observed

	Observed data				EM estimate			Imputed data		
Mechanism	N	μ	σ	r_{XY}	μ	σ	r_{XY}	μ	σ	r_{XY}
(No)	10000	0	1	0,488						
MCAR 0% compl.	5000	0,011	0,998	?	0,003	0,997	**0,004**	0,003	0,831	**0,006**
MCAR 5% compl.	5000	0,011	0,998	0,536	0,005	0,998	0,547	0,005	**0,804**	**0,738**

When missingness is induced by design of the research, all μ estimates are very good (Table 3). Variance estimates are also good, but variances of imputed dataset are underestimated, surprisingly more so when 5% of units have no missing data.

The correlation (r_{XY} = 0,488 in a complete dataset) is, as expected, almost equal to 0, when no units have simultaneously observed both X and Y values. When there are 5% of such units, r_{XY} is drastically overestimated, which is similar to the situation where only two variables were involved in the analysis.

Discussion

The following findings are important for the use of EM algorithm with single imputation of missing data:

- EM estimates of means are good, as well means, estimated from the EM imputed data, except with NMAR missingness mechanism.
- Variances are underestimated in all situations.
- Correlations (their absolute values) are in most cases overestimated. Surprisingly, estimates are bad even when using data concatenation with 5% of cases with complete data.
- Estimates calculated from EM imputed data are in most cases much worse than estimates given by EM algorithm itself.

Underestimated variances suggest that it is better to use multiple imputations than single one (as in SPSS).

Implementation of EM algorithm in SPSS has proven appropriate. Convergence is achieved in most cases in less then 25 iterations. However, relatively strong assumptions must hold for good estimates, i.e. many numerical, normally distributed variables, MCAR or MAR missingness mechanism, and low proportion of cases with missing data. This finding is in agreement with some other studies (e.g. Scheffer, 2002; Rässler, 2004). SPSS does not support multiple imputation, so in most cases users should consider other programs to deal with missing data, such as *Amelia* (King et. al., 2001) or R (functions *em.norm* and *imp.norm* in *Norm* library).

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HOW TO CONDUCT BASIC QUALITATIVE RESEARCH: THE MISSING LINK

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Abstract

The purpose of this paper is to describe how a researcher may conduct a basic qualitative research. Sample, the criteria for the sample, as well as sources of information for the study – especially that of interviews, observations and documents are discussed.

How to Conduct Basic Qualitative Research: The Missing Link

More and more researchers are beginning to utilize qualitative research. This approach to understanding particular phenomena enables the researchers to capture the voice of the participant. This is a discussion of the sample, how to select the sample, and the sources of information for qualitative research.

The Nature of Sampling in Qualitative Research

The sample in qualitative research is the result of a careful process. Sample selection is a pivotal part of the research because the sample becomes the data and addresses the particular problem of this research. The theoretical framework is the philosophical foundation for the overall study, and the sample provides resources to address this framework (Merriam, 1998). Basic qualitative study is a specific research project to "seek to discover and understand a phenomenon, a process, or the perspectives and world views of the people involved" (Merriam, 1998, p.11). Data will be collected primarily through interviews, but will include observations and documents. The findings of this research will become a combination of description and analysis. This analysis is based on theoretical frame made obvious through the study as well as recurring patterns found in the interview data (Merriam).

The sample is often one of the more distinguishable aspects of qualitative research. Quantitative analysis contains large, random samples, whereas qualitative inquiry contains small, purposely selected samples. Rather than concerns with generalizations, this is an attempt to capture information-rich cases that will supply rich and thick data (Patton, 1990).

Non-probabilistic sampling will occur in order to capture the essence of this study (Merriam, 1998). This research will describe phenomenology rather than logic, quality of experience rather than quantity. These findings will describe, discover, and understand, rather than predict, control, or test. As a result of this investigation the researcher desires to see that which evolves and emerges rather than that which is structured or predetermined. The sample will be purposefully chosen rather than random or representative. The researcher will be personally involved with the research and will induct, rather than statistically deduct. Findings will be rich expressive descriptions rather than precise numbers (Merriam).

In addition to purposive or criterion sampling, snowball or chain sampling will be incorporated by locating key informants. This occurs often by asking specific questions to those who are aware: "Do you know someone that is…who would be interested in participating in this research? Whom should I talk to?" This may lead to opportunistic sampling and fieldwork 'on the spot' decisions to take advantage of new opportunities during data collection (Patton, 1990). There are no rules for sample size in qualitative research; more important is the location of information rich cases (Patton, 1990).

Criteria used in selecting the sample

In order to arrive at a sample that has been purposively chosen, the researcher must have a set of criteria. This criterion creates a list of important attributes for the sample based on the purpose of the study and its theoretical lens (Merriam, 1998). Like a coach carefully crafting a team by scouting for specific recruits, the researcher should be diligent to have a sample that reflects the purpose of the study.

There are various types of purposeful sampling. For example, 'typical' sampling, one that is selected because it reflects an average person of the phenomenon. Also network sampling will be employed to help identify candidates for this study. The researcher will ask for recommendations from the participants for others who may be interested (Merriam, 1998). However, in some ways 'theoretical sampling' will also occur. The researcher begins with an initial sample, yet the data may lead the investigator to the next document or person to be interviewed. This is an evolving process guided by the emerging theory and analysis will occur simultaneously with this process (Glaser & Strauss, 1967; Merriam, 1998; Taylor & Bogdan, 1998).

Similarly Patton (1990) discusses there may not be concrete rules how to focus the study. A knowledge of the literature will help, but more important will be for the researcher to disclose what has occurred in this study (Seidman, 1998) Leaving an audit trail enables the reader to arrive at his or her own decision concerning the veracity of the study. Regardless, there are always tradeoffs among the decisions, yet often these choices are not between good and bad, but from alternatives all of which have merit (Patton).

The researcher must explain what are the criteria of the sample, and how they came about these decisions.

Sources of Information

Interviews. In qualitative research, the interview is usually the main source of data. Therefore, all aspects of the interview are carefully attended, from the walk through the front door to the final transcription. Patton (1990) discusses the 'interview guide approach.' Topics and issues are specified in advance, yet the interviewer will decide the sequencing and wording during the interview. The outline allows for the collection of data to be somewhat systematic for each respondent, and if there are gaps, they can be anticipated and closed. The interview should remain fairly conversational and situational. The flexibility of this format, can allow for a change of sequencing and wording of questions. Yet this may result in substantially different responses reducing the comparability of responses.

In addition, the 'informal conversational interview' can add some important dimensions (Patton, 1990). This natural flow from the immediate surroundings allows for 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. The weakness is that the researcher may have different information from different people with different questions (Patton, 1990). A blend of an interview guide and informal conversational interview will be incorporated.

Seidman (1998) recommends three interviews to gain insight for in-depth, phenomenological based interviewing. Seidman incorporates this method from Schuman (as cited in Seidman). This approach is based on open-ended questions and intends to build and explore the participant's response to the questions. Hopefully the participants can reconstruct his/her experience within the purpose of the study. These three interviews are life history, details of the experience, and reflection on the meaning.

Based on previous pilot studies, this research will use the first interview 1). To become comfortable with one another, 2). To hear the life history of the participant, 3). To become familiar with the tape recorder, and 4). To explain the research and receive appropriate signatures of approval. How and what questions, will be preferred over why questions. The main focus of the research will be introduced and the questions reflecting the study will be given to the participant. This is also a time to make sure the participant fits the criterion of the study. The second interview will concentrate on the specific purpose of the study. The interviewer will use a set of pre-determined questions.

The third interview is time for the interviewer to clear up any questions from and to clarify the purpose of the study. Although all three interviews are tape-recorded only the second will be transcribed for use in the study. Spreading this search for knowledge over three interviews may help prevent a misrepresentation of the sample and allow time to compensate for some of the problems incurred in traditional qualitative research (Hollway & Jefferson, 2000).

Kroth and Boverie (2000) included three separate interviews in their qualitative research on life mission and learning. The three interviews were approximately two hours each, and over a three-month period. The first interview was to establish a general foundation with the person, and to understand the context of their life. The second was focused on the participant's life mission, and the third was a member check. After each interview, tapes were transcribed, coded, and analyzed, and an interview guide was prepared for the next interview. Having more time with the sample not only produces rich and thick data, but also moves the data from mere conversation to portraiture. This portraiture requires careful watching, listening, and interacting with the participant to piece together a more complete picture of the life of the sample (Lawrence-Lightfoot & Davis, 1997).

Merriam (1998) suggests a 'semi-structure' approach as a possibility to the qualitative interview. This description is a mix of open ended and structured question. Questions should be carefully considered, they are the key to the door of data. The questions during this interview will be based on late life adjustment, and not solely focused on learning. For example, the following questions are suggested. What is it like to be an older adult? Can you describe this for me? What changes have you experienced, can you describe these for me? Can you tell me a personal story about being an older adult? What have you done about these changes? Three interviews based on a semi-structured and flexible guide will be incorporated.

Observation and Documents.

As mentioned earlier, the research focus may be hard to discern or observe. The interviewer must be careful to attempt to understand the context of the setting for the interview, but more important is to observe the SDL of the participant. When it becomes clear that the participant is involved in a personal learning, the researcher must focus on this activity. It would be in the interest of the study to participate with them in this self-directed learning and ask them for permission to videotape this experience. During this experience the researcher will try to incorporate any documents that may be available. Perhaps this will be a book, or a craft, or some project that involves personal learning. This visual observation as well as seeing some document will add substantial credibility and triangulation to this work (Patton, 1990).

Summary

There is a need for more qualitative research especially in the field of recreation. Qualitative research allow for the voice of the participant to be understood. There is a need for a thorough understanding of the sample, to have the correct criteria in selecting the sample, and to understand the value of interviews as well as observation.

REDEFINITION OF KINESIOLOGICAL PROCESSES

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Abstract

With special methodology for process identification, we transform initial data to forms that represent main basic processes visible in any sample. Redefinition includes avant-garde approach that describes processes on three-function level as: Persistency, Development and Integration. These processes can be also interpreted as: Defensive acting, Offensive acting and Connection acting. On that basis we recommend future process programming in kinesiology.

Key words: *process, continuum, defense, offense, connection*

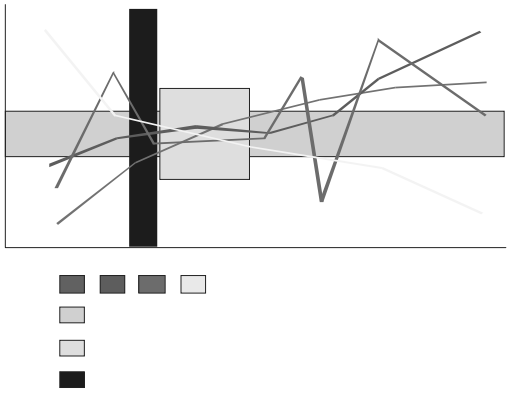
Introduction

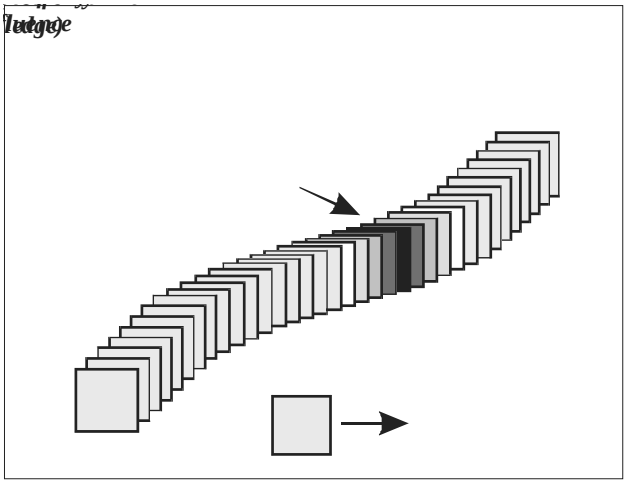
Conventionally, process in general is a continual set of different variable values of some objects visible over several time points. In order with that definition, we obviously have to prepare specific metric instruments for definition of some "measured" virtual space. Within that space, we wish to analyze some interesting objects in manner of their changes. This approach is well known and very often in kinesiology, likewise in all other disciplines. Results generated under such model presents one possible global dimension of transformation types. That dimension is generally marked with area of variables or higher latent dimensions (factors). Therefore, in very rare cases, that approach can give us some useful information about structure changes in sense of clusters of objects, but in that situation we still observe transformation manifestations of objects described in time. Limitations of such logic are more then clear, just because of basic definitions of processes in terms of object characteristics, which irrefutable lead us to control of short bounds of object behavior (Graph 1.). Of course, consequences of such approach are continual disorders, impossibility of object guidance and need for permanent interventions. Although seems that object characteristics are final aim of our researches, globalization of scientific comprehensions lead us to suggestions which are far from such simple conclusions. This paper offers radically different approach. Concerning a process is conception of any kind of changes, construction of local procedures for time points hypothesis proofing is not sufficient any more. This attitude stands especially because we always deal with cumulative effects of previous "unmeasured" periods, which are definitely included in all our data streams. New concept of data analysis incorporates and respects everything that happens in passed periods and affects our data in any possible way.

Human is a complex bio-psycho-sociologic entity that passes various development and transformational phases through its life (Katić at all 2001., Luria 1983., Malina 1984., Piaget 1968.). All of those phases are marked with unchangeable influence of exercising, integrated in total human composition (Mraković 1992.). Neither one human activity is "spared" of that influence and result of each individual depend of appropriate level of cumulative kinesiology knowledge incorporated in total individual integrity, as movement control or as appropriate energetic integration, or both (Katić at all 2001., Mraković 1992.). This means that we cannot just "offer" some blocks of paradigmatic types of exercising, without scientific established and proofed programs (Malacko and Rađo 2004., Malina 1984, Mraković 1992.) It is not acceptable that "market" regulates quality of programs without real scientific competencies. From various sides and from various aspects we offer various exercise programs to various groups of entities, and that whole bunch we too often call treasure (in Latin manner: "*varietas delectat").* Therefore, our children participate in educational programs under developmental models. Some of them, as very young, participate in agonistic sport model programs. For few percent of children with development and other problems we, of course, organize special activities programs. To 2-3% of adults of app. 20-30 years, we can offer leagues and other types of competition activities, up to top-level sports. Some number of adults generally participates in specialist curative treatments after sport, traffic, professional and other injures or diseases. For all others of that age (and some other entities), we gladly think as of people included in some type of recreational activities. With middle-aged people, we try to create exercise habits as health prevention in relation with lifestyle consequences. Finally, with older groups or individuals we organize some energetic low-level activities as typical condition for health preservation. Maybe all of that seems very rich and acceptable, but it is generally inappropriate dispersion and dissociation, because mentioned areas, as kinesiology utilities, do not present integrated scientific model. Reflections of those different models results in bad criteria definitions, so exercise exist in forms with at least doubted determinants. It is impossible to generate efficient kinesiology programs for particular, aged or differently defined groups of entities, without consistent, complete and very clear global comprehension model for exercise, as articulation of clear common theory (Bonacin 2005.,

Malina 1984., Mraković 1992.). In this modest article, we will offer you a model that pretends to be a generalization off crucial fundamentals that unifies all theoretical approaches. Basic questions of all such theories always consider same doubts like nature principles, elements combinations, individuality (Akvinski 1996.), or searching for logical invariant essence of Universe (Akvinski 1996., Hawking 1988.), or construction of reality through mental life development (Piaget 1955.) accepting conceptual tought from senzorimotor intelligence. Some scientists courageously established basics of deterministic natural laws (Newton), and sometimes social development theories (Cleveland and Jacobs1999.) try to establish specific types of hirerachical existence over learning through "social operating systems" and authorities, just like the constructivistic approaches generates conceptual objectives for optimal forms of knowledge transfer (Bloom 1956.). Furthermore, we can register similar indistinctive situation and doubts in different approaches, like materialistic and spiritual models that concentrate tensions in confused theories like Cognitive model domains (Skiner 1989.).

In our days, especially "attractive" ideas come from confusing Chaos models (Cardeira at all1990.), or even singularity models (Hawking 1988.) that represents only strictly local solutions, just as Heisenberg's In-deterministic principle (Strnad 1990.). Unfortunately, that theories have all failed in the moment of complete generalization, so giant amount of logical conclusions and concrete situations do not comply with principles of such theories. In kinesiology, this means that we do not have clear permanent strong point for strategy planning and operational synthesis of reproducible scientific based activities. Finally, as normal consequence, too many of our "programmed" activities lays out of acceptable bounds and are contaminated with important amount of inconsistency and errors. From scholasticism and structuralism, through behaviorism and genetic epistemology (Piaget 1968.), up to constructivism, existentialism, relativism (Strnad 1990.) and singularity, there is no completeness and absolute correspondence of main principles and natural laws. Consequently, kinesiology programs creation is inconsistent and depends of individual standings or attitudes more than it is scientifically acceptable.





Methodological basics

As we all know, many philosophers and scientists for centuries try to explain Universe existence, questions of purpose, development, individuality and other Universe logical premises. Owing to them, we can establish our methodological (including in kinesiology) basics in order with theory we find suitable for project definitions and explanation of our findings. However, we must assume that presence of theories, which number is bigger than one (and no one theory includes all others), means that probably all of them have failed. In that context, for this paper purposes, we will follow an idea of Comprehensive Continuum (Bonacin 2004, Bonacin and Carev 2001) in manner of Continuum Tunnel that explains development, knowledge, comprehension, object position etc. much better then all other existent scientific theories (Graph 2.). Total comprehensions of any individual object are evidently different from all others. That characteristic defines appropriate development position, as visible on graph. However, another important logical dimension exists, a dimension that explains maximization of information in local area. That kind of information, in terms of continuum, is not comprehension but just knowledge. Knowledge, no meter how big, is local collection of information that insures expansion and application on particular artificial comprehension level. This dimension has no frontiers too, but expansion and wideness of this dimension only maximizes transversal Continuum component without unconditional affecting of object in sense of higher repositioning through Continuum. For progress, approaching Continuum forward infinity, a minimal surface of transversal component is quite enough. Of course, that is possible if Continuum comprehensions are immanent to object, and if the object accepts its actual position trying to advance.

Everything more is only a loss of resources and capacities. In such Continuum, we are not talking of Time points but Comprehensive points exclusively. Process in such continuum is nothing but accumulation and structuring of comprehensions, no meter if they are resources, information or anything else. Exactly because everything is determinate, we are able to find laws and regularities that are existent in variably conditions and repeatable. That is what science is dealing with. Under described conditions, processes in kinesiology contain completely different and very new meaning. Simple project will explain ideas of that methodological approach.

Methods

The sample was comprised of 249 children measured three times through 18 months, primary school first formers from Split, who, at the beginning of the experimental procedure, were 7 years +/- 2 months old. All the children had no visible aberrations, and they were all able to participate in a normal program of work in primary school. **The sample of variables** necessary for the assessment was selected in such a way as to cover both the morphological and the motor status: body height (AVIT), arm length (ADUR), leg length (ADUN), biacromial width (ASIR), bicrystal width (ASIK), knee diameter (ADIK), wrist diameter (ADRZ), body weight (ATEZ), chest circumference (AOGK), lower leg circumference (AOPK), forearm circumference (AOPL), skinfold of the back (AKNL), upper arm skinfold (AKNN) and abdominal skinfold (AKNT). All the measures were taken according to the international biological program. The following variables were used for the assessment of the motor status: side steps (MKUS), held part in the hang (MVIS), long jump from a standstill (MSDM), standing on the bench (MP20), polygon backwards (MPOL), sit-ups (MDTS), 20m run from a standing start (M20V), straddle forward bend (MPRR), hand-tapping (MTAP), foot-tapping (MTAN) and throwing the ball for distance (MBLD), 3-min run (FT3M) was used to assess the aerobic work. All the measurements were done by qualified people who had significant experience in collecting the aforementioned initial data. **The data processing methods** implied everything from the metric characteristics, over the elementary statistical indicators, up to the multivariate methods. First step of complex data analysis includes concatenating of all three measures to provide data streams of 747 locations. For common data part preservation there was used image analysis over all 747 “entities”. After that we applie polar taxon analysis, and finally Analysis for process identification (Bonacin 2004, Bonacin and Carev 2001.). Structure of comprehension taxons describes processes that really exists in that sample.

Results and discussion

Table 1. Three main processes over composite sample and variance

	CH1	CH2	CH3
AVIT	**0.99**	0.09	-0.34
ADUR	**0.98**	0.10	-0.36
ADUN	**0.96**	0.11	-0.38
ASIR	**0.80**	0.09	-0.09
ASIK	**0.81**	0.22	-0.13
ADIK	**0.83**	-0.03	-0.06
ADRZ	**0.73**	0.01	0.10
ATEZ	**0.86**	0.24	0.17
AOGK	**0.65**	0.17	***0.28***
AOPK	**0.69**	0.20	***0.29***
AOPL	**0.62**	0.23	***0.39***
AKNL	0.10	0.54	**0.65**
AKNN	0.01	0.60	**0.66**
AKNT	0.05	0.60	**0.65**
MKUS	-0.24	**0.64**	-0.12
MPOL	-0.19	**0.69**	-0.13
MP2O	0.23	**-0.47**	0.11
MPRR	0.29	**-0.33**	0.08
MTAP	0.05	**-0.53**	***0.43***
MTAN	0.10	**-0.57**	***0.39***
MSDM	0.15	**-0.73**	0.16
MBLD	0.32	**-0.49**	0.18
M20V	-0.14	**0.64**	-0.24
MDTS	0.25	**-0.58**	0.23
MVIS	0.05	**-0.65**	0.01
MT3M	0.25	**-0.57**	0.06
?	***7.97***	***5.42***	***2.48***

Although seems that results are given in standard manner, it is critical to understand that Table 1 shows three main processes. First is Energetic and other recourses accumulation or, in order with Continuum definitions Persistent acting (CH1). This characteristic includes everything from far past until today for self-preservation. We built everything else around that our axis of force and strength, which grows under specific physical circumstances. It includes body mass in all forms of different bones and other internal and external volume characteristics. Without that, we will not be able to endure and exist in various natural conditions. More expressed Persistent acting – bigger chance for survival and develop.

We can mark this characteristic as some kind of little passive comprehension but it is essential for existence, because it represents our defensive potential. In terms of kinesiology, we can name it as Antagonistic acting. It obviously starts very low on the Continuum Tunnel, and is logically very old, although we will “carry” it with us for a long time in future comprehensions. There is no need for special discussion that this characteristic is slowly loosing its dominance in human’s existence.

All composite elements of CH1 are organic, of course, but in the same time, they represent nothing “alive”, so describe pieces of stones, water, metals, Earth and Sun adequately incorporated in our bodies. On the other side of such thinking, there stands Develop acting (CH2). As we can se, all movement characteristics make such combination, with persuasive composite, which can efficiently act in entity environment. Just as CH1 represents internal accumulation, CH2 is nothing but managing and manipulation with external objects. That possibility includes self-repositioning in natural environment, because of easy understandable changeable environmental natural conditions that affect any entity. Solving problems connected with any kind of other entities is directly under control of this characteristic. As CH1 is essential for long-term survival and defense, CH2 is essential for develop of routines

for long-term acting and attacking, which means that this characteristics represents our offensive potential. In terms of kinesiology, we can name it as Agonistic acting. Through Comprehensive Continuum, this characteristic is newer in existence, and we must agree that attacking (or offense) is main human factor of our centuries, and will be for many more. In its essentials, CH2 represents accumulation and nature of life and leads us to higher continuum levels. Finally, CH3 describes Integrative process especially through first third of presented Continuum when integration must harmonize everything else. This process must ensure two main important things. One is energetic reserves regulation for actual and future acting, and the other is information disposition. Information component is clear and plays important role because of better recognition of various objects, object anticipation and manipulation, and semantic projection of other object future behavior, just as in the internal comprehension organization and optimal regulation of self-component in multidimensional space. Adequate optimal control of energetic reserve resources represents experience and anticipation of needs too, so CH3 is nothing but Regulation acting for optimization purposes, with maximization of interpolation, or in terms of kinesiology - Regulative acting.

In Comprehensive Continuum, that is obviously important comprehensive category. We all know that anticipation is important human global characteristic and represents power of information manipulation. Third process (CH3) regulates relations between entity and its environment, but also between first two mentioned processes, ensuring homeostatic balance in variable conditions that entity is exposed, in middle term acting. Graph 3 illustrates importance of those processes in continual development phases without any doubt.

Conclusion

With special methodology concept, on specified level, we identify three main processes in completely new manner. Those processes we describe as:

a) Persistent acting (Defense, old process, antagonistic),

b) Develop acting (Offense, attacking, young process, agonistic), and

c) Integrative acting (Connection, optimization, "middle aged process", regulation,)

Under exposed model, seems to be much easier to construct any kind of different programs for kinesiology purposes (education, active sport, recreation, health prevention, curative treatments, etc.).

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NATURAL SCALING IN GOLF PUTTING

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Abstract

The applicability of natural scaling (Borg & Borg, 2001) in golf putting was examined in two experiments with skilled golfers as participants. Putting took place in a laboratory setting as well outdoors on real green, and players were instructed to use the Borg centiMax scale (CR-100 scale) for estimation and production during putts of different distances. The two studies showed convincingly that the participants easily could use psychophysical scaling during putting. It is suggested that beginners as well as advanced golfers might benefit from the scaling procedure.

Key words: *psychophysics, centiMax scale, CR-100 scale, skilled players*

Introduction

In virtually every sport there is need for accurately performed movements and actions. Often there is a demand for movements that are both precisely aimed towards a target and executed with precise force. That is the case for a pass in soccer, a penalty shot in basketball, or a serve in tennis. In particular, such a demand is evident in precision sports like dart, curling, billiards, or golf. However, although athletes spend much effort practising precise direction of shots, it seems that less attention has been focused on how to practise the force of the shots. This is definitely the case in golf, where a vast literature exists on advice of how to make the perfect putt. Still, not much is said about how to achieve the right force of the putt.

One example is a book by James Frank from 1999 entitled "Precision putting", where Frank states what seems to be self-evident, namely that "you must know how to judge distances and then change the force of your shot accordingly". He then goes on saying that judging distances needs practising, and that can be done by striking the ball to five or six different distances, Another example comes from Tiger Wood (2001), who in his book "How I play golf" suggests that you will get a better feeling for different distances if you practise putting with your eyes closed, and before you open your eyes you guess how long the shot was. Tiger Woods also suggests that you get a feeling for the force of a putt if you first make a practice swing while looking at the hole. What is typical for these and most other examples of advice in golf books is that there is a reliance on the player's intuition and automatic mental and motor processing, and a belief that a putting skill will appear if you just keep practising. However, we believe that conscious processing of already acquired information might be a safer and faster road to expertise. We call this road natural scaling.

Natural scaling (Borg, & Borg, 2001) refers to psychophysical scaling in general and to a level-anchored ratio scaling procedure in particular. There is a vast literature showing the usefulness of psychophysical scaling in various areas (Borg, 1962, 1998). Also, there are numerous applications of psychophysical scaling within the field of sports, mostly for determining and regulating exertion and effort (Borg & Ottosson, 1986), but also for measuring various psychological dimensions occurring during competitive conditions (e.g., difficulty, amount of unwanted thoughts, competitive anxiety).

In the present study our purpose is to examine the applicability of natural scaling, i.e., the centiMax or CR-100 scale (Borg & Borg, 2001, 2002) during putting. This scale varies from "0" to "100", and several values on the scale are given verbal descriptors in addition to numerical values. Thus "0" is described as "nothing at all" and "100" is described as "maximum". In between these points descriptors such as "minimal", "extremely weak", "very weak", "weak", "moderate", "somewhat strong", "strong", "very strong", and "extremely strong" are interspersed. An option in this scale is "absolute maximum", a value above 100, which can be given by the participant, in case he/she experiences a magnitude of force never needed before.

The use of descriptors makes the scaling quite natural and it is assumed that the participants have quite good previous experience of how much force is needed for a putt described as, for example, "very weak". In the study to be presented below we examine how the centiMax scale is handled on two different playing surfaces (fast and slow) by moderately skilled young golfers with no previous experience of psychophysical scaling.

Methods

Participants were 26 golfers, all male, who participated in the study under informed consent. Mean age was 21.6 years (range 16-32 years) and mean golf handicap was 15.2 (range 2-36). Competitive experience varied among the players from no experience at all to ten years of experience. Three of the players played from the left. Participants received three golf balls to a value of approximately US$ 15 for their participation.

The first part of the study took place in a laboratory equipped with a full-scale flat miniature golf hole, on which the surface had been exchanged for a textile surface simulating the surface of a grass green. The miniature golf construction was only 11 m long, and in order to allow for very strong and maximum putts a screen was put up at a distance of 8.4 m from the starting point. A ball passing under the screen was caught noiselessly by foam-rubber material. The players could not see what was behind this screen.

The speed of the textile surface was 3.50 m as measured by a stimp meter, a device that is commonly used to measure the speed of a ball on a green. This measure revealed that the surface was relatively fast as compared to speed on normal Swedish greens, and comparable to what is standard speed on South European greens.

The experimental conditions involved a production phase and an estimation phase. During production the player was asked to produce a putt with a force chosen randomly from eight of the scale values of the centiMax scale (scale values within parentheses): extremely weak (3), very weak (6), weak (13), moderate (25), somewhat strong (37), strong (50), very strong (70), and maximum (100). The scale with the verbal descriptors printed along the scale was available to the player all the time during the phase. Putts for the first seven of the above scale values were repeated four times, and putts for the maximum value were repeated twice, all in all 30 trials. In each trial the distance of the putt was measured, as well as the speed of the ball.

In the second phase a piece of cardboard, the size of a regular golf hole and circularly shaped, was placed on the centre line of the course and at different distances from the player: 1.50 m, 2.50 m, 4.00 m, 6.00 m, 8.00 m, and 9.40 m. The player was instructed to make a putt as close as possible to the cardboard target, and then use the centiMax scale to estimate the force of the putt. The six distances were randomly repeated in each of four series during this estimation phase. The player was also asked to make two more maximum putts, a total of 26 trials. In addition to registering the scale value estimated by the player, we also measured the distance and speed of each putt. Before the start, and during both phases, heart rate (bpm) and rated anxiety (centiMax scale) was measured.

Two months later 12 of the golfers participating in the laboratory experiment agreed to play on a grass green belonging to one of the golf clubs in Umeå. In addition seven more players matching the others in skill and age participated. Thus, 19 players participated in each of the two experiments, 12 of these players participating in both experiments. The green was 45 meters wide and slightly uphill. The grass was cut at 7 millimetres, and as measured by the stimp meter the mean speed of the green was 1.73 m. The speed was measured for each participant and varied between 1.45 m to 1.88 m. The real green was then much slower than the textile surface in the laboratory.

The procedure was the same as in the first experiment: (1) a production phase and (2) an estimation phase, including two trials of maximum putts in each phase. All putts were registered as to distance and scale value. Also, as in the first experiment, measures of heart rate and rated anxiety were registered.

Results

Mean heart rate was 74.8 bpm during the laboratory experiment and 71.7 bpm during the field experiment, the rating of anxiety being "low" in both experiments. Thus, the requirement of scaling and other procedures did not put too heavy load on the players.

In order to determine the players' consistency and ability to putt in accordance with the scale during the production condition the power function $R = c\,S^{n}$ was calculated, where R is the response (e.g., the distance of a putt), S is the stimulus intensity (e.g., "weak"), c is a measure constant, and n is the exponent. The power function was calculated as a linear regression on log data: log R = n log S + log c. Functions were calculated for two groups of players, (1) the group of 12 players that participated in both experiments, and (2) the group of 7 players that participated only in experiment 1. The procedure for calculating the results of the estimation phase was similar, with the difference that R was either the distance of a putt or a rated scale value, and S was the distance of the target. The power functions for production (distance) and estimation (ratings) are presented in Table 1.

Table 1. Power functions in production and estimation in the laboratory setting

Production		Estimation	
Group	R = length	Group	R = ratings
1	$R = 0{,}99*S^{1,49}$	1	$R = 2{,}05*S^{1,25}$
2	$R = 0{,}77*S^{1,52}$	2	$R = 2{,}26*S^{1,34}$

As Table 1 shows, the size of the exponent is very similar in the two groups, for the production condition as well as for the estimation condition. This is noteworthy, as Group 2 comprised only seven players. These calculations are based on aggregated data (means for each S-R pair). Log-log plots of the production data for the two groups showed good agreement over the scale.

Similar results were obtained in the field study. As pointed out above, the green was slightly uphill, and the speed of the green varied between participants due to weather conditions. Production and estimation values for Group 1 (the 12 players that also participated in the laboratory study) and Group 3 (seven new players) can be seen in Table 2. In Figure 1 production data are log-log plotted for the two groups.

Table 2. Power functions in production and estimation in the field setting

Production		Estimation	
Group	R = length	Group	R = ratings
1	$R = 0{,}53*S^{1{,}28}$	1	$R = 3{,}30*S^{1{,}08}$
3	$R = 0{,}32*S^{1{,}05}$	3	$R = 5{,}43*S^{1{,}08}$

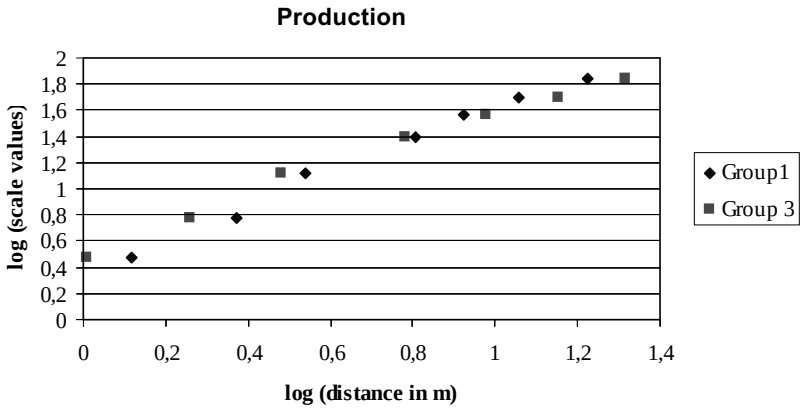

Figure 1. Production functions for Group 1 and 3 in the field setting.

Table 2 shows that the difference in exponents between the groups was somewhat larger during the production condition than in the estimation condition. One possible reason for this discrepancy could be that Group 1 had previous experience of the scaling procedure. This explanation is supported by the results in the estimation condition, where there was no difference between groups. As the estimation phase occurred after the production phase, players in Group 3 were more familiar with the procedure in the former condition. This same reasoning could be applied to the plot in Figure 1, where the production function for Group 1 is straighter than for Group 3.

Discussion

This study demonstrates that it is possible to use psychophysical methods for regulating putting shots in golf. With no previous experience of such methods moderately skilled players produced reliable motor actions and ratings by using the centiMax category-ratio scale. Putting on slow or fast surfaces or on surfaces with different slopes did not seem to have any negative impact on the use of the scale.

One could argue that the scaling procedure creates an unnecessarily high cognitive load on the player, with decisions and judgements all the time, and with need to remember the verbal descriptors and their place on the scale. It seems to be much easier not thinking at all, moving the club intuitively. Our experience, though, was that the players managed to use the scale very well, and there were no complaints implicating that the procedure disturbed the putting. On the contrary, several players found the method interesting and thought that it could be of value for improving the putting skill. We share that opinion. By practise the scale will be easier to use, and some aspects of the procedure will even be automatic, thus reducing possible cognitive load. In fact, a well-learned scale could be particularly valuable in situations of high load and competitive anxiety, serving as a tool for rational behaviour. One further advantage is that the scale contributes to the acquirement of mental representations that are needed for better accuracy and control of the shots (cf. Ericsson, 2001).

It is of interest in future studies to find out how well the scale functions in teaching beginners how to putt, and how well it functions in skilled players during competitive events. Of interest are also studies examining how various parameters of the putt swing are related to scaling responses.

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DECLARATIVE KNOWLEDGE ASSESSMENT IN FOUR TEAM SPORTS

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Abstract

To enable further research of declarative-procedural knowledge relationships, the forty-item test of sport-specific knowledge of history, official rules, organisation, competitions, requisites, etc. of soccer, handball, volleyball and basketball was constructed. Each sport was represented by 10 items, forming four subscales. It was applied on the sample of 354 undergraduate students from different departments of University of Zagreb. The analysis show acceptable metric properties of the test, but not for all four subscales. Used undivided, in total of forty items it could be useful instrument in later studies.

Key words: *semantic knowledge, soccer, handball, volleyball, basketball*

Introduction

Neuroscience proved that motor behavior and cognition are in very complex connections. As was first found in monkeys, there are neurons (mirror neurons) that discharge in both occasions, when the objects are manipulated and when subjects observes the experimenter making similar actions (Rizzolatti and Arbib, 1998). Procedural and declarative memories are neatly connected. Jeannerod (2003) uses the term motor cognition to describe not only the action itself (how it is planned, prepared and finally executed), but also of how motor action contributes to the representations we build from objects and from others. The importance of declarative knowledge in motor performance was early recognized. Fits and Posner (1967) stated that motor learning starts with cognitive phase. In review of declarative – procedural knowledge relationships, Boyd and Yin (1999) concluded that sport experts, compared to novice performers, are characterized as possessing more sport-specific semantic knowledge, which is more organized, having more links interrelating semantic knowledge structures.

To enable further research of relationships of semantic knowledge and motor performance, the forty-item test of sport-specific knowledge of history, official rules, organisation, competitions, requisites, etc. of soccer, handball, volleyball and basketball was constructed. To put it into use, the analysis of its metric properties was done.

Methods

The paper-and-pencil test consisting of 40 choice-response questions regarding history, official rules, organisation, competitions, requisites, etc. of soccer, handball, volleyball and basketball was constructed, following the soccer knowledge test by Bush et al. (2002). Each sport was represented by 10 items, forming four subscales. Test was applied anonymously on the sample of 354 students from different faculties and departments of University of Zagreb, including students of kinesiology and students of theology at the regular classes.

Results and discussion

The distribution of total results in paper-and-pencil soccer, handball, volleyball and basketball knowledge subscales are in Table 1, and distribution of total result in all forty items is in Table 2. As the correct answers were valued 1, and incorrect 0, possible range is 0-10 for subscales and 0 to 40 for total result in test. The results in soccer knowledge test are the best, and almost three quarters of results are eight or more. That is also seen in Table 3. The mean of soccer knowledge results is highest and standard deviations lowest among four sports.

Table 1. The distribution of total result in four paper-and-pencil knowledge sub-tests

Total result	Soccer		Handball		Volleyball		Basketball	
	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
1	-	-	1	.28	-	-	1	.28
2	-	-	6	1.69	8	2.26	1	.28
3	2	.57	13	3.67	16	4.52	8	2.26
4	4	1.13	33	9.32	43	12.15	11	3.11
5	9	2.54	53	14.97	50	14.13	38	10.73
6	24	6.78	78	22.03	59	16.67	51	14.41
7	52	14.69	52	14.69	63	17.80	86	24.29
8	95	26.84	49	13.84	79	22.32	96	27.12
9	147	41.53	65	18.36	35	9.89	57	16.10
10	21	5.93	4	1.13	1	.28	5	1.41
Total	354	100.00	354	100.00	354	100.00	354	100.00

The total result in whole sport-specific knowledge test ranges from 12 to 38. The number of multiple-choice responses at each item was four. So, the lowest value is, nevertheless, higher than obtained by simple guessing. Nobody had all correct answers.

Table 2. The distribution of total result of all 40 items of paper-and-pencil sport knowledge test

Total result	Frequency	Per cent
12	1	.28
13	1	.28
14	2	.56
15	2	.56
16	1	.28
17	1	.28
18	6	1.69
19	7	1.98
20	17	4.80
21	8	2.26
22	7	1.98
23	12	3.39
24	16	4.52
25	15	4.24
Total result	Frequency	Per cent
26	29	8.19
27	24	6.78
28	24	6.78
29	28	7.91
30	26	7.34
31	24	6.78
32	38	10.73
33	22	6.21
34	23	6.50
35	9	2.54
36	7	1.98
37	3	.85
38	1	.28
Total	354	100.00

Table 3. Means (M), standard deviations (SD) minimal (Min) and maximal (Max) results in four subscales and whole paper-and-pencil sport knowledge test

Total result	M	SD	Min	Max
Soccer scale	8.102	1.271	3	10
Handball scale	6.492	1.870	1	10
Voleyball scale	6.322	1.818	2	10
Basketball	7.062	1.560	1	10
Total results of all scales	27.977	4.985	12	38

The correlations of subscales are in Table 4. All correlations are positive and statistically significant. Values on the principle component of the matrix of sport knowledge test correlations show very similar and high values. The first eigenvalue is =2.318 and explains 58 per cents of common variance of four sport-specific knowledge subscales.

Table 4. The correlations of four sport-specific knowledge subscales (soccer, handball, volleyball and basketball) and the value of subscale on the principle component of correlation matrix.

	Soccer	Handball	Voleyball	Basketball	F
Soccer	1.0000				.72137
Handball	.41867	1.0000			.76943
Voleyball	.33385	.47648	1.0000		.75586
Basketball	.47266	.44212	.48836	1.0000	.79665

Table 5. Coefficients of internal consistency (Cronbach's alpha) and average inter-item correlation (Rm) of four sport knowledge subscales and total test result

	Cronbach's alpha	Rm
Soccer	.791	.084
Handball	.479	.086
Voleyball	.567	.116
Basketball	.594	.106
Total	.416	.069

Coefficient of internal consistency (Cronbach's alpha) for the total result of all 40 items is high ehough to allow to use total result in further research. Internal consistency coefficients are not so high for subscales, not due to average inter-item correlations. It seams that ten questions is far from enough to describe the field good enough.

The proportions of correct answers, standard deviations and correlations of items with total result are in Table 6. Item difficulties vary enough, from very easy to very difficult. Correlations with total result vary too, from even negative value with question about dimensions of handball goal, to r=.517 with question about world handball association abbreviated name. To improve scales and the whole semantic sport knowledge test, some items should be changed (Handball 1, Volleyball 6 and Volleyball 4), and perhaps some more should be added.

The analysis show acceptable metric properties of the test, but not for all four subscales. Used undivided, in total of forty items it could be useful instrument in later studies.

Table 6. The proportions of correct answers (mean), standard deviations (SD) and correlations of items with total result (r)

Item	Mean	SD	r
Soccer 1	.986	.118	.242
Soccer 2	.444	.498	.391
Soccer 3	.992	.092	.193
Soccer 4	.658	.475	.362
Soccer 5	.893	.310	.108
Soccer 6	.726	.447	.225
Soccer 7	.548	.498	.228
Soccer 8	.427	.495	.043
Soccer 9	.136	.343	.024
Soccer10	.559	.497	.319
Handball 1	.073	.261	-.212
Handball 2	.958	.202	.183
handball 3	.901	.299	.120
Handball 4	.921	.270	.128
Handball 5	.669	.471	.517
Handball 6	.907	.291	.107
Handball 7	.845	.363	.268
Handball 8	.492	.501	.380
Handball 9	.653	.477	.512
Handball 10	.822	.383	.021

Item	Mean	SD	r
Volleyball 1	.941	.237	.290
Volleyball 2	.695	.461	.384
Volleyball 3	.794	.405	.402
Volleyball 4	.138	.346	-.035
Volleyball 5	.977	.149	.119
Volleyball 6	.167	.373	-.092
Volleyball 7	.847	.360	.436
Volleyball 8	.718	.451	.428
Volleyball 9	.585	.493	.465
Volleyball 10	.986	.118	.203
Basketball 1	.582	.494	.262
Basketball 2	.814	.390	.482
Basketball 3	.924	.266	.154
Basketball 4	.904	.295	.483
Basketball 5	.220	.415	.237
Basketball 6	.862	.346	.278
Basketball 7	.915	.279	.422
Basketball 8	.599	.491	.405
Basketball 9	.944	.232	.210
Basketball 10	.760	.428	.486

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MORPHOLOGICAL SPACE STRUCTURE OF 12 YEARS-OLD WATER POLO PLAYERS AND NON-SPORTSMEN*

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Abstract

The purpose of this research is to compare the structures of morphological space between 12 years-old water polo players and non-sportsmen. The research group consisted of 195 healthy males, age 12 ± 6 months divided into two subgroups. The first subgroup, *water polo players group,* with total 92 members was named. The other subgroup, *non-sportsmen group,* with total 103 members was named. The set of total 14 measurements for evaluation of morphological characteristics was applied. By performing statistical analysis differentiation of morphological space structure has been located in selected 12 years-old water polo players (3 isolated factors) in regard to their non-sportsmen coevals (2 isolated factors). Values of Tucker's coefficient of congruency show that the two groups of isolated factors in latent morphological space of analyzed subgroups are similar.

Key words: *compare the structures, Tucker's coefficient of congruency, morphological adaptation*

Introduction

The progress of modern water polo imposes more and more complex demands to players. The great part of those demands has to do with morphological characteristics, the fact that demands attention in the period of selection. In the equation of specification of every sport as well as every specific function in the team, certain morphological characteristics are relevant for achieving technical and tactical quality (Šimenc & al., 1999). Morphological characteristics are very important in water polo, because they define biomechanical laws of motion and movements (Lozovina & Pavičić, 1999).

As a consequence of the secular trend of population and sport morphological adaptation in the last 25 years, top water polo players had a numerically positive trend in skeletal and body firmness measurements and a negative trend of adiposeness, while there are no relevant differences in body weight and body weight index (Lozovina & Pavičić, 2004).

High values of the skin wrinkles' thickness are explicated by the influence of hypodermic fat tissue on the increase of buoyancy, protection the low water temperature, taking food of high nutritive value and thermoregulation, where the body weight high values are not representing the obstacle for optimal water polo performance. The average somatic-type of all contestants is endo-mesomorph, with highly developed muscular- skeletal tissue with moderate presence of hypodermic fat tissue and longitudinal skeleton dimensionality (Toteva & al., 1989).

Analysis of water polo players' structural characteristics is a complex process. Cognition of manifest and latent anthropological (and by that, morphological ones as well) water polo players' dimensions enables more adequate approach to individualization of training (Lozovina & Pavicic, 1999).

In countries with tradition and good results in water polo, training begins at the age of 7, and first competitions are organized for 10 years-old water polo players. At the age of 12 young water polo players have years of swimming experience and a certain level of technical, tactical, physical and psychological preparation. All this affects the structure and structure's position of young water polo players' anthropological space. By this, it is expected that the 12 years-old long-term experienced water polo players' morphological space structure is specific and different from the structure of their non-sportsmen coevals.

The purpose of this research is to compare the structures of morphological space between 12 years-old water polo players and non-sportsmen.

Methods

The research group consisted of 195 healthy males, age 12 ± 6 months. The research group was divided into two subgroups. The first subgroup consisted of sportsmen that had been training water polo for at least four years continuously trough training practices and competitions. This subgroup with total 92 members was named *water polo players group.* The young water polo players that participated in the research are the members of water polo clubs "Niš" from Niš, "Partizan-

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Raiffeisen", "Red Star" and "Zemun" from Belgrade. The other subgroup consisted of pupils of town's elementary schools, which, besides regular classes of physical education didn't attend have never done some organized sport. This subgroup with total 103 members was named *non-sportsmen group.* These were the students of "Čegar", "Stefan Nemanja" and "Miroslav Antić" elementary schools from Niš.

Before the research began all the participants, as well as their parents, coaches and teachers were familiar with goals and methods of work. All the participants were voluntarily involved in the research with full consent of their parents.

Anthropometric measuring was performed by anthropometric instruments (GPM, Swiss) according to methods recommended by International biological program (Weiner, J., Lourie, J., 1969) and with following adequate ethical norms. All the measuring was done by experienced research team according to identical protocol for all the participants of the research. The set of total 14 measurements for evaluation of morphological characteristics was applied. The following measurements have been used: body height (AVIS), arm longitude (ADRU), Leg longitude (ADNO), hand longitude (ADŠA), shoulder span (AŠRA), pelvis span (AŠKA), hip span (AŠKU), upper arm scope of reached out arm (AONL), average chest scope (AOGR), body weight (AMAS), upper arm skin wrinkles' thickness (AKNN), belly skin wrinkles' thickness (AKNT), back skin wrinkles' thickness (AKNL).

In order to determine the morphological characteristics' space structure, for each group separately, following methods were applied: Hoteling's main components method (relevant main components or latent dimensions were defined by Guttman-Kaiser criterion (GK) which characteristic roots (λ) are equal or greater then 1.00); rotation of main components in Virmax solution. In order to determine similarity of factor's structure among their latent dimensions, in both groups Tucker's coefficient of congruency was used.

Results

Performed factor analysis of water polo players' latent morphological space explains almost 80% of total variability, and 3 factors have been isolated (Table 1.).

Table 1. Results of factor analysis of water polo players' latent morphological space

	λ	% Var	Cumul. λ	Cumul. %
1	7.10	50.72	7.10	50.72
2	2.87	20.52	9.97	71.24
3	1.19	8.47	11.16	79.70

Eigenval (λ), % total Variance (% Var), Cumulative Eigenval (Cumul. λ), Cumulative total Variance % (Cumul. %)

The first characteristic root in latent morphological space of 12 years-old water polo players is 7.10 and it defines 50.72% of common variance (Table 1.). Based on obtained results the first isolated factor in water polo players' latent morphological space can be defined as *the factor of longitudinal and transversal skeleton and body weight dimensionality*, i.e. *the factor of body growth and development* (Table 2.). Taller and bigger boys with increased body weight are preordained for successful water polo play in that age. Results are showing that the body weight is not an obstacle for optimal water polo performance.

The second characteristic root in water polo players is 2.87 and it independently defines 20.52% of common variance (along with the first factor 71.24%) (Table 1.). It can be defined as *the factor of skeleton's adiposeness and circular dimensionality* (Table 2.). 12 years-old water polo players are persons with high numeric values of hypodermic fat tissue and body scope and volume, which is the consequence of secular population trend (Lozovina & Pavičić, 2004.).

Table 2. Isolated factors in water polo players' latent morphological space

Variable	F 1	F 2	F 3
AVIS	0.79	0.03	0.51
AMAS	0.49	0.64	0.50
ADRU	0.79	-0.16	0.40
ADŠA	0.91	0.03	0.01
ADNO	0.85	-0.01	0.34
AŠRA	0.76	0.34	-0.22
AŠKA	0.57	0.35	0.16
AŠKU	0.71	0.30	0.20
AOGR	0.18	0.31	0.88
AOTR	0.21	0.43	0.74
AONL	0.38	0.75	0.42
AKNN	0.05	0.91	0.10
AKNT	0.01	0.88	0.25
AKNL	0.06	0.89	0.10

Isolated factor (F)

The third characteristic root in water polo players is 1.19. With 8.47% of common variance it is defined as the third factor in water polo players' latent morphological space (Table 1.). This factor can be called *body volume factor* (Table 2.). Selected water polo players have higher values of body scope and longitudinal dimensions.

Factor analysis of latent morphological space of 12 years-old non-sportsmen explains 81.22% of total variability. Two factors have been isolated here (Table 3.).

Table 3. Results of factor analysis of water polo players' latent morphological space

	λ	% Var	Cumul. λ	Cumul. %
1	8.72	62.30	8.72	62.30
2	2.65	18.92	11.37	81.22

Eigenval (λ), % total Variance (% Var), Cumulative Eigenval (Cumul. λ), Cumulative total Variance % (Cumul. %)

The first characteristic root in latent morphological space of 12 years-old non-sportsmen is 8.72 and the first isolated factor defines 62.30% of common variance (Table 3.) and it can be defined as *the factor of skeleton's adiposeness, volume and transversal dimensionality* (Table 4.). Male participants that were not involved in any sport activities are mainly obese and they define the endomorph type (Weiner & Lourie, 1969).

The second characteristic root is 2.65 (Table 3.). With 18.92% of common variance it is defined as the second factor in non sportsmen's latent morphological space that can be called *the factor of longitudinal and transversal skeleton dimensionality* or *the general growth and development factor* (Table 4.).

Table 4. Isolated factors in non-sportsmen's latent morphological space

Variable	F 1	F 2
AVIS	0.24	0.94
AMAS	0.77	0.60
ADRU	0.11	0.94
ADŠA	0.20	0.82
ADNO	0.04	0.93
AŠRA	0.44	0.74
AŠKA	0.59	0.60
AŠKU	0.69	0.61
AOGR	0.67	0.30
AOTR	0.75	0.28
AONL	0.90	0.34
AKNN	0.94	0.07
AKNT	0.91	0.12
AKNL	0.94	0.02

Isolated factor (F)

Values of Tucker's coefficient of congruency (Table 5.) show that the two groups of isolated factors in latent morphological space of analyzed subgroups are similar in the following way: the second factor in water polo players group and the first factor in non-sportsmen group (T=.96) and the first factor in water polo players group and the second factor in non-sportsmen group (T=.99).

Table 5. Coefficients of congruency between water polo players and non-sportsmen students

	U1	U2
V1	.52	.99
V2	.96	.34
V3	.68	.61

Water polo players (V), non-sportsmen students (U)

Discussion

More complex differentiation of morphological space structure has been located in selected 12 years-old water polo players (3 isolated factors) in regard to their non-sportsmen coevals (2 isolated factors). This fact can be explained first of all, by morphological adaptation caused by doing sports that has specific demands, the length of sport experience, training frequency and intensity, directed selection, time spent in water and nutrition regime of tested water polo players.

Conclusion

Results show that the latent morphological structure from the mere beginning of water polo career (and with certain length of sport experience) is strictly and specifically profiled and differentiated. Therefore, the selection of players for top class water polo should be directed toward boys with primarily strong longitudinal skeleton dimensionality.

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DEFINING CANONICAL CORRELATIONS OF FUNCTIONAL AND SITUATION--SWIMMING MOTOR SKILLS OF 12 YEARS-OLD WATER POLO PLAYERS*

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Abstract

The purpose of study is to determine influence of functional abilities on situation and swimming motor skills of selected young water polo players. Research group consisted of 90 water polo players, aged 12 years ± 0.5. Sample of functional abilities' variables consisted of five variables and situation and swimming motor skills were represented by a battery of six tests. In order to determine the correlation between the sets, canonical correlation analysis was used. Data obtained by canonical correlation analysis show that there are two pairs of relevant canonical factors on the level of 99% which are sufficient for explaining the common variability of examined set of variables. Magnitude of correlation of the first pair of canonical factors is .63, and it is defined with 39% of the common variance; correlation of the second pair of canonical factors is .52, and it is defined with 27% of the common variance. These results are significant for exploring the possibilities of real selection and load individualization during training.

Key words: *Inter-correlation matrix, two pairs of relevant canonical factors*

Introduction

Water polo belongs to the group of poly-structural complex sport disciplines. Modern top-class water polo requires the player to be maximally prepared. During the last couple of years the system of competition demands year-round engagement (clubs' national championships, clubs' national and international cups, national teams' international competitions). Consequences of these demands are the changes in process of selection and training. In order to achieve the required top level, players ought to be in absolute technical, tactical, physical, psychological and theoretical condition.

Top water polo players under the influence of an adequate training can develop their energy potential to the extremes, and especially glycogen- lactic mechanism of energy derivation. The water polo player's organism has to be able to stand alternate efforts that load intensely both aerobe and anaerobe capacity of energy during the game (Geladas & Platonou, 2000).

Various authors think that during the long period of time, interrupted by short and long brakes, players have to stand the efforts of variable intensity with frequent change of direction. (Lozovina, 1984; Dopsaj & Matković, 1994).

More different researches showed a significant influence of water polo training on organism's functional characteristics, first of all on cardiovascular and respiratory system. (Smith, 1998; Aleksandrović & al., 2000; Pavlik & al., 2005). Target compared studies showed that relevant differences in functional abilities among children that were submitted to systematic water polo training and the children't that aren't doing sport, could show up even in pre-puberty age (Baxter-Jones & Maffulli, 2003; Radovanović & al., 2004).

The purpose of study is to determine influence of functional abilities on situation and swimming motor skills of selected and trained young water polo players.

Methods

Research group consisted of 90 water polo players, aged 12 years ± 0.5 (156.99cm ± 22.31; 50,99kg ± 34.21) members of following water polo clubs: "Partizan Reifeisen" – Belgrade, "Red Star" – Belgrade, "Zemun" – Zemun and "Niš" – Niš. Players that participated in the research trained water polo for 3 ±1 years and played at least one official game.

Sample of functional abilities' variables consisted of five variables: absolute value of maximum oxygen intake (AMPO2), relative value of maximum oxygen intake (RMPO2), forced vital capacity (FFVK), Forced expiratory volume in first second (FFEV), heart beat frequency at ease (FFSR). Part of the research that had to do with functional analyses was performed in laboratory before noon. Maximum oxygen intake was measured by an indirect method on the static bicycle with bike-o-meter. Heart beat frequency at ease and while under load was monitored telemetrically. Values of forced volumes and capacities were determined by measuring respiration on a computer.

Situation and swimming motor skills were represented by a battery of six tests: 25m swimming (25M), 50m swimming (50M), 100m swimming (100M), 4x5m crawl-back swimming (4X5M), Ball leading 3x5m (3X5VL), ball throwing

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(BACL). This battery of tests was used in similar studies of swimming abilities as well. (Volčašnek & Grčić-Zubčević, 1984; Bratuša, 2000). Part of the research that had to do with motor abilities was performed in Olympic sized swimming pool. All participants were tested voluntarily according to identical protocol.

Inter-correlation matrix of variables is presented to determine correlation between particular functional and situation-swimming variables.

In order to determine the correlation between the sets of functional and motor skills, canonical correlation analysis was used. Values that were obtained by performing statistic analyses are presented below tables 2-4.. Analysis computer program Statistica 6.0. was used for processing of all data.

Results

Table 1. Inter-correlation matrix of variables between functional and situation-swimming variables

Varijable	25M	50M	100M	4X5M	3X5	BACL
AMPO2	**- .21**	**- .31**	**- .33**	**- .25**	**- .26**	**.34**
RMPO2	- .03	- .12	-.09	- .21	- .05	- .16
FFVK	**- .33**	**- .26**	**- .41**	- .10	**- .30**	**.37**
FFEV	**- .22**	**- .28**	**- .39**	- .19	**- .32**	**.45**
FFSR	**.24**	.12	.10	- .15	.05	- .10

In dependence of freedom level, according to level of significance 95%, all correlations over .20 are significant.

Absolute value of maximum oxygen intake variable (AMPO2) is in relevant correlations with all applied tests of situation and swimming motor skills. Variables representing respiratory function (FFVK and FFEV) are in relevant correlation with results of all swimming tests: (25M, 50M, 100M), agility with the ball (3X5VL) and explosive strength of arms and legs (BACL). Results of the relative value of maximum oxygen intake test (RMPO2) are in relevant correlation with the results of the situational agility test – 4x5m crawl-back swimming (4X5M), while the values of the heart beat frequency at ease (FFSR) correlate with swimming sprint (25M) (Table 1).

Data obtained by canonical correlation analysis show that there are two pairs of relevant canonical factors on the level of 99% which are sufficient for explaining the common variability of examined set of variables. Magnitude of correlation of the first pair of canonical factors (from morphological and situation-swimming area) is .63, and it is defined with 39% of the common variance. (Table 2).

First canonical dimension in area of functional abilities is defined in a mono-polar way. Presence of pulmonary functions measures (FFEV= .86, FFVK= .82) and relative values of maximum oxygen intake (AMPO2= .57) is dominating. This factor defines persons with dominating respiratory function and aerobe abilities. (Table 3). In situation-swimming area first canonical dimension is defined in bipolar way. Only the variable of agility is on the very verge of relevance (4X5M= - .26), while other variables relevantly define this factor. Explosive strength of arms and shoulders variable also dominates (BACL=- .88). Values of variables for evaluation of swimming abilities: endurance, speed endurance and sprint (100M= .66, 50M= .50, 25M= .44) and agility (3X5VL= .53). This factor can be defined as the general factor situation and swimming motor skills (Table 4).

Based on in this way constructed directions of the first pair of canonical dimensions it can be conclude that functional abilities of sportsmen defined by respiratory function and aerobic ability, work as the factor of adequate manifestation of situation-swimming motor skills.

Magnitude of correlation of the second pair of canonical factors is 52, and it is defined with 27% of the common variance (Table 2.). Linear combinations of functional and situation-swimming variables are forming on the part of variance which hasn't been explained in previous pair of canonical dimensions. Relatively high linear correlation of the second pair of canonical factors and the amount of common information indicates that the first canonical dimension has barely exhausted the fund of useful information about the influence of manifest motor skills on the results of applied situation-swimming tests.

Second canonical dimension in area of functional abilities is defined in a bipolar way. Variables for evaluation of heart beat frequency at ease (FFSR= -.69), maximum oxygen intake (RMPO2= - .37) and expiration function (FFEV= .32) give high attribution to defining this dimension (Table 3). Variables for evaluation of situational agility (4X5M= .55), and swimming sprint (25M= - .40) give high attribution to defining this dimension. (Table 4).

Table 2. Matrix of canonical correlations coefficient between two sets of variables

	R	R^2	χ^2	Df	p	λ
0	.63	.39	.86	30	.00	.35
1	.52	.27	.60	20	.00	.58
2	.41	.17	.24	12	.08	.79

Manifest variable's projection magnitude on to the canonical factor (CAN)

It can be concluded that latent area of functional abilities is extremely defined by heart adaptation, aerobic ability and expiration function, and it serves as a stimulant for agility and as a disturbing factor on the swimming sprint.

Coefficient of correlation of canonical factor pairs (R), common variance of canonical factor pairs (R^2), strength of canonical correlation obtained by Hi-square test, relevance of isolated canonical factors tested by Bartlet's test (p)

Table 3. Structure of canonical factors that belong to the functional ability sets of variables

Varijable	CAN 1	CAN 2
AMPO2	**.57**	- .25
RMPO2	- . 29	**- .37**
FFVK	**.82**	**.32**
FFEV	**.86**	- .13
FFSR	- .17	**- .69**

Table 4. Structure of canonical factors that belong to the situation-swimming sets of variables

Varijable	CAN 1	CAN 2
25M	- .44	- .38
50M	**- .50**	.08
100M	**- .66**	.01
4X5M	- .26	**.55**
3X5 VL	**- .53**	.11
BACL	**.88**	- .10

Manifest variable's projection magnitude on to the canonical factor (CAN)

Discussion

Results obtained during this research show relevant correlation between 12 years-old organism's functional abilities and specific situation-swimming motor skills. As such, these results are significant for exploring the possibilities of real selection and load individualization during training. In this way it is possible to create the work optimally and direct it toward the great demands of modern water polo.

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METHODOLOGICAL CONTRIBUTION FOR DEFINING MOTOR SPACE IN REFERENCE TO DIFFERENT TYPES OF RESULTS REGISTRATION WITH COMPOSIT TESTS

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Abstract

On a sample of 219 students at the age of 18 years, for the assessment of the motor abilities 12 composite tests, each containing three particles, were applied. The following abilities were assessed: preciseness, balance, coordination and frequency of body movements. On the results of the particles from the tests the main components were calculated and were transformed into promax factors. These calculations were specially applied on those results that were established in four manners: from the first particle, from the best particle, from the sum of the results of the three particles and from the factor scores of the first main component of the three particles. On the promax factors resulting from the manner of establishment of the results from the particles, calculated were percentages of congruency. The best definition of the motor abilities is received from the factor scores of the first main component and the summed results of the particles. The satisfactory defining of the motor factor structure is obtained from the best particle, while the defining from the first particle was the weakest.

Key words: *motor, composite tests, first main component, factor scores, promax factors, congruency.*

Introduction

The necessity for exact and stricter methodological criteria is a precondition for the defining of the latent structure of the motor dimension of the entities. She emerges from the parasite influence of most of the conditions in the procedure for measuring when applying the tests for the defining of that structure. Among them are: mistakes at measuring, selection and standardization of the tests, education of the measurers, micro-social environment of measuring, design and preciseness of the measuring instruments, the motivation of the participants and the measurers, the choice of the methods for the processing of the data and other similar conditions as the manner of registration of the results for their transformation at composite tests for the defining of the latent structure of the motor space.

The analysis of the final condition, i.e. the influence of the manner of registration of the results, by the virtue of which the starting data matrix is determined for its future transformation when extraction of the motor factors has shown in some of the previous research (Naumovski 2001, 2002a, 2002b; Bala 2003) different results in the parsimony when defining the latent motor space.

Having in mind the complete methodological need for exactness of this parsimony, the aim of the research was to determine the structure of some motor factors on the basis of different procedure of measuring of the results on the same group of composite tests at the same sample of participants.

Methods

For the realization of the aim of the research a sample of 219 students was used. For the estimation of the hypothetic motor abilities 12 composite tests each with three particles were applied. For the estimation of the preciseness: 'Throwing of large stick' (PGDOLGS), 'Throwing of short stick' (PGKUSS) and 'Aiming a target on the wall with the leg' (PGMZIDNO); of the balance: 'Standing for balance on one leg on a desk in length with open eyes' (BNADOTV), 'Standing for balance on one leg on a desk in width with open eyes' (BNAPOTV) and 'Standing for balance on one leg on a desk in length with closed eyes' (BNADZATV); of coordination: 'Move through and jumping over' (KPROPRES), 'The eight with bow' (KOSUMKA) and 'Moving floor' (KPODPOD); of frequency of movements: 'Hand tapping' (TTAPRAKA), 'Leg tapping' (TTAPNOGA) and 'Leg tapping on the wall' (TTNOGZID).

The tests were processed using the same statistical methods, and results of the processing were obtained in the following manner: from the first particle (F); from the best particle (B); from the summing of the results of the three particles (S); from the factor scores of the first main component of the three particles (K).

Special processing of the results of each manner was performed using the method of main components the number of statistical importance is determined by the Guttman-Kaiser's criteria. Their transformation is performed by the application of the Promax procedure of Hendrickson and White (1964).

For detailed defining of the extracted motor factors a percentage of congruency was calculated.

Results

When processing the data obtained from all applied manners (P, N, S, K) isolated was the same number (four from each) of significant main components, i.e. promax factors. The characteristic roots (λ) and the percentages from the cumulative variations of the significant main components (table 1) at the first particle (F) have the lowest values. At the significant main components obtained by the registering of the data from the other manners (B, S and K) the values gradually increase.

Beside the fact that the research was not oriented towards the nominal defining of isolated factors, but towards their improved, i.e. more stabile defining depending on the manner of the registration of the measuring results, it was obvious that the results are structures with the following existence (table 2): 1. Preciseness of hands in the frequency of their movements; 2. Balance; 3. Frequency of movements of the feet and coordination (on the opposite value of the factor); and 4. Coordination of the whole body and preciseness of the feet (on the opposite value of the factor).

This nominal defining of the structure of the isolated factors exists and emerges from the factorization of all four different manners of the establishment of the results from the measuring. It is confirmed by all percents of congruency between the obtained factors with the application of those manners. The percents are significantly high and statistically important.

Table 1. Characteristic roots (λ) and cumulative percents (%) of the variations of the significant main components obtained from the different manners of registration of the results from the measuring.

Compo-nents	F		B		S		K	
	λ	%	λ	%	λ	%	λ	%
1	2.35	19.57	2.60	21.66	2.73	22.77	2.73	22.78
2	1.87	35.17	2.03	38.55	2.13	40.50	2.15	40.70
3	1.36	46.49	1.45	50.59	1.47	52.77	1.48	53.03
4	1.08	55.23	1.07	59.48	1.12	62.06	1.12	62.37

Table 2. Matrix of the composition of the promax factors from the results of the first particle (F); from the best particle (B); from the summed results of the three particles (S) and from the factor scores of the first main component of the three particles (K).

	F1	F2	F3	F4	B1	B2	B3	B4
PGDOLGS	.81	-.09	.00	.06	.82	-.08	.06	.03
PGKUSS	.72	.04	-.10	-.04	.66	.05	-.17	-.12
PGMZIDNO	.09	.23	-.59	.33	.10	.11	.38	-.76
BNADOTV	-.01	.70	-.05	-.28	.13	.67	-.16	-.11
BNAPOTV	-.08	.77	-.03	.02	-.17	.86	.02	-.01
BNADZATV	.09	.73	.09	.05	.05	.80	.03	.11
KPROPRES	.05	-.01	.79	-.02	-.03	-.04	.14	.70
KOSUMKA	-.03	.13	.68	.25	.11	.19	.25	.72
KPODPOD	.36	-.03	.11	.67	.25	-.07	.79	.04
TTAPRAKA	.63	.09	.15	-.09	.73	.01	.00	.02
TTAPNOGA	.40	-.12	-.17	-.28	.34	-.03	-.45	.09
TTNOGZID	.26	.11	.08	-.82	.17	.02	-.77	-.02

Table 2. (prolongation)

	S1	S2	S3	S4	K1	K2	K3	K4
PGDOLGS	.84	-.03	.01	.06	.83	-.03	.02	.05
PGKUSS	.72	.03	-.09	-.16	.72	.03	-.08	-.17
PGMZIDNO	.17	.10	.32	-.73	.19	.09	.30	-.72
BNADOTV	.07	.73	-.17	-.08	.08	.73	-.17	-.08
BNAPOTV	-.09	.81	.03	-.08	-.09	.81	.03	-.08
BNADZATV	.04	.83	.04	.12	.04	.83	.04	.12
KPROPRES	.05	-.10	.06	.77	.05	-.10	.05	.77
KOSUMKA	.10	.20	.25	.72	.11	.19	.24	.72
KPODPOD	.30	-.09	.78	.02	.31	-.09	.78	.03
TTAPRAKA	.74	.01	-.09	.07	.75	.01	-.12	.08
TTAPNOGA	.37	-.07	-.55	-.01	.36	-.08	-.60	.01
TTNOGZID	.17	.05	-.79	.05	.16	.05	-.78	.04

Table 3. Percents of congruency between the promax factors from the first particle (F); from the best particle (B); from the summed results of the three particles (S) and from factor scores of the first main component of the three particles (K).

	1B	2B	3B	4B		1S	2S	3S	4S
1F	**.98**	-.03	.07	-.02	1F	**.99**	-.02	-.12	-.02
2F	.02	**.98**	-.01	-.07	2F	.03	**.98**	-.01	-.07
3F	.01	.02	.12	**.96**	3F	.02	.01	.10	**.98**
4F	-.06	-.06	**.97**	-.02	4F	-.02	-.08	**.97**	-.04

	1S	2S	3S	4S		1K	2K	3K	4K
1B	**.99**	.05	-.11	.00	1F	**.98**	-.02	-.13	-.02
2B	-.01	**.99**	-.02	-.01	2F	.03	**.97**	-.01	-.07
3B	-.03	-.05	**.99**	.02	3F	.02	.01	.10	**.98**
4B	-.01	-.01	.01	**.99**	4F	-.01	-.09	**.96**	-.04

	1K	2K	3K	4K		1K	2K	3K	4K
1B	**.99**	.01	-.12	.01	1S	**.99**	.01	-.10	-.01
2B	-.01	**.99**	-.02	-.01	2S	.01	**.99**	-.01	-.02
3B	-.01	-.05	**.98**	.03	3S	-.07	-.04	**.99**	.01
4B	-.02	-.01	.01	**.99**	4S	-.01	-.02	.01	**.99**

Discussion and conclusion

The influence of the different manners of the establishment of the data over the stability and the degree of the defining of the isolated motor factors is obvious since the value of the characteristic roots and the percents of the cumulative valid variation. According to them the isolated factors of the summed particles (S) and factor scores of the first main component of the particles (K) are with similar and larger degree of verification of their existence, then at the first and the best particle, that have the same similarity. So it is preliminarily noticeable that the best defining is obtained at the factors received from the manner "K", and then follow the manners "S", "B" and "F". Still the difference between the manners "K" and "S" is very small.

It could be noticed from the analysis of the data for the structure and the congruency of the promax factors that are isolated from each applied manner of the factor results for the starting matrix of the factorization. First of all, the order of the obtained promax factors (even though not so important at the transformation) is not identical with the manner of the establishment of the results at the first particle (F) and with the manner defined with the best results (B).

The factor of coordination of the whole body (with the participation of the preciseness of the legs at the opposite value of the factor), at the manner "F" is defined as third, and at the manner "B" as fourth. Opposite of this, the order of the obtained factors of the manner "B" is the same as the order of the factors of the summed results from the three particles (S) and the factor scores from the first main component of the three particles (K).

Also, the stability of the saturations of the tests at the corresponding factors that are obtained from the best particle (B) is larger then those that are isolated from the results of the first particle (F). This stability of the manner of the best particle (B) is weaker compared to the manners that have the similar stability: from the summed results of the three particles (S) and the results from the factor scores of the first main component of the three particles (K).

The congruency between the factors obtained at the different manners of the establishment of the results of factorization, have the similar relations. In that sense, it is noticeable that the congruency is high between the factors obtained from the best particle (B) and from the summed results from the three particles (S), as well as from the best particle (B) and the results from factor scores of the first main component of the three particles (K). Still the highest (more than .99) is the congruency between factors that were obtained from the summed results from the three particles (S) and the factor scores of the first main component of the three particles (K). According to this congruency, the best defining of the factors is received from the summed results of the three particles (S) and from the results of the factor scores of the first main component of the three particles (K).

From the stated results and their discussion the following could be concluded:

- The manner of the establishment of the results of the measuring of the motor composite tests influences the defining of the isolated factors.
- The factors that would be received from the result of the first particle would have weaker definition (lower parsimony) from those that would be obtained from the best particle, the summed results from the three particles and the factor scores of the first main component of the three particles.
- A small advantage of the treated manners (in this research) for the establishment of the results from the measuring of the motor composite tests when defining the isolation of the latent dimensions, would have the manner with the calculation of the factor scores from the first main component of the three particles.

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STATISTIC SVB MACRO PROGRAM FOR TESTING OF QUALITATIVE CHANGES BETWEEN TWO MEASUREMENTS

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Abstract

The main aim of this paper was to reprogram one algorithm to Statistica Visual Basic program language. LSDIF algorithm was described by Momirović et al (1987). That algorithm perform testing hypothesis about equality of correlations matrix of two different measurements. The first macro program of LSDIF algorithm by Momirović (1987) was written in the *GENSTAT ver.4.04* statistical program. The new version of *GENSTAT* statistical program exist, but authors has an opinion that every algorithm it's better to translate to Statistica Visual Basic (SVB) program because *STATISTICA* from StatSoft ver. 6.0 is on the disposal of the researchers and student from all Croatian universities and many other researchers and student form other countries. Because of that LSDIF algorithm is reprogrammed and it is described in this paper. Also this Statistica svb macro program was tested whit some results of posture indicators at the children of seven and eight years. The program successfully tested qualitative changes between posture indicators measured in two time points.

Key words: *algorithm, correlation, Statistica Visual Basic, posture*

Introduction

That algorithm is called LSDIF and functionality of this algorithm is testing of qualitative changes in relations between variables measured in two time points. Whit this algorithm is very simple to do testing did some time period, between two measurement points, do some qualitative changes in some group of variables. That testing it's based on the hypothesis of non differences between two correlations matrix, one correlation matrix of variables from first measurement and one of variables from second measurement. Qualitative changes would appear if we reject the null-hypothesis.

The program in this paper is written as SVB Macro in the program *STATISTICA 6.0.* This program must be started by pressing the option **Macros** in the sub-menu of **Tools**. In the sub-menu of **Macros**, must be choused **Open**. After opening this SVB file pressing the **Run Macro** from the sub-menu of option **Run,** program will be started. This SVB program is simply the best retype into the **Statistica Visual Basic Editor**, under the **Tools** in sub-menu of **Macros**. After retyping it, it is best to save it as **Global Macro**, because of the easier running.

Methods

Algorithm

Let are $\boldsymbol{Z_1}$ and $\boldsymbol{Z_2}$ two matrix obtained from set of entities $\boldsymbol{E = \{ e_i ; i=1,\ldots,n\}}$ who are measured with one set of quantitative variables $\boldsymbol{V = \{ v_j ; j=1,\ldots,m\}}$ in two time points $\boldsymbol{t_1}$ and $\boldsymbol{t_2}$. Define the vectors of arithmetic means as $\boldsymbol{M_1}$ and $\boldsymbol{M_2}$ in the way that is $M_1 = Z_1^T \cdot 1 \cdot n^{-1}$ and $M_2 = Z_2^T \cdot 1 \cdot n^{-1}$. Define two matrix $X_1 = Z_1 - 1 \cdot M_1^T$ and $X_2 = Z_2 - 1 \cdot M_2^T$ as matrix of center values of $\boldsymbol{Z_1}$ and $\boldsymbol{Z_2}$ matrix. Matrix of covariance in the first and second measurement time point will be define as $C_1 = X_1^T \cdot X_1 \cdot \frac{1}{n}$ and $C_2 = X_2^T \cdot X_2 \cdot \frac{1}{n}$, and correlation matrix as $R_1 = D_1^{-1} \cdot C_1 \cdot D_1^{-1}$ and $R_2 = D_2^{-1} \cdot C_2 \cdot D_2^{-1}$ where are the D_1^2 and D_2^2 diagonal matrix of matrix C_1 and C_2, $D_1^2 = diag \cdot C_1$ and $D_2^2 = diag \cdot C_2$. Matrix $R = (R_1 - R_2)^2$ is matrix of square differences between correlation coefficients from two measurement time points $\boldsymbol{t_1}$ and $\boldsymbol{t_2}$. Function $p = \frac{n}{2} traceR$ is obtained from $\boldsymbol{R}$ matrix and because function $\boldsymbol{p}$ has a χ^2 distribution we can perform significant statistical test to testing hypothesis $\boldsymbol{Ho: R_1 - R_2 = 0}$.

Svb program

```
'#Uses "*STB.SVX"
'#Uses "*GRAPHICS.SVX"
Dim ADS As Spreadsheet
Dim STBReport As Report
```

```
Dim MDIFF As Double
Public VARS1() As Double
Public VARS2() As Double
Public p() As Double
Public Q() As Double
Public HIsq() As Double
Dim J As Integer
Dim M As Double
Public TZ() As Double
Dim GUMB As Double

'NOTE:  IN THE MAIN SPREADSHEET IT'S IMPORTANT THAT ALL CASES HAVE VALUES IN ALL VARIABLES. IF SOME VALUES MISSING THIS SVB PROGRAM CAN'T CALCULATE PROPERLY CORRELATION MATRIX.'

Sub Main
    Set ADS = ActiveDataSet
    Set STBReport = Reports.New

    ReDim Preserve VARS1(1 To NVars(ADS)) As Double
    ReDim Preserve VARS2(1 To NVars(ADS)) As Double

    SelectVariables2(ADS,"SelectVariables",1,NVars(ADS),VARS1,M,"Select variables from first measurement",
    1,NVars(ADS),VARS2,M,"Select variables from second measurement")

    ReDim Preserve VARS1(1 To M) As Double
    ReDim Preserve VARS2(1 To M) As Double
    ReDim Preserve Z1(1 To NCASES(ADS),1 To M) As Double
    ReDim Preserve Z2(1 To NCASES(ADS),1 To M) As Double
    ReDim Preserve R1 (1 To M, 1 To M) As Double
    ReDim Preserve R2 (1 To M, 1 To M) As Double
    ReDim Preserve R (1 To M, 1 To M) As Double
    ReDim Preserve Rsq (1 To M, 1 To M) As Double
    ReDim Preserve HIsq(1 To 1) As Double
    ReDim Preserve Q (1 To 1) As Double
    ReDim Preserve p (1 To 1) As Double
    ReDim Preserve DF1 (1 To 1) As Double
    ReDim Preserve DF2 (1 To 1) As Double
    ReDim Preserve TZ(1 To 1,1 To 5) As Double
    ReDim Preserve MDIF ( 1 To 1) As Double
    For I = 1 To M
        MatrixCopy(ADS.Data,1,VARS1(I),NCASES(ADS),1,Z1,1,I)
    Next I
    For I = 1 To M
        MatrixCopy(ADS.Data,1,VARS2(I),NCASES(ADS),1,Z2,1,I)
    Next I
    MatrixCorrelations (Z1, 1, R1)
    MatrixCorrelations (Z2, 1, R2)
    MatrixSubtract (R2, R1, R)
    MatrixMultiply(R, R, Rsq)
    MatrixTrace (Rsq, MDIFF)
    DF1(1) = M
    DF2(1) = NCASES(ADS)
    HIsq(1) = (MDIFF * DF2(1)) / 2
    Q(1) = IChi2 (HIsq(1), DF1(1))
    p(1) = 1 - Q(1)
    MDIF(1) = MDIFF
    MatrixCopy(MDIF,1,1,0,0,TZ,1,1)
    MatrixCopy(DF1,1,1,0,0,TZ,1,2)
```

```
        MatrixCopy(DF2,1,1,0,0,TZ,1,3)
        MatrixCopy(HIsq,1,1,0,0,TZ,1,4)
        MatrixCopy(p,1,1,0,0,TZ,1,5)
    RETURN:
        GUMB = DisplayButtonBox("Choose results ","First correlation matrix | Second correlation matrix | Quadratic
        matrix of differences | Test of signification")
        If GUMB = 0 Then
                End
        End If
        If GUMB = 1 Then
                TAB1 = NEWSCROLLSHEET(M,M,R1," First correlation matrix ","","")
                SCROLLSHEETSETCOLUMNWIDTH(TAB1,1,1)
                SCROLLSHEETSETROWNAMEWIDTH(TAB1,10)
                For J = 1 To M
                        ScrollsheetSetRowName(TAB1,J,VarName(ADS,VARS1(J)))
                Next J
        End If
        If GUMB = 2 Then
                TAB2 = NEWSCROLLSHEET(M,M,R2," Second correlation matrix ","","")
                SCROLLSHEETSETCOLUMNWIDTH(TAB2,1,1)
                SCROLLSHEETSETROWNAMEWIDTH(TAB2,1)
                For J = 1 To M
                        ScrollsheetSetRowName(TAB2,J,VarName(ADS,VARS1(J)))
                Next J
        End If
        If GUMB = 3 Then
                TAB3 = NEWSCROLLSHEET(M,M,Rsq," Quadratic matrix of differences ","","")
                SCROLLSHEETSETCOLUMNWIDTH(TAB3,1,1)
                SCROLLSHEETSETROWNAMEWIDTH(TAB3,1)
                For J = 1 To M
                        ScrollsheetSetRowName(TAB3,J,VarName(ADS,VARS1(J)))
                Next J
        End If
        If GUMB = 4 Then
                TAB4 = NEWSCROLLSHEET(1,5,TZ," Test of signification ","","")
                SCROLLSHEETSETCOLUMNWIDTH(TAB4,1,1)
                SCROLLSHEETSETROWNAMEWIDTH(TAB4,1)
                SCROLLSHEETSETCOLUMNNAME(TAB4,1,"MDIFF","")
                SCROLLSHEETSETCOLUMNNAME(TAB4,2,"df1","")
                SCROLLSHEETSETCOLUMNNAME(TAB4,3,"df2","")
                SCROLLSHEETSETCOLUMNNAME(TAB4,4,"HIsq","")
                SCROLLSHEETSETCOLUMNNAME(TAB4,5,"p","")
        End If
        GoTo RETURN
    End Sub
```

Testing of this statistical SVB Macro program was taken on the sample of 4 variables of body posture indicators and on the sample of 224 children (110 boys and 114 girls). Variables are: SRGL- difference between distances from scapula's upper edge to the spine (cm), SVGL-the difference between highs of scapula's upper edge (cm), SRDL-difference between distances from scapula's lower edge to spine (cm), SVDL-difference between highs of scapula's lower edge (cm). All indicators are measured at the age of seven and once again at the age of eight years.

Results

Testing of this Statistica SVB macro program was successful. The results show that the correlations between some variables in the first measurement are smaller than the same correlation relations in the second measurement. Significant test of qualitative changes between two measurement points shows statistical significations on the p-level of 0,001.

Table 1. Correlation matrix between variables of first set and second set, and test of signification of MDIFF

	SRGL 1	SVGL 1	SRDL 1	SVDL 1		SRGL 2	SVGL 2	SRDL 2	SVDL 2
SRGL 1	1,00	0,81	0,68	0,54	**SRGL 2**	1,00	0,82	0,78	0,72
SVGL 1	0,81	1,00	0,68	0,71	**SVGL 2**	0,82	1,00	0,75	0,86
SRDL 1	0,68	0,68	1,00	0,85	**SRDL 2**	0,78	0,75	1,00	0,77
SVDL 1	0,54	0,71	0,85	1,00	**SVDL 2**	0,72	0,86	0,77	1,00
MDIFF	**df1**	**df2**	**Hlsq**	**p**					
0,159	4	224	17,782	0,001					

Discussion

Main aim of this paper was to present the macro program in the statistical software for Windows called Statistica 6. That SVB Macro program is for testing of qualitative changes between two measurements. Whit some results of children body posture indicators who was measured in two time points this SVB macro program was tested. The results show that the program can calculate correlation matrix of variables from first measurement and other correlation matrix of variables measured in the second time point. Also this program can calculate signification test of qualitative changes in measured variable. This example shows that correlations between variables are bigger in the second measurement and that the signification test shows that qualitative changes are statistical significant.

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Sociology, History and Philosophy of Sport

4th INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

"SCIENCE AND PROFESSION – CHALLENGE FOR THE FUTURE"

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FROM THE SPORT HISTORY FOR THE HISTORY OF SPORT

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I.

Gymnastics, agon, athletics, stadium, hippodrome, disc, palestra, Olimpija, Olympic ... Yet words that are old and belong to some other, different times. Were they truly different? Moreover, if they were, placed in determined historical time, space and (social) environment or milieu, what are these words doing in modern terminology? What did the modern and humanistic man want by putting into action old Greek words? Become modern by modelling upon the heritage and the past? To become the *l'uomo universale*, a human that God gave, as Plato would say, music and gymnastic art that develop in him *"the good"* and *"a good human being"*, which of course does not mean that gymnastics shapes merely the body.

Numerous records and archaeological remains witness that gymnastics was in old Greek times socially appreciated, respected and as well criticised. As such, it was the source of inspiration and an ideal to renaissance and later humanists and educators in their aspirations for shaping ideal educational models or to the striving for national health, improvement of productivity, national emancipation and self-defence. In searching modern ways, following examples of ideals and shaping of utopian models, the contemporary time has developed a unique system of physical culture, which is based on nationalisation of exercise, walking and play, demonstration, march and competition or duel. In our Central European Slavic environment, gymnastics became *telocvik, tjelovježba* and *telovadba*, and the medieval de(s)port became a global sport, which found its way to our region as well by superseding traditional activities – the merge of antiquity and the middle ages in the modern age into modern physical education and modern sports.

In Europe, gymnastics and sport root in the 19th century. On the one side we are witnessing the nationalisation or institutionalisation and transition of traditional games and disciplines to competitive games or sports, for example football, rugby, tennis, athletics, rowing, and on the other the formation of gymnastic systems. Both are a social innovation of the time, environment or milieu and the European space, British on the one side and continental on the other. Sport is the product of spare-time activity of the new social class that derived from the increasing industrialisation and urbanisation. Initially sport was of exclusive character and it excluded workers, women and ethnic minorities – for example Jews and Romanies. On the contrary, gymnastics (various gymnastic systems such as Ling's, Jahn's, Nachtegal's and Tyrš's) soon became a significant political, health-eugenic and military instrument in the shaping of national identities and characters. Gymnastics based on the principles of the French bourgeois revolution and democracy, was open to every member of a nation, man and woman, peasant and townsman, capitalist and worker, and was modelling on the antique genus of liberals, free and equal in fraternity to whom freedom and national interest were first. It was important to exercise, as by exercise one strengthens, is healthy and makes progress. Thus, the ideal is virtue, individual and national, and progress, that magic word of modernism, as to progress was in the circumstances of the middle of the 19th century a must because, as Miroslav Tyrš stressed, in the light of the universal natural survival law, a perpetual struggle for existance and survival exists among nations and societies that have in their life and in culture neglected physical and moral values and thus became effeminate, they succumbed. Human being, the centre of Ptolemian philosophy, had to reconcile themselves to the fact that in the rational comprehension of the world and cosmos they were merely part of nature and subjected to natural laws.

Gymnastics soon became the central activity of physical education and reformed educational systems including exercise, walking, demonstration, performance and match while sport was progressively symbolising competition and was self-purposed. The ritual converted into spectacle, it econimized, the winner remained a hero, a superman, eternized by the media, materially rewarded and existentially provided. Professionalism was mocking the honourable and the *"good"* spirit, the sacred agon became a profane match, amusement of the crowds, a social-business interaction and a professional selective elitism of muscles. However, neither is exercise immune from advancement. Based on voluntary societies, on renouncing in behalf of the collective benefit, in care for the nation's progress, the gym hall had to adapt to human's consumption conformism. Progress collided with the tradition of discipline and order, responsibility and fixed forms, advancement demanded exercise freedom in view of content, innovativeness, service and a gym or trim cabinet. The voluntary activity of societies and amateurs, emotionally conditional, was forced to subject in the name of progress to technocratic consumption interests, and the public national interest subjected itself educational exercise.

II.

The physical-cultural development left behind material heritage. Many trophies, medals, cups, diplomas, gym, sport, mountaineering and other equipment, devices, manuals and textbooks, societies' and associations' minutes, reports and other documents, and least but not last, statistics, piles of data on attendance at trainings, membership fees, members,

on victories and defeats, games of teams and individuals noted in media and in official reports and stories, for example the story about the football games of the Prague Slavija – incidentally, the newspaper *Slovenski narod* saved for us the mythological lines in the year 1913, commending the Slavija game with the English *"how goalkeepers were running out of their goals because they did not want to catch the ball that the famous Kolšek was sending at the goal; his shots were so strong that the ball and the goalkeeper fell through the goal".* The material needed treatment, actual and historical, synthetic and analytical, while specialised museums (of physical education and sports or of physical culture and Olympism) took care of the legacy.

Yet, a certain paradox occurs in the story. *"It is surprising circumstance that our national idiosyncrasy of which so many of us are proudest – our love for sport – has hitherto signally failed to arouse the enthusiasm of the historian",* meaningfully wrote W. A. Baille-Grohman in 1902 in the article *The Shortcomings of Our Sporting Literature* in the *Fortnightly Review.* The dealing with the past of sports was in the first half of the 20th century tied with the writing of sports committee members and journalists or enthusiasts; of the latter, there are still many today. The first anniversaries of modern clubs were used for writing about the beginnings, the first matches, and memoirs. A typical case in Slovene history of sport the case of the magazine *Sport*, which in 1925 at the 15th anniversary of the SK Ilirija issued a special volume dedicated to Ilirija only. With regard to deficiency of primary sources, the magazine is a splendid document of sports of that time, although in time-environment and milieu broadness linked only to Ilirija, and non-critical – anniversaries surely deal with merely their part of the mosaic. Such writing was from the aspect of historical speciality that studies the past by using specific technique, laic; by that we are not maintaining the writing was bad. What needs to be pointed out is the fact that sport was for the historical speciality not a serious activity and that it did not earn attention except if maybe some of the club members were not historians themselves as for example the late Ferdo Gestrin, PhD who was a member of the skiing section of Ilirija.

The attitude of the academic "serious" history to the "new" or "modern" and ever more asserting cultural and social activity was modest. Was the popular activity inferior because it was presumably merely playful and physical? Yet, was it at all a "new" activity, or was it that only the form, the structure and the appearance have changed? The question was not even raised as history had too many problems with itself and its status. By confronting with new humanistic disciplines in the 19th century, such as Hegl's philosophy, Tyler's anthropology or Comt's sociology, history was pushed in the corner with a task to ascertain only single facts and phenomena the new asserting disciplines make use of. Forced into a defensive position, it was compelled to develop a counter-defence, and new contents appeared on the historical screen. The field of research was no more limited to merely politics and chronology, it was extending with the economy and culture, and finally with cultural everyday. A frame was shaped, linked to the human being, society, and social movements in time, space and milieu, seeking causes to events and establishing rules of social development or structure based on analysis of sources, primary and secondary. Historical, anthropological and philosophical paradigms of sport associated with the game, playfulness, and ritual conception of the match. Sport is a modern game, a nationalised agonic play, and the American historian Allen Gutmann distinguished in his work *From Ritual to Record: The Nature of Modern Sport* (1978) modern and traditional sport or sport in different chronological periods on the basis of seven characteristics such as "secularism", "equality", "bureaucratisation", "specialisation", "qualification", and "obsession with records", if we only mention them with no additional comment. Modern sport thus establishes a bond with older periods, although in practice, legacy is in many a times and many a place used only for promotion or verification of traditionality and prestige, and for attracting attention of media or establishing social and local identification.

History of gymnastics as well is in the beginning inventoried by gymnasts and committee members; still their laic historical view is broader. As gymnastic was the carrier of physical education idea, they inspire in antique tradition. Etbin Henrik Costa, a lawyer and first doyen of the Južni Sokol, the first gymnastic society in the Slavic South, stressed in his speech in 1863 that

> *"history tells us that gymnastic is several thousands of years old and it developed and accomplished systematically. The very name relates that gymnastic is such art through which the body exercises and gains suppleness and strength.*
>
> *We find its origin in old Greece where bodily motion first developed into art that came from Crete to Sparta, from there to Athens where it lost its rough military character and gained a more noble and corteous form. There were three types of gymnastic: military, which taught how to grab the enemy and protect from one; energizing to strengthen one's bodily powers and health; and combative, most famous of all, born from pleasing and from the wish to demonstrate before the audience one's strength and suppleness."*

Somewhat later Vinko Zaletel related in his work *Zgodovina telesne vzgoje in Sokolstva* (1933), written on the basis of relevant literature and primary archival sources, to Tyrš's perception of cultural development and physical-educational and moral virtue, and pointed out in his preface that *"cultural development and decline of nations were always in causal connection with physical culture of nations."* Alienation from gymnastic and thus from virtuous way of life resulted in engaging *"paid defenders"* of national freedom and consequently into downfall. *"It has been so since the ancient times"* stressed Zaletel and added *"prehistoric human was building up his muscles in open nature in order to defend himself and his family. The stronger he was the less endangered were his and his family's lives"* – fight for survival.

III.

Gymnastic development positioned historical treatment of the profession that was established by the formation of gymnastic and/or physical training education systems. In Slovenia Viktor Murnik and others with articles in the magazine *Slovenski Sokol*, and Vinko Zaletel with his work on the history of physical education and the Sokol movement, a fundamental work from before World War II, in Croatia Franjo Bučar in the *Povijest gimnastike*, were pioneers of formal dealing with the historical development and social role. History became a compound part of gymnastic self-awareness that is not only modern and new but also old, antique and socially grounded. When in 1929 the Yugoslav Sokol members wrote to the government the *"Spomenica o telesnom vaspitanju"* (Memorandum on physical education) with a proposal on forming a *"college for physical education"* – a six semester study, one of the first subjects was *"the history and literature of physical exercises"* by one lesson in the first four semesters. Laic history gained recognition and formalized; the next step was employing of historians academicians in the educating of PE teachers. In Slovenia, that was Drago Stepišnik and in Croatia Živko Radan. Laity has crossed the Rubicon of academism. Their synthetic works on the development of physical culture at home in comparison with the rest of the world are to a great extent still fundamental works while we are lacking analytical works linked to specific time and space. The work by Nikola Žutić, *Sokoli, Ideologija u* fizičkoj kulturi Kraljevine Jugoslavije *1929-1941* (1991), filles up that void. The work is written in the basis of unpublished archival material of the Arhiv Jugoslavije for the period 1929-1941, and enlightens integration and dezintegration processes in the Kingdom of Yugoslavia through the field of physical education. It is an analysis of circumstances in a given time, space and milieu.

The historical front is open, additionally opening it are the changes of political and social systems and ideological or perception changes. The latter impose reflection and critical-objective interpretation-reinterpretation. Facts remain; for example, the Sokol organisation was an important organisation in the nation's cultural development, and a national factor, yet still bourgeois and as such did not fulfil expectations as it was by Marxist interpretation a bourgeois organisation and therefore a class opponent. But let us ask ourselves: to what extent did it not accomplish its mission? Has the disunited Sokol movement with its ideological change of name after World War II performed a more positive role as it did during the time of parliamentary kingdom? Was gymnastics with its socialist transition of physical culture to physical education, recreation and sport still preserving its role or was it doomed to consumption transformation into recreation with negative consequences for the societies' massiveness and subjection to sport? Parallel, new questions are being opened linked to individual nations, for example, the position of the Croatian Sokol in the years up to 1929 in the national - that is Croatian, and in Yugoslav environment in view of actual political circumstances and aspects regarding solving the national question. Or in Slovenia - the problematic of the just bygone period, and the question of the famous, for some notorious *"Portorož conclusions",* to what extent should we preserve educational amateurism, and to what extent accelerate professionalism and selection of sports? A new fact is the decay of the Socialist Federal Yugoslavia and transition into market economy and democracy. The latter has been partly seen in history, during the Kingdom when from the view of national interest, gymnastic oriented physical education and civil-social sphere had a primary role. An experience ran over by time some would say, yet still a concrete one, while the present time offers short-term and long-term economic statistical dull simulations without considering the historical emotional experience and deliberation about the integrity of the system, value and technical.

Finally yet importantly, Yugoslavia is politically indeed a dead letter on paper, but not historically. Historical work is in the field of physical culture at its resumed beginning. Facts are written down; there is a deficiency of analyses, and succession. The common Yugoslav experience reminds us of exchange of opinions and researches, as was the case with the magazine *Historija za telesno kulturo*, which was only being published for a short period, or *Povijest sporta*, which was mainly linked to Croatian space but Slovene writers published in it as well. It is to hope that this year's expansion of the sociology section with history is the first step. This is precisely why the section did not choose a specific theme, as we are aware that researchers and lecturers do not know each other in this new time while the future is ahead of us. And history is showing us the way …

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IMPORTANCE OF THE SLOVENES' MOTIVES FOR FOLLOWING SPORTING EVENTS

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Abstract

Today, the followers of sporting events, either gathering at sports venues or watching and reading about sporting events in the media, are an important segment of sport and to some extent impact the entire organisation and purpose of sports competitions. A good knowledge of spectators' values and interests is important for the organisational culture of sport that is also geared towards commercial success, which nowadays is inevitable – primarily in terms of athletes' professionalism. The study was based on a survey of 1,727 people and its purpose was to investigate the culture of sporting event followers. According to the results the most important motives could be classified in the category of Dionysian values. This means that the role of sport in a spectator's life is not that influential; it is much more considered a source of relaxation and pleasure. The data reveal those attributes of sport that have always caught and will also continue to catch the eye of the young and the not so young. Sport goes hand in hand with the spectacle and consumer cultures to which we are all bound and which have become integral parts of our everyday life.

Key words: *sporting event spectators, motives, adult Slovenes*

Introduction

From the point of view of extrinsic sport values, the role of spectators in sport is extremely interesting and by all means deserves further in-depth scientific analyses. The humanities in particular, placing sport in a broader social framework, may contribute substantially to broadening of knowledge of spectatorship, an important phenomenon that has been a companion to sport throughout the history. A quick glance at the history of Romans and ancient Greeks and their historical remains reveals that competitive events, the circuses and various combats were always tremendously interesting for passive onlookers – those watching from the side. The modern sports stadiums resemble the antique stadiums and arenas. The central stage where a competition or a combat takes place is surrounded by tiers of seats for spectators.

In the present era of technologically highly developed media the stadiums find their way to the passive public in many ways. The leading medium is the one that most effectively transposes the real atmosphere – of course, television has a big edge here, which is also proven by our survey. However, radio and printed media have also developed sophisticated ways of conveying information. This points to the fact that spectacle production is an important attribute of sport. Spectators represent an indispensable part of the current elite sports culture.

The sports culture is anthropologically conditioned by participation of an individual, irrespective of the role they play in a cultural context. In each role, participation of an individual depends on their values and needs which in a specific manner trigger their motivated behaviour and activity. By all means, following of sporting events is a specific activity of an individual, which is in a causal relationship with the impact of different motivational dimensions, with some of them resting on biological and other on completely sociological bases.

In this article, we shall not reach beyond the autonomy of the sports world and we uncritically assume spectacle to be an important attribute of sport. We are well aware of the criticism that the humanities level against the spectacle society (Debord, 1999), however, it is not reasonable to translate this criticism bluntly into the world of sport, without a methodological adaptation.

The term "specere" means "to watch, observe what is displayed". A spectacle aims at creating a visual impression. Not everything we watch is a spectacle. Spectacle is based on an exhibition of the object and hence presupposes spectators. It is an organic connection with synergic effects. Of course, not every performance that is observed by a spectator is already a spectacle. Spectacle calls for a certain grandeur, undivided attention, attractive dynamics etc. (MacAloon, 1989). To identify the possibilities and mechanisms for impressing of a sporting event on the spectator's mind and consequently also the reproduction and reconstruction of the sports culture, our survey tried to establish the motives that guide spectators.

Therefore, the purpose of this survey was to identify the factors influencing the public's motivation for following sporting events and the achievements of the sports culture at large. It is the knowledge of the basic motivational dimensions that enables a positive value transformation of sports culture, increasingly impacting the modern way of life.

Methods

The sample consisted of 1,727 randomly selected adult inhabitants of Slovenia who were divided evenly into 8 constituencies according to the electoral system scheme (Election Regulations, 2. amended edition, Official Gazette of the

Republic of Slovenia, Ljubljana, 1996). The age structure of the sampled respondents corresponded to the age structure of the adult Slovene population (above 18 years), while in terms of gender, the distribution was almost balanced (52.7% of males).

As regards the level of education, 15.5% had completed three-year secondary school and 31.2% four-year secondary school, 14.5% almost graduated from college or university and 11.7% had university degrees. The age structure was the following: under 25 years – 25.7%, 26-35 years – 26.9%, 36-45 years – 20.6% and 46-55 years – 17.6%. In terms of employment, 69.8% of participants were employed and 20.1% were students. Their family status revealed that 35.2% of the surveyed respondents lived with their parents and 49.1% raised their own family (including children).

On a scale from 1 to 5 (1 standing for "completely unimportant factor" and 5 for "very important factor") the respondents in terms of importance ranked the proposed factors (motives) in sport reflecting the purpose and/or goals of sport as well as the factors defining the modern sport. For each motive the mean values were calculated and the scale of motives by importance was drawn up.

Results and discussion

The most important motives for following sporting events were: "one's liking for sport", "successes of Slovene athletes" and "entertainment", while the least important motives were: "nothing else to do", "successes help us overcome problems" and "most people follow sporting events" (Table 1).

Table 1: The structure of answers shows the importance of motives that induce the respondents to follow sporting events

Motive	Mean	S.D.	Very important (%)	Important (%)	Moderately important (%)	Unimportant (%)	Completely unimportant (%)
One's liking for sport	4.06	1.05	42.3	32.4	17.6	3.9	3.8
Successes of Slovene athletes	3.94	1.05	35.1	36.6	19.6	5.0	3.8
Pleasure	3.79	1.10	31.7	31.2	26.1	6.1	4.9
Entertainment	3.69	1.05	24.5	34.9	29.4	7.0	4.3
Sport dynamism	3.49	1.08	17.9	35.3	31.7	9.0	6.2
Competitiveness, fighting spirit, struggle for victory	3.46	1.21	23.6	27.3	29.0	12.4	7.8
Unpredictability of sports results	3.43	1.17	20.1	31.0	29.0	12.4	7.4
Interest in an achievement	3.43	1.13	19.0	31.0	31.8	10.8	7.3
National importance of sport	3.36	1.26	21.8	27.6	26.9	12.6	11.1
Attraction of sport	3.32	1.14	15.6	30.6	32.2	13.9	7.8
Cheering for a club or individual athlete	3.30	1.21	18.3	28.1	30.3	12.8	10.5
Useful spending of leisure time	3.23	1.22	16.3	28.6	28.2	15.9	10.9
Personally engaged in sport	3.08	1.34	19.0	21.0	25.6	18.0	16.3
Wide media coverage	2.96	1.12	8.5	24.1	35.0	20.3	12.1
Aesthetic impression	2.94	1.19	10.9	21.6	33.5	19.5	14.5
Element of general culture	2.90	1.09	6.8	22.4	37.8	20.9	12.2
Familiarity with athletes' private life	2.76	1.13	7.5	17.2	34.5	25.9	14.9
Ignorance of sports discipline	2.74	1.10	6.2	17.1	36.2	25.6	14.9
Active involvement in sport	2.60	1.22	7.1	17.3	28.0	24.6	23.1
Success boosts self-assurance	2.53	1.26	8.2	16.0	23.3	25.6	26.9
Viewing satisfies the need for activity	2.41	1.15	4.9	13.6	26.3	28.0	27.2
Plenty of leisure time	2.37	1.14	4.6	12.2	27.7	27.7	27.8
The fact that most people follow sporting events	1.96	1.02	2.2	6.1	18.6	31.0	42.0
Successes help us overcome problems	1.95	1.08	3.2	6.9	17.4	28.0	44.5
Nothing else to do	1.78	0.97	2.3	3.4	15.1	28.8	50.5

One's liking for sport was the most important motive for following sporting events. Perhaps the results could be interpreted in two ways. The first interpretation deals with intrinsic values of sport that are common to each sports discipline. If a spectator internalises these values, either through their own experience or through emphatic re-living of sport, and the sport satisfies or fulfils them in any way so that they declare they like sport (to be precise, the factor in the survey was: one's liking for sport – I like sport), then there is high probability that the reasons for following sporting events are latent. The statement that one likes sport may be fuelled from many sources, giving the respondent a chance to "express" their love for sport. This expression of love for sport is not substantiated rationally and instrumentally – it allows irrationality and is self-contained. The other interpretation may be developed towards identity. Roughly speaking, if the identification mechanism is divided into two segments, i.e. equality and diversity, it appears that the answer *I like*

sport implies identification through equality, which correlates to the second most important motive: "successes of Slovene athletes". When sporting events are followed internationally, a context emerges in which "the national" becomes important – it constitutes a difference on which identification and national equality are based.

Pleasure and entertainment as the next high ranking motives point to the attributes of sport. Already in the introduction, spectacle was put in a broader social context. In a culture that promotes progress and is geared towards achievement and instrumentalisation of each activity, sport has a high symbolic value. Pleasure and fun in watching sporting events would not be possible, if sport failed to satisfy some desires, projections as well as natural and cultural needs etc.

The least important factors in following of sporting events were: "spending one's leisure time", "the fact that most people follow sporting events", "athletes' successes help us overcome personal problems" and "nothing else to do". The motives referring to leisure time and lack of other activities perhaps point to the same findings as reported in the Special Eurobarometer 213 survey (2004), namely that 42% of the Slovenes do not practice sport for lack of time. With further analysis and by putting the sports culture in a broader social context, it would be interesting to correlate the level of socio-economic development of the country with the frequency of viewing or practicing sport.

The motive "most people follow sporting events" is proved insignificant and corresponds to the findings of the above mentioned survey, reporting that the highest share of population (31%) views at least one sporting event on TV. All other ways of following sporting events (newspapers, magazines, radio and spectatorship) rank even lower. Therefore, in view of the percentage of people who follow sporting events on a regular basis it is logical that the motive "most people follow sporting events" is insignificant, as the survey shows that this is not the case.

Conclusion

The motives that induced the Slovenes to follow sporting events were love for sport and emotional state during viewing of sports competitions. A major role in this phenomenon is also played by high performance of Slovene athletes, considering the fact that some previous research (Jošt, 1998) already established that popularity of sport and athletes' successes are highly correlated and that those sports in which the Slovenes score high are more popular. It is of course clear that the sports in which Slovene athletes excel are covered by media more frequently and thus the correlation between high performance, popularity and spectatorship is even stronger.

Division of sport into practices and institution is based on the above mentioned MacIntyre's theory (1985: 187). It is about the concept that ascribes to practices intrinsic goods which are personal and attainable only through practices, while institution more likely provides a setting for extrinsic goods. The term "practices" is understood as: "*... any coherent and complex established co-operative human activity through which goods internal to that form of activity are realised in the course of trying to achieve those standards of excellence which are appropriate to, and partially definitive of, that form of activity, with the result that human powers to achieve excellence and human conceptions of the ends and goods involved are systematically extended*."

"*Institutions are characteristically and necessarily concerned with what I have called external goods. They are involved in acquiring money and other material goods; they are structured in terms of power and status, and they distribute money and power and status as rewards. Nor could they do otherwise, if they are to sustain not only themselves, but also the practices of which they are the bearers. For no practices can survive any length of time unsustained by institution*.." (MacIntyre, 1985: 194)

Based on the results the sports theory will develop towards establishing of an interaction between sport practices and following of sporting events. It is known from practical examples that many sports adapt and change their rules so as to increase viewer rating, seeing that the economic criterion is closely related to the component of popularity and media coverage. On the other hand, changes in rules affect sport as such and impact its intrinsic values, which is felt by athletes and spectators alike.

Co-ordination of interests and values is necessary and the institution has to implement preventive measures against excessive instrumentalisation of sport, since practices cannot resist to extrinsic values. At this point it is reasonable to include spectators as an important segment of sport, which – based on the findings – will be one of the fields of research in the future. Namely, in our opinion, the spectators interfere with the values within practices as well as with the extrinsic values managed by the institution.

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SPORT AS AN IMPORTANT PART OF THE SLOVENIAN NATIONAL IDENTITY

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Abstract

The purpose of the research was to ascertain what kind of influence sport has in forming the national identity of Slovenian people. Value categories, attitudes to sport, the national pride of respondents at various events, pride at sports competitions, events and achievements were examined relative to gender and nationality on a sample of 857 Slovenian residents and with the help of variance analysis.

The results show that the respondents consider family, the Slovenian language and Slovenian citizenship as the highest value categories. During various events citizens are proudest when Slovenian sportsmen achieve important results. The findings show that competitions and events, such as Planica, Golden Fox and the Vitranc Cup, help promote Slovenia around the world and that the best publicity for the country are the achievements of Slovenian sportsmen. People relate feelings of national pride to those events and people that have left an imprint on the history of world sport, with the ski jumper Primož Peterka being singled out as the first and only champion in the history of modern Slovenian elite sport.

The results indicate that there are some differences between both genders and between people who are/are not Slovenian nationals.

Key words: *national identity, sport, Slovenian citizens*

Introduction

Sport is a mass cultural phenomenon that has at least two important roles for the nation; firstly, it represents the nation in the world and, secondly, it brings out national emotions of citizens within the nation (Whitson and Mcintosh, 1993). Sport and sports events create very good circumstances since sport is seen as an apolitical activity although in reality it cannot be isolated from the political environment in which it exists (Hargreaves, 2000). Sport should overcome all social differences such as gender, race and age. Therefore, sports events can bring together people regardless of their differences. The nature of competition itself also increases national ardour and thus also national awareness.

The connection between sport and national identity is centuries old. Most nations have national heroes in different historical periods and some of these are sportsmen. Countries also have national sports that are important for the national identity.

The sport of Slovenian people as a nation can only be examined from the early 20th century onwards. The beginnings of national identity and national awareness have their basis in language and literature. In the formation of the Slovenian nation, the national identity of Slovenians was built up gradually; not only through cultural awareness but also via a sense of political belonging. The first influence of sport on the national identity of Slovenian people can be traced to the start of the 19th century when Sokol, the first gymnastics club, was formed. This was a big cultural and political milestone in Slovenian history. During the time of Yugoslavia, national identity strengthened mainly due to the success of our Alpine skiers (Starc, 2004). Upon gaining independence Slovenia also acquired its own "national hero", namely Primož Peterka, who ignited enthusiasm across the nation. Further, clearly the "Slovenian football fairytale" also became a phenomenon of the modern Slovenian national identity.

The study will analyse sport's impact on the formation of the Slovenian national identity and determine whether the national identity differs according to the gender and nationality of the individual.

Methods

The study included 857 residents of the Republic of Slovenia aged between 19 and 80 (M= 40). The sample consisted of 445 men and 412 women.

Social-demographic variables, value categories, attitudes to sport, national pride of the respondents at different nationally important events, pride at sports events and achievements were all analysed. Respondents answered the statements according to the level of their (dis)agreement on a 6-level Likert-type scale (1 – entirely disagree, 6 – entirely agree).

The data were analysed with the SPSS for Windows statistical package. Simple statistics was calculated, as well as variance analysis (F-test and its statistical significance) for the examination of differences between genders and nationalities.

Results

The research results show that family, knowledge of the Slovenian language and Slovenian citizenship are the most important value categories for the respondents. They regard their interest in politics and religion as being less important.

Men consider "friends" as the most important value category, whereas women still think of family as being the most important. Men also value sport more strongly, while women place more importance on culture. Probably men spend more of their free time on sport, which forms part of their relaxation and socialising with friends. Women spend their free time for less "energetic" activities, such as culture and art. When the results are compared for different genders, statistically significant differences in the responses can be noticed.

A comparison of the results according to nationality shows that those respondents who are not Slovenian nationals consider science, friends and respect for Slovenian law to be more important value categories. They regard the value category "being born in Slovenia" as less important. The respondents who are not Slovenian nationals put a high value on science and education; they probably consider knowledge as one of the more important factors when looking for a job and trying to fit into their new environment. Presumably friends are a big support for anyone not living in their original country or when one is a different nationality than the majority of citizens living in that country. Usually people of the same nationality living in a foreign country form a community which helps them in their social life, the celebration of holidays and by offering support when needed. It is also understandable that those respondents who are not Slovenian nationals do not think that being born in Slovenia is very important since most of them were born outside of Slovenia anyway.

The research analysed different events during which Slovenian citizens feel proudest to be residents of Slovenia. The respondents feel proudest when Slovenian sportsmen achieve important sports results, but also when talking to foreign people about the cultural and natural charms of Slovenia and during visits by important political figures to Slovenia. They are less proud during visits by religious leaders and seeing reports revealing comparisons of the Slovenian economy with the European average. Reasons for these results could include the worldwide recognition of sports achievements which lead to the greater recognition of Slovenia than during visits by religious leaders who visit many countries each year. While the visits by presidents Putin, Bush and Clinton were big political events for Slovenia, it is the sports results of Slovenian sportsmen that make the respondents feel even prouder to be Slovenians.

Our analysis of the results according to gender also shows that both men and women feel proudest to be Slovenians when sportsmen achieve important results. For women, this also compares with talking to foreign people about the cultural and natural charms of Slovenia. Women also regard visits by high political figures (Putin, Bush) to Slovenia as being more important than how men see them. The results show that women highly value it when foreign people praise Slovenia or when the foreign press writes about President Bush visiting Slovenia since, according to women, this contributes to Slovenia's recognition around the world.

Similar results were shown when the respondents were compared according to their nationality. Subjects who are not Slovenian nationals feel proud when Slovenian sportsmen achieve important results, whereas they place less value than Slovenian nationals on other events.

It was found that international competitions such as the skiing events Planica, Golden Fox and the Vitranc Cup contribute to Slovenia's recognition around the world and that the achievements of Slovenian sportsmen are the best promotion for the country. The respondents do not agree that football is a sport of people from the Balkans (M= 2.89) and that Slovenia has a lot to learn about sport in comparison with other former Yugoslav republics. The argument that 'football is a sport of Balkan people' was forgotten a long time ago as only a small percentage of the respondents agreed with this statement and, in particular, men disagreed with it. The statement 'I am happiest when we beat one of the former Yugoslav republics' had a high average value, indicating that the Slovenian public still 'likes' victories over former Yugoslav republics. Men in particular agree with the statement 'I am happiest when we beat a former Yugoslav republic'. This indicates that, amongst men, competitiveness with former Yugoslav republics is strong so therefore they pay special attention to such events and competitions.

When comparing the results of those respondents who are Slovenian nationals with those who are not some differences emerge in their answers. The respondents who are not Slovenian nationals agree more strongly with statements that Slovenians are a sporting nation, that team sports are not a '*forte*' of Slovenia, that football is 'the most important pastime activity in the world' and that Slovenia has a lot to learn about sport. It may be assumed from the results that most of the respondents who are not Slovenian nationals are from the former Yugoslav republics where football is indeed 'the most important pastime activity in the world'. Further, people living in those countries often say that Slovenian people will never be good in team sports, although the recent good results seen in handball clearly run counter to this argument. It is not surprising though that these subjects also agree more strongly with the statement that Slovenia has a lot to learn about sport.

The respondents relate feelings of national pride to those events and people that have left an imprint on the history of world sports. Thus Slovenian people highly value Leon Štukelj, the organisation of the Golden Fox skiing competition, Bojan Križaj and the ski jumping world record. The respondents relate more strongly to more 'recent' sports events and

sportsmen. The only exception to this rule is Leon Štukelj. However, even he became 'famous' only after Slovenia gained its independence and after the 1996 Olympic Games in Atlanta when he was introduced at the opening ceremony as an honorary guest of the IOC. Alpine skiing was almost the only sport in which Slovenians excelled vis-à-vis other republic during the time of Yugoslavia and it could be said that it has become a way for Slovenians to distance themselves from the other former republics. A similar example is the Golden Fox competition, almost the only sporting event at the world level being organised in Slovenia.

An analysis of the results between genders and the respondents of Slovenian and non-Slovenian nationality yield similar results. Respondents who are not Slovenian nationals on average gave lower marks to sportsmen from the earlier period of history in Slovenian sport. Reasons for this can probably found in the lack of familiarity with these people.

In the group of the six biggest sporting achievements men most often place the 1999 and 2000 overall ski jumping World Cup victories of Primož Peterka, the 800-metre run world record by Jolanda Čeplak, the rowing Gold medal won by Iztok Čop and Luka Špik at the 2000 Olympic Games, the qualification of the Slovenian football team for the 2002 World Cup, the long-distance swim down the Mississippi river by Martin Strel and the 100-metre hurdles silver medal at the 1996 Olympic Games by Brigita Bukovec. Interestingly, not many people placed the Olympic Silver medal won by Andraž Vehovar in this group of the six best achievements, even though he won it at the same Olympic Games as Brigita Bukovec. Obviously, the respondents consider athletics and 'black' sports and disciplines in particular as being harder to win a medal in than in the white water kayak. This indicates that the criteria for valuing individual sporting achievements relate to the popularity of a sports discipline. The 'popularity' of an individual sports discipline is principally related to the media and sponsors of that sport.

The ski jumping World Cup victories of Primož Peterka, the world record by Jolanda Čeplak and the national football team's qualification for the World Cup are achievements which the respondents are the most proud of. The results also show that the respondents feel slightly less proud about the achievements of Slovenian teams playing in European club competitions.

Primož Peterka topped the list of the most important Slovenian sporting achievements in every group of respondents we analysed. This shows that Primož Peterka is the first and only champion in the history of modern Slovenian elite sport. The twice World Cup winner in what Slovenian people consider as a 'sacred' sport has become the biggest national hero. His achievements brought him rapidly into the spotlight of Slovenian national identity and he started some level of sporting euphoria. He has become an item and the property of the nation and undisputedly the only individual sportsman of this young independent country to invoke jubilation of national dimensions in Slovenia.

Discussion

In the short period since gaining independence Slovenia acquired its first national hero, the ski jumping ace Primož Peterka. Due to his incredible achievements at such a young age he became a symbol of pride for Slovenian people. People went on a pilgrimage to the Tamar valley to see the ski jumping. The well-known football chant goes: 'Whoever is not jumping is not Slovenian!' and, in ski jumping, this could be paraphrased to be 'Whoever does not go to Tamar is not Slovenian!'

The main characteristic of sport in the independent Slovenia is the revival of team sports. Slovenia has, together with its independence, gained entry to international sports organisations. Matches between nations in team sports are nowadays the key reason for the formation of a national mythology. When the Slovenian team plays against a team from a nation with a common history, the emotional intensity involved is entirely different than when playing with countries that have only 'crossed interests' on the playing field.

Sporting achievements do have a strong correlation with the national identity. However, there is no rule that a sporting achievement influences the national identity since there are many cases where sportsmen obtained elite results which did not ignite too much enthusiasm. Clearly the sporting achievements of Slovenian sportsmen have an important impact on the national identity; nevertheless, the path to 'national sport' is long and winding and depends as much on both historical and political backgrounds as on worldwide trends, which everyone is trying to follow.

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THE PRIMORSKA EMIGRATION AND SPORTS IN LJUBLJANA AFTER WORLD WAR I

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Abstract

The Ljubljana sports club Primorje was founded in 1920 by the Primorje emigration; the club performed a significant social role as the immigrants in Ljubljana used it for their mobilisation and socialisation and promotion of that special group in Ljubljana. In the article, we focus - based on primary and secondary sources and relevant literature – on circumstances regarding the organization of the club that are linked with the development of sport in the region of Primorska as well as with the end of World War I and post-war geopolitical order.

Key words: *sport, Primorje, emigration*

The Roots of Primorje

The roots of the club are linked to the development of sport in Primorje (having in mind the Tržaško and Goriško regions) prior to World War I and the political events at the end of World War II. Apart from gymnastic societies (in 1882, the Trieste Sokol was founded and in 1887 the Gorizia one; they were the central Sokol societies of the Tržaška and Goriško regions), cycling societies were being founded in Primorska, and immediately before the war football societies. In 1893, the Club of cyclists of the Trieste Sokol was established in Trieste as an autonomous section within the gymnastic society. The Bicycling club Balkan was in 1899 started from the latter under the leadership of Anton Podbrščček. The new club was the most active Slovene cycling society in Trieste and opponent to Italian clubs. In 1895 founded Cycling society Gorica spread bicycling in the region of Goriško (Rupel, pp. 15-20). Both societies organized before World War I a few larger bicycle races. For example, in Nova Gorica they have prepared a cycling manifestation at the there velodrome that attracted approximately 6000 spectators. A festivity followed the race with solemn Slavic atmosphere and envy of the Gorizia Italians. Organizing the cycle race on the tour Ljubljana-Tireste was next. It was considered a Yugoslav championship and only (Yugo)Slav competitors took part in it (Rupel, pp. 18-19; Stepišnik, pp. 31-35). The winner of the 1912 ans 1913 races was Albin Šiškovič who we after World War I find among members of the cycling section of Primorje. We should mention that Slovene cyclists from Primorska participated in races of Italian clubs as well.

In the school year 1907/08, the students' football club Yugoslavia was founded in Gorizia. Members of the club were exclusively Slovene pupils from Gorizia. A similar club in Trieste was the Societa sportive Studentesca in which despite its Italian name Slovene pupils played as well. The club Yugoslavia was managed by A. Gorjup and Sportiva by Ernest Rajgelj (Sport, 1920, No. 4). In 1911 or in 1912 at the latest, the Gorizian pupils broke the school frames and founded the civil Slovene football club Yugoslavia. Among others playing for the club were A. Gorjup, Banovec, Zuchiatti, Peter Birsa, Mozetič, Milan Lenassi; we find the mentioned in the Ljubljana clubs immediately after the war (SN, May 5 1923). The best Gorizian players reiforced a few times the in 1911 established Slovene footbal club Ilirija in Ljubljana, particularly in matches against the stronger and more experienced Zagreb club HAŠK (ZAL: SK Ilirija).

Footbal had, like cycling, a social role of gathering Slovene youth; the names as the footbal club Yugoslavia and cycling Balkan speak of the national perception of the young Slovenes of Primorje and of the views upon solving the national question in that time.

Another factor linked to the organizing of Primorje is the Primorje during and post-World War I emigration. The joining of Italy to the entente in 1915 opened the Austro-Italian front along the Isonzo river, which triggered a refugee wave from the region of Goriška to the nearby Slovene and Austrian provinces, and after the war, the Italian occupation of Primorska, Istria and other territories (in accordance with the London agreement) and the performing of nationalist denationalisation policy provoked another wave of emigrating. First on the stroke were public employees, and the first post-war wave of emigrants aimed at larger Slovene towns while some went to the south of the new Yugoslav state. In Ljubljana, war refugees and later immigrants were accomodated in barrack camps in different parts of the town (Bežigrad, Šiška, Moste) and in railway carriages on abandoned rails.

The immigrants met in Slovenia with quite tense social circumstances, social riots and strikes, fights for the northern border and with mobilisation. Hard were the times for the war refugees from Goriško that were accomodated in camps in the river Savinja valley, in Ljubljana, at Ptujsko polje and elsewhere in Slovenia. They were mainly jobless and wanting to return home, which all depended on Italian authorities and on international talks between the kingdom of SHS and Italy. The Slovenski narod wrote in March 1919 that 30.000 refugees from Goriško were waiting to return to their "native soil", that "exiles are vegetating in barracks, most of them unemployed" and that the Yugoslav "government … proposed

to the Italian commission a list of approximately 4000 refugees in regard of passes, … but there is no solution yet" (SN, March 16 1919). In such circumstances, various aid organizations emerged offering help, advice and mediating work to war refugees and immigrants such as the SHS Advisory bureau for refugees that mediated jobs to refugees, or the Refugee advisory committee that offered all refugees in camps or outside them, all classes and professions, free advice in all refugee matters, or the pro-political Office for the occupied territory, which for example called the refugees from Goriška to sign a statement on annexation of Goriška to the Kingdom of SHS (SN, Feb. 20 1919; June 21 1919).

Not to be forgotten is education and the foundation of the Ljubljana Universtiy in 1919. Thus students joined the first emigration wave since the University in Ljubljana enabled studying in Slovene language; secondary school graduates continued their schooling in Slovenia where Slovenisation was in process in the education system while in Primorska intervention of the Italian authorities was perceived; consequently many of the pre-war schools were not renovated, similar was with Croatian schools in Istria.

Employment conditions were for the first wave of immigrants favourable. The newly established state was in need of cadres, and the people from Primorska were with their national-Yugoslav orientation welcome. As the number of people from Primorska was in Ljubljana large it was natural they began to gather and organize in their own societies where they were preserving or strengthening their local national patriotism and giving it stress with the names of societies. Their aim was also to help those that followed them on the emigrant path (Čermelj, p. 43). Among the first organized was the Sokol organisation – the Primorski sokolski krožek (PSK), which was in connection with the Sokol members in refugee camps outside Ljubljana. The founding meeting took place in Ljubljana in April 1919 to the initiative of the pre-war secretary of the Gorizia Sokolska župa Rozman. Over 90 Primorska Sokol members of both genders participated at the meeting, and Dr. Slavko Fornazarič was elected doyen. The PSK united the Trieste and the Gorizia Sokol members. At the meeting, Rozman read the memorandum of the Gorizia Sokol members on occupied territory, which was presented to him at his departure, in which they promised they would not allow that "Goriška will be detached from the entire state of ours – the SHS Yugoslavia", and that they "are ready to defend it from any enemy by force if needed". As we know, the Sokol organisation in Primorska was the first on the stroke of the Italian authorities. The PSK initially organised hiking excursions, entertaining evenings, various lectures, and later physical training as well. The club was active until 1922, which coincides with the implementation of the Rappalo peace treaty from June 1922 by which Primorska, Istria and Dalmatia were part of the Kingdom of Italy. The PSK members joined other Sokol societies (SN, April 22 1919); Sokol, 1919).

In 1920, we register the founding of the cultural society Soča and the Club of women from Primorska, a society with a humanitarian mission to help refuges and the young people from Primorska taking education in Ljubljana. Part of the youth, together with adults resorted to sports and established the Sportni klub Primorje. The organisations cooperated as members of the PSK were also members of Soča or the SK Primorje as well, and vice versa, they cooperated with the Club of women from Primorska.

SK Primorje

Primorje was founded in the turbulent time of revival of Slovene sport, which was on Slovene territory poorly developed before World War I, and in time of organizing Yugoslav sport that wanted international recognition. Initially, clubs that were active before World War I were renewed, for example Ilirija, Ljubljanski sportni klub and Slovan. Followed newly organized clubs among which we find in the year 1920 the Sportni klub Primorje.

When answering the question why the club was founded we must take into consideration the fact that among numerous refugees, emigrants, students and pupils from Primorska there were sportsmen, former and still active, and that the war interrupted their sporting activities. In Ljubljana, they initially included themselves in the post-overturn sport events and joined the Ljubljana clubs. There was not enough space in the new clubs for all the youth from Primorska for the clubs were primarily clubs for the locals; on the other hand, they were getting lost in local clubs and consequently they would become lost for Primorska.

As we have already mentioned, the PSK was organized coincidently; as physical training and football were not compatible the sports club of Primorci in Ljubljana was founded. Senior sports committee members, former sportsmen, some political men of note, for example Dr. Dinko Puc, later mayor of Ljubljana or the Sokol member Dr. Slavko Fornazarič (doyen of the PSK), and the youth from Primorska participated in organizing the sports club. The founding meeting or general assembly took place in the coffeshop Zvezda on May 5th 1920. In the minutes of the 1st general assembly, it was stressed that the SK Primorje was being founded for "the purpose of cultivating the sport idea among the youth of Primorska in Ljubljana." The club was to form some sort of seminary of sports propagators in order to develop sport organisations after the concluded teachings in the unredeemed soil of Primorska. Besides those ideal goals, there were other ambitions such as to show Ljubljana that the youth of Primorska is capable and will not stand aside the nascent cultural life in the new free state (SN, May 7 1923).

The pre-war cyclist and cycling committeeman Fran Bajtel was elected first chairman (Bajtel retreated to Ljubljana during the war; there he opened an inn and later started a bicycle and baby carriage factory named Tribuna); the club

colours they chose were black and white – black stripes on white base as a sing of mourning for the occupied territory. In the clubs' coat-of-arms was the Trieste halberd on white-black background. Membership was initially linked to people from Primorska; the fifth paragraph of the club rulebook defined that members born "on by Italians occupied territory (Primorska, Inner Carniola, Croatian Primorska)" have active and passive right to vote. Additionally enlightened is the appurtenance to Primorska by the 19th paragraph, which defines that in case of agreed dissolution of the club, the last general assembl decides to whom belongs the club property, and in the case of authoritative dissolution the "club property belongs to the management of the PSK in Ljubljana until the foundation of a club with identical goals of which members must be from the occupied territory (Primorska, Inner Carniola, Croatian Primorje)." The first significant change of the Rulebook was realised at the general meeting in January 1921 when the instruction that limited membership to only the "born in Primorska" (AS, Index file of societes 8040), was cut out of paragraphs 5 and 19, presumably because of the Rapallo treaty between Italy and Yugoslavia from December 12th 1920, which ratified the Italian "occupation".

Soon after the founding meeting, the newspapers announced the foundation of the club. Football players from Primorska that played at Ilirija (Ernest rajgelj, Milan Lenassi, Karol Bano, Mario Černovic) and at Slovan (Peter Birsa, Stanko Mozetič) soon joined the Primorje club. Consequently, the young club incurred sporting opponents. The club was planning its first official presentation and performance in August 1920: a cycle race from the inn Slamič in Glince to the demarcation line and back (SN, July 9 1920); presumably the race was because of tragic events in Trieste, the fascist arson of the Narodni dom, postponed for indefinite time.

The activity in the first year was subjected to football; during the year athletes, two cyclists and a swimmer appeared at competitions. As regards organisation we register besides football and cycling sections, organizing of athletic and swimming sections, and a swimming pool or a women's section (women were practicing hazena – a game similar to handball, and athletics; the young diva from Primorska Ida Kravanja, more known as film actress Ita Rina, was a member of the club for a short time). In autumn 1920, the football players officially played in the football championship and were by the end of the season ranged in the Ljubljana first class and thus for the first time confronted with Ilirija at a championship match. Their derbies became in mid-twenties a sports delicacy in the sporting beat of Ljubljana, and as well a "mirror" of social status and frictions between the locals and immigrants in Ljubljana.

In this way Primorje, the fruit of tragic political events in Slovene national history, indelibly noted itself down in Slovene history of sports. In addition, the Ljubljanski akademski sportni klub merged with Primorje in 1925. Thus, Primorje gained in the name academic, that is - the Akademski sportni klub Primorje, and the University Chancellor into the management. The mentioned fact indicates gained sports grandeur in relatively short time.

Primorje performed an important sports and social role as the emigrants from Primorska in Ljubljana used it for their mobilisation, socialisation, and promotion of a special social group in Ljubljana, some sort of minority. The sportive Primorje brought together emigrants from Primorska regardless of their political convictions. The motto of the leader of the athletic section Danilo Sancin was "all for Primorje and Primorje", for the club and for the land. Lado Božič who in the twenties fled from Idrija and thus from under Italy to Ljubljana alleged in his memoirs that after his emigration to Yugoslavia in 1927 he was first secretary of the football section of Primorje. He did not join Primorje because of being a sports enthusiast, but to meet as many emigrants from Primorska as possible. The social side of sport and the Primorje club was for him important as it presented a gathering place of all that "scented at least a little of Primorska". At matches and other sport events of Primorje, the Ljubljana people from Primorje, members and non-members of the society, sympathizers and fans gathered. Božič made use of his sports officiating for establishing contacts with emigrants and for founding a new emigrant organisation ORJEM, which was open to all coming from the occupied Slovene lands and to all citizens of the Kingdom of Yugoslavia (Božič, 1976)). Precisely from the aspect of gathering, socialising and attracting "all from Primorska" the fact that the pre-war consulate in Ljubljana controlled and kept record over the club, is not surprising (in the Archives of the Italian Foreign Office Milica Kacin-Wohinc find the mentioning of Primorje as emigrant society). Moreover, in mid-thirties, an Italian confidant was disclosed among club members, Vanja Drufovka, otherwise supporter of the football section who was then exchanged for a Yugoslav agent captured in Italy (FŠ: ASK Primorje).

With the Italian occupation of Ljubljana and the annexation of part of Slovenia to the Kingdom of Italy in 1941, the club automatically ceased its activity and was dissolved by the authorities. It was not revived after World War II. The new era brought about new clubs.

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SPORTING LIFESTYLE AS A FEATURE OF SOCIAL HEALTH

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Abstract

Social health and well being is being challenged by interruptions, disturbances and relations of many kinds. Social pathologies are epidemically growing and constantly threatening the existence. When physicality is no longer the only mode of working regime, sporting lifestyle becomes shelter for preservation of psychosomatic characteristics.

Key words: *humanism, social pathology, ideology, sport, lifestyle*

1.

Social interruptions, disturbances of relation towards others and self are exceeding the psychosomatic ones. Partly, because of exaggerated ultraliberal conception of contemporary way of life that produces total confusion and existential disorientation along. Partly, regarding psychosomatic capabilities, because of undemanding life circumstances of human character. Ever greater part of human activities is following the pattern of passive adaptation to universal consumer society. This kind of society is unified under the common denominator of lowest demands or more or less under the key of techno-instrumentalization of the mind.

Pseudo-humanistic denial of any form of irregularity is also contributing to epidemic social interruptions (and pathological symptoms of modern civilization). Such approach is pressing all deviations of our times into pathological (schizophrenic) category of universal differences, on the ground that we are all equal from one point of view and all different (special) – in any given way not being obliged to agreed social norms. This doesn't mean anything less then unnoticed anarchyzation of social system, degradation of structured social norms and decaying of traditional values.

2.

General features of contemporary lifestyle are confusion, narrow-mindedness, and aberration. They are energized by the consumption hysteria, brainless parvenu, and non-abolishing feeling of uncertainty. The most fatal consequence of confusion is negligence of primal needs and irresponsible relation to body (as the only refuge of liveliness). Being lost is simultaneous result of confusion; it is an outlook of self-alienation, which is pumped up by phantom promises of unimaginable options of development and progress. Narrow-mindedness is a safe reflex, and aberration is a virtual compensation of lost reality – reality that is still present (since it is non-abolishing) but non-recognizable because of aberration.

Consumption hysteria has a role of universality, the role of perverted unification and general mutual (human) recognition, the role of cheapest, least demanding, least tiresome, and least obliged self recognition between people. Consumption is therefore most common form of promiscuity, the only way of global solidarity.

Parvenu is irrational since successfulness in our times is no longer dependent on effort given extra (from this only just a pure existence, as always, is dependent). Success comes from certain coincidence, from certain state of affairs in which we are at given time and place, and we recognize the moment as our chance to succeed. Respectively, we have to consider that successfulness is effortless state of bliss only for those who are not there yet, and eager to become alike. The sum of the problems gained by successfulness is experienced in no other way then the sum gained by unsuccessfulness. In this respect the feeling of unabolishing uncertainty is the same for successful and unsuccessful ones. It only differs in reasons and in forms of lacking self-experiencing.

3.

Philosophy of life based on genes, early childhood breeding and effects of close environmental characteristics is being determined by two categories: can and know.

Uncontrollable and irrational technologization of modern world is excessively if not even exclusively stressing and privileging the category of knowledge. The society of knowledge we are called today as a consequence of technical

approach towards human wholeness (be it because of total automatization of production processes, because of misuse of deep existential threat of the third world – known as cheap working force), which takes into account only sole work efficiency, and fully forgets the most important ability of self-experience; being pleased with life. This ability today is regarding an instant appendage of privileged society of knowledge known as "quality of life".

To possess knowledge which cannot be used, through which no joy of realization can be gained, means to be exposed to constructive frustration. It is about a kind of curse, a surrender to destructive powers of own mind.

Capacity is always before knowledge. This order, for any given price, should never be changed (as well as breathing and drinking are always ranked). Knowledge can have a methodological advantage (only when capacity is ready, the knowledge gains strategic advantage, and not in final content). Since this is the well know fact, no doubts, the irrational privileging of knowledge leads to "fach-idiotic" self understanding. This kind of self understanding goes on to treatment with disdain, further on to neglecting and finally to self exclusion of capacity. One important contribution to such state is stigmatization of the notion "can", which is being one-sidedly, manipulatively, and vulgarly connected with force, violence, primitiveness, etc.

4.

Regenerative capacities and degenerative characteristics of human organism are setting the coordinate system within the life outlook, habits and work culture is being formed.

Personal stability, where basic feature is balanced relation between capacity and knowledge, is the only guarantee for presence of mind, discernment and temperance. Presence of mind is principal mechanism of self recognition, and temperance is capability of simultaneous differentiating of priorities (capability of following the principles of cyclic order, and capability of differentiating the cyclic and linear features of the world). Discernment is a category which is suppose to determine the most exalted human characteristic – human dignity – characteristic, which is meant to be able to manage the world by itself, to decide what is wrong and what is right, what is evil and good etc.

This very characteristic, reasoning itself, is highly abused, questioned and least reliable in the world we live in. Globalization made the whole world realize this. It seems like we are facing the age of economic and virtual fatalism, of blind confidence to the world order that no longer exist. It is more then obvious that the world is moving with its own dynamic, unforeseen paths – man is only following it wherever it goes.

Regardless of feelings of dooms-day the world consist in itself, is safe, reliable and non-destroyable. Human confidence in being able to control, and to save the world from danger is the crown symptom of, hopefully not chronic, social disease. Man is not able to destroy the world, not even himself. But human being is certainly able to ruin or irreversibly deform the relation to world as it is in its primacy. In this respect, constantly very important to him, human being is time and again highly dependent on his own psychosomatic reasoning i.e. on integral strength of his body and mind.

5.

In times when physical work has become redundant it is hard to imagine any other way then sporting way of life that can effectively and elementary replaced such daily routine. It is a replacement on fundamental level of preserving human physicality, while this being his lively outlook. Man counts his life from physical birth till the lost of the physicality.

Not long ago, sport was seen as synonym of power, health, nobleness, stability, justice, determination, order etc. Regardless of not being solely what it used to be, we can say that sport is the worst possible activity, but no better exist. The same as it is with democracy, it is the worst social order, but no better exist.

Fundamental pattern of physical exercise or sport activity can form a certain sporting lifestyle. Such way of life engages and preserves those psychosomatic characteristics which non-disturbance is of fatal nature for human, personal and social well being.

Considering social side of sporting lifestyle we can talk about regularity, endurance, stability, endeavour, working habits, comparison, temperance, resistance and many other appropriate virtues. Goes without saying, sporting lifestyle unavoidably includes some sort of sport activity.

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THE ROLE OF UNIVERSITY SPORT IS MUCH MORE IMPORTANT THAN WE THINK

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Abstract

The purpose of the research was to explore the present state of Slovenian university sport and it presents positive and negative sides of its current organisation and a different view on its role. The article bases on 2 researches, performed at University of Ljubljana and University of Maribor. According to the results most of the students are not satisfied with current organisation of university sport, but they are aware of the positive influence sport has on their life. Consequently, the majority search for unorganised sport activity. The anticipations that the conditions and awareness affect the way of students' sport activity were confirmed. The reorganisation of Slovenian university sport is needed. We suggest that it should take a different, more responsible role. Sport culture is a part of academic culture, which has a very important role at shaping of student's personality and also at profilation of university.

Key words: *university sport, academic culture, sport culture*

Introduction

Sport should be an important part of every student's life. Beside all known positive influences of sport on individual's health, physical and psychological status, university sport can play a really important role at the profilation of universities. Above all, in this paper we would like to show that the sport culture is a part of the academic culture, which protects and spreads the essence of the university between students and professors.

In Slovenia, the knowledge and awareness of advantages of PE for students has been changing with time. It was mostly affected by the changes in society, culture and economy and above all development of sport science by establishing the Faculty of sport at University of Ljubljana. After Slovenia became independent in 1991, several changes have broken out at all fields of social life. Both universities had to face serious dilemmas – new knowledge and new tasks required different answers and actions, but adjustment and reorganisation have still not been succeeded. Therefore, the problems remain unsolved. The quality of conditions for organised sport activities is falling and so is the number of sport active students (Majerič, 2002).

Consequently, the following organisations take care for the Slovenian university sport today: the faculties of University of Ljubljana, University of Maribor and University of Primorska which perform PE as the obligatory program of 30 hours per semester in at least two years of study; three student sport organisations at universities, which take care for sport recreation, and SUSA, taking care for organising student national and international competitions and championships.

According to many experts the university sport in Slovenia is highly uncoordinated with many problems at the field of organisation, finance, sport programs and facilities (Markelj, 2004; Majerič, 2002; Stanič, 1992).

In the last two years few efforts were made to change current situation. On the one hand, all three student sport organisations with help of SUSA initiated renewed sport programs under the one name "ZZ - healthy fun" two years ago. On the other hand, at University of Ljubljana a trial central organisation of PE has been initiated for a few faculties as part of the Bologna process (Omladič, 2004). Status of PE has changed from obligatory subject to optional sport recreation. That change was made to reduce University's costs for student sport. The University expects that all faculties will join this project in the near future.

The aim of this paper is first to present a positive and a negative side of current organisation of university sport in Slovenia, based on the results of a field research. Secondly, on the basis of the collected information and results a different view on the role of the university sport will be presented, focused on what impact has the university sport on academic culture.

Methods

The sample of participants in the survey

5% representative sample of regularly registered students of University of Maribor (705 student) in school year 2001/02 were questioned. The answers were compared with the results of similar research on 3% representative sample of regularly registered students of University of Ljubljana (1614 students) in school year 2000/01 (Majerič, 2002) and with

the results of the longitudinal research Sport recreational activity in Slovenia (Petrović et al., 2001). Students answers were also compared with the answers of six (out of eleven) PE teachers at the University of Maribor.

The questionnaire and the sample of variables

The authors of the students' questionnaire are Strel, Tušak and Majerič (2000; Majerič, 2002). The questionnaire measures socio-demographic characteristics, frequency and ways of sport activity, sport disciplines, motives for sport participation and students' satisfaction and opinion about specific factors of university sport. For all variables were calculated correct statistical analyses and the statistical significant differences were considered with 5% risk of mistake (Q=0,05). The questionnaire for PE teachers measures socio-demographic characteristics, objective and subjective reviews about characteristics and quality of sport at University of Maribor and also about students' satisfaction. They were asked for their opinion and suggestions for further development of university sport.

Results

The results showed that 89,7% of students from University of Maribor and 90,7% students from University of Ljubljana is sport active. 55,5% students of University of Maribor and 63,4% students of University of Ljubljana are regularly (at least 2-3 times a week) sport active. The comparison of the results for both universities showed a statistically significant difference (F (1) = 25,758, p = 0,000): more students at University of Ljubljana do sport daily or never do sport and more students at University of Maribor do sport 2-3 times a week.

Slovene students are also more frequently sport active in comparison to adult citizens of Republic of Slovenia, aged 18 – 25 (70,9% are sport active, 32,4% are regularly active), pointing at student's awareness of benefits of sport. They are, however, not satisfied with the offer, conditions and organisation of university sport. This results to a low participation in student sport associations, organisations and PE programs, even though the latter is obligatory. On the contrary the percentage of unorganised, individual activity is very high (UNIMB - 44,35% and UNILJ - 58,71%). Since the organised sport programs do not correspond with their requirements they take their own initiative to find appropriate recreation, usually with friend or alone.

The differences between Maribor and Ljubljana students are statistically important in all areas of sport and types of recreation. Students from Ljubljana mainly attend unorganised sport activities and also private programs. On the contrary, students from Maribor are more active at PE, in student sport clubs and programs of student organisations. The new university sport hall built in proximity of most Maribor faculties provides better conditions for sport activities than those conditions, which students from Ljubljana have. It is our belief that the new hall and more offered terms are the main reasons for greater number of students from Maribor participating in PE and programs of student sport organisation than students in Ljubljana. Surprisingly despite better conditions for university sport in Maribor students are on average less sport active than students from Ljubljana. That means that the frequency of sport activity is not influenced only by the conditions but also by the level of awareness of individuals, which is higher at students from Ljubljana (Z = -2,371; p = 0,018).

Current organisation of university sport have its advantages and disadvantages (Markelj, 2004). In comparison to many other countries, PE programs are financed from state budget and therefore available for free for all students, even those who otherwise could not afford it, PE teachers are fully employed, what enables development of university sport, student sport organisations offer various sport programs, many students develop first organising skills working for student sport organisations, student sport organisations can enter public orders, student sport organisations are relatively successfully integrated into surroundings.

On the other hand, goals of university sport are not well defined, PE once a week does not assure appropriate influence on psychosomatic and mental status of individual student, there is weak developed research activity, state budget do not assure enough finance for creation of appropriate sport programs, interesting for students, personal disagreements between PE teachers and also between student sport organisations hold back development of university sport, PE teachers are not integrated into their surroundings, old and inappropriate sport facilities, which hold on decentralisation, inappropriate terms for sport programs, low utilisation of potential financing, sport facilities and cadres.

We assume that the improved sport programs, working conditions and education would pull in more students. We could reach a higher number of sport active young people after graduation and consequently higher number of sport active adults.

Discussion

The meaning and tasks of universities today have changed considerably compared to the first established universities. University is still a carrier of knowledge and its development, but in order to stay recognisable and embedded in its surroundings it has to change its philosophy. That has not happened with Slovenian universities in the time of transition (Brglez, 2004).

In the time of the Bologna process universities have the opportunity to present themselves on a market to wider surroundings in a new outlook. A danger of current changing of the study programmes is orientation to average, which the Bologna process is actually generating - reducing the differences between universities leads to average. Orientation to average could make a small country such as Slovenia unable to maintain the critical mass of intellectuals. A critical mass of intellectuals is needed for discrete steps in the understanding of our environment and the development of science. To preserve an excellency university's tasks should be viewed from a different angle.

To become competent on the free market of European universities, a university should generate competent graduates armed with knowledge, with competencies, which are nowadays required, common knowledge and culture. Modern universities create specialist in narrow field of knowledge, who are not capable of thinking globally (Kump, 1994), which can be dangerous to human kind.

For those reasons university is responsible for educating well versed graduates – experts with universal cultural values. Every graduate should be proud of his/her university. This pride is acquired through academic culture present at every university. Academic culture could be defined as a special set of norms and rules of behaviour, values and forms of thinking which is common to all the members of academic community (Kump, 1994). Academic tradition is preserved, continued and developed in the process of academic socialisation. Values, knowledge and forms of thinking of different sciences, whole university and student's personality assimilate when different members of academic community come into contact. This occurs at lectures and seminars, but above all at extracurricular activities, where students and professors participate. One of the most important activity is sport

Current organisation of Slovenian university sport makes it impossible for sport to fulfil its tasks. The first problem is decentralisation, which renders more difficult for students from different study fields to meet and associate. Therefore the students are deprived of rich pallet of values, modes of thinking and of exchanging different views.

Furthermore, that kind of organisation also excludes interference of students and professors, which decreases the possibilities of acquaintance and understanding of each other and also prevents the continuity of academic values. In the past this role used to belong to academic sport clubs. Academic sport clubs are practically extinct today due to the artificial parting of university into faculties.

The results of this research show that most of the students like to participate in sport activities and sport means a lot to them. However, universities do not offer appropriate sport programmes, therefore students take their own initiative to find appropriate recreation. Furthermore, universities have not done anything for top athletes and students with special needs. All that points out the fact that universities are not able to use the sport as one of the generators of academic culture.

Nevertheless, a positive trend in that direction has been noticed recently. Student sport organisations with SUSA's help seem to be approaching traditional organisation with bounding, co-operation with PE teachers, establishing academic sport clubs (for example Academic golf club, Academic athletes club…) and motivating students for sport participation. On the other hand, at University of Ljubljana a trial central organisation of PE for a few faculties has been initiated as part of the Bologna process (Omladič, 2004). The only problem is that the status of PE has changed from obligatory subject to optional sport recreation. This change has been made to reduce University's costs for student sport. Furthermore, more researches about university sport have been done recently.

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STANDARDIZATION OF TERMINOLOGY – SOME EXAMPLES FROM THE HISTORY OF SPORT AND PHYSICAL EXERCISE

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Abstract

The area of language that changes most frequently is vocabulary. New concepts are developed, and consequently, new names are created for them. The concepts transfer from the language of their origin to other languages, and the words (terms) assigned to them seek their equivalents in the language to which the concepts were transferred. The description of a certain concept may vary from speaker to speaker, from author to author. The more the descriptions overlap, the better the understanding between the speakers of the same profession or a scientific discipline. Attempts to collect and standardize the terminology of a certain field or discipline follow their development throughout history.

Key words: *concepts, terms, development, language*

Introduction

Language is the subject to synchronic and diachronic changes as the consequence of the changes occurring in the society. It is due to this feature of *changeability* that language is suitable for communication – communication would not be possible were it not for the changes that occur in language. The area of language that changes most frequently is vocabulary. New things are invented, new concepts are developed, and consequently, new names are created for them. The *words*, or *terms* as referred to in technical language, encode various concepts, thus reflecting the meaning of these concepts as perceived by various people or by various groups of people.

General language operates in terms of words, whereas technical language operates in terms of terms. Naturally, the general and the technical language partially overlap since technical language cannot operate without general language. Constantly, words from general language enter the technical language thus becoming terms and vice versa, technical terms enter general language. Technical language is the sub system of language, intended for unambiguous understanding among the experts of one profession, which uses terminology that is characteristic for profession in question. The terminology of a profession is the result of the standardization of terms within the system of concepts (Mihaljević, 1998, p. 101).

Some examples from the history of standardizing Croatian terminology of sport and physical exercise

Concepts and the corresponding terminology develop simultaneously with the development of the society in general. Each scientific discipline has its subject matter of research, its own field of research, the research methodology and its own technical (or scientific) language. The standardization both of the concepts and of the terminology assigned to them is the prerequisite for understanding among the speakers within the same profession or a scientific discipline. Naturally, the system of concepts and the corresponding terminology in one language need to conform to the system of concepts and the corresponding terminology in other languages to enable the communication among experts of the same profession. Attempts to collect and standardize the terminology of a certain field or discipline follow their development. Several examples will illustrate the attempts to collect and standardize the terminology of sport and exercise science in Croatia in the period of almost one and a half centuries.

It was in the year 1875 that Andrija Hajdinjak, who was the teacher of the Croatian language in Zagreb, and who worked as a teacher from 1871 to 1873 in Karlovac and from 1873 to 1875 as a teacher in Donjogradska school in Zagreb, was appointed teacher in Kraljevska vježbaonica spojena s Kraljevskom učiteljskom škol*om u Zagrebu* (*Royal Gymnasium affiliated to the Royal Teacher-Training School in Zagreb*). During his professional career he has published many books, among other *Tjelovježba u pučkoj školi* (*Physical exercise in elementary school*) in the year 1875 and *Njemačko-hrvatsko nazivlje za tjelovježbu* i *nazivlje za mačevanje* (*German-Croatian terminology of physical exercise and terminology of fencing*) also in 1875 (Jajčević, 1987, p. 12). The latter work consists of three parts in which 1,600 terms were collected and analysed. In the first part the author collected 1,000 terms referring to physical exercise, in the second he explained 253 terms used in fencing, and in the third, *Dodatak k nazivlju za tjelovježbu* (*The addendum to the terminology of physical exercise*), 120 additional terms connected, as expressed in the title, with physical exercise. Many of the Croatian terms that can be found in this work by Hajdinjak are still used in the Croatian language, for example, *hvat* (*grip*), *raskoračni stav* (*straddling position*), *prekopit* (*somersault*), etc. Some terms underwent morphological change due to the development of

Croatian language from Hajdinjak's translation of the German word *Sieger* (*winner*) as *pobjeditelj* to the contemporary term *pobjednik*, from *prigib koljena* (German *Kniebeugung*) to *pregib koljena* (*knee flexion*) (Jajčević, 1987, p. 15). In the year 1892 Franjo Hochman, a gymnastics teacher, published, with the help of some other people, *Rječnik nazivlja kod tjelovježbe* (*The dictionary of terminology in physical exercise*) in the journal *Gimnastika* (Issue 10, Vol. 3) (Jajčević, 1987, p. 17). The first part of the dictionary contains 512 terms written in Croatian, German and in Czech, for example, *hvat*, *Griff*, *hmat*, and the second part contains 480 terms written in German and in Croatian, for example, *Ansprung*, *naskok* (Jajčević, 1987, p. 17). The previously described examples show the attempts to collect and standardize the terminology of physical exercise and sport comparatively in two or more languages.

However, as new concepts develop in the society and in a certain natural language, it is necessary to name those concepts in that particular language. In the year 1893 in November the journal *Sport* was published for the first time as the Official journal of the Association of Croatian Cyclists, the Croatian Club of Cyclists *Sokol*, the Cycling Club *Sloven* and the first Croatian Association of Cyclists. The texts about cycling, skiing, fencing, equestrian, angling, etc. were published. It is interesting to consider the terminology that was then used in certain areas of sport and physical exercise. In the second issue of the journal *Sport* a text can be found about skiing in which *skis* (nowadays termed *skije* in Croatian) are referred to as *snježaljke* (approximately, *snow boards*) (*Snježaljke*, 1894). It is interesting that at that time a *bicycle* is termed both *bicikl* and *wheel* (*Različite vijesti. Medjunarodno natjecanje gospoja u umjetnoj vožnji na kotaču,* 1895). In the year 1894 the English word *training* is still written etymologically in Croatian, for example, training pluč*a* (literally, *lungs training*), *training* (*training*) and *trainirati* (*to train*) (*Domaće vijesti. Training pluča.,* 1894). In the year 1885, when Ivana Hirschmann, "the heroine of physical education and of the written word in sports" (Jajčević, 1987, p. 20), published the article *Igra croquet* (*The game of croquet*) in the professional journal *Gimnastika* (Issue 5), the name of that game, namely, *croquet*, was written etymologically. Approximately ten years later in his book *Sokolsko vježbanje* (*Falconian physical exercise*), published in 1894, Hinko Mašek Bosnodolski wrote this word (Jajčević, 1987, p. 19) *kroket*, and this is the way it is still written today in Croatian. Franjo Bučar, whose name is the synonym for the development of sport and sports journalism in Croatia, also contributed time and effort to the standardization of Croatian terminology of physical exercise. In the year 1900 he published a handbook under the title *Gimnastičke vježbe s batinama i čunjevima* (*Gymnastic exercises with bars and clubs*) (Jajčević, 1987, p. 23). It was written according to the work written by the Czech Josip Klenka. Bučar added a dictionary that dealt with "the Czech gymnastic-specific literature" (Jajčević, 1987, p. 24) and in which he collected more than 500 terms. Among other works published throughout history on the topic of the collection of terminology in sports and physical exercise let us mention *Sportski leksikon* (*Sports lexicon*) (editor M. Flander) (1984) and a series of small Croatian-English-French dictionaries of various sports (for example, basketball, football, tennis, gymnastics, athletics, etc.) published in the year 1987 in Croatia when the World University Games were held in Zagreb (Croatia). These dictionaries present a good basis for making a comprehensive dictionary of sport and exercise science in the future.

Some examples of how the terms were created

The origin of the sport that we all know today under the name of *tennis* can be traced back to France and to the 16th, 17th and 18th centuries when it became the sport of kings and noblemen. At that time it was called *Jeu de paumme*, the game of the palm. The game presumably begun by the serving player shouting *Tenez!* meaning *take, hold* or *receive* (the Old French verb *tenir* entered Middle English in the form *tenetz, ten(e)ys*) to the opponent. However, this game was very different from the game of tennis that we know today and whose beginnings are in England. Some people believe that this ball game, popularly called *tennis-on-the-lawn* or *lawn tennis*, was invented in 1873 by Major Walter Clopton Wingfield, a British army officer (Microsoft® Encarta® Encyclopedia 2000, 1993-1999), who, according to many authorities, adapted the principles of the popular English games of court tennis, an indoor racket game, squash racquets, the game developed in England in the mid-18th century at the Harrow School, and badminton, the game that involves the use of a net, rackets (lighter than in tennis) and a *shuttlecock* (a cork ball fitted with stabilizing feathers) for outdoor play. In the year 1875 the All England Croquet Club had failed to attract enough visitors so that they decided to offer lawn tennis as an attraction that would help attract more people. Tennis became so popular that the club changed its name into the All England Croquet and Lawn Tennis Club. An example of the trace of the French origin of tennis is the term *love*, the name for a score of *zero* in tennis. The term *love* was presumably derived from the French word for egg, *l'oeuf,* thus referring to the physical appearance of the number zero (Microsoft® Encarta® Encyclopedia 2000, 1993-1999).

Breaststroke had been the traditional stroke of swimming for hundreds of years. At the start of the 20th century in Sydney, Australia, the crawl stroke that was based on the powerful ocean stroke used by the Polynesians was discovered (Colwin, 2004) – it was a new swimming stroke faster than any other. However, this stroke was a difficult stroke to swim so that after years of experimenting the crawl stroke that we know today evolved. Around the year 1902 backstroke was swum with the reverse crawl action and using an inverted flutter kick. The swimmer Henry Myers invented the butterfly stroke in 1933. Today, there are four recognised strokes in swimming – *backstroke*, *breaststroke*, *butterfly stroke* and *front crawl stroke*. Their equivalents in German are *Rückenschwimmen*, *Brustschwimmen*, *Schmetterlingsschwimmen* and *Kraulstil*, and in Croatian *leđno plivanje*, *prsno plivanje*, *plivanje leptirovim načinom* and *kraul*. The first three terms

used in Croatian are loan translations from German, whereas the last one, namely, *kraul* is the loanword from English. Differences between the terms in various languages are only natural. In Croatian, for example, the term *tehnika* (*technique*) is used instead of the English word *stroke*, so that the four recognised swimming strokes are termed *techniques.* Again in Croatian, the butterfly stroke was named *dupin tehnika* (*dolphin technique*) according to the resemblance of the swimmer's motion to the motion of a dolphin's tail.

In the year 1876 William Wilson formulated the first rules of the game today known as *water polo.* The name is said to be a misnomer since it was actually the name of a game that preceded it and "that was played atop barrels and truly resembled the sport of polo" (Australian Water Polo Inc., 1999). The beginnings of water polo are traced back to the 1870s in England and this sport is said to have been the aquatic variety of rugby football. According to *Encarta® World English Dictionary* (1999, p. 1459) the word *polo* is derived from Tibetan *pholo* that literally meant *ball game* – thus *water polo* is *a ball game played in water.* The equivalent in Croatian for the English name *water polo* is *vaterpolo.*

As for the history of *skiing*, the area under the name of Telemark, Norway, is credited with developing skiing into a sport, and its origins date back to the early 1700s. The word *ski* can be traced back to Old Norse *skið* that meant *piece of split wood* or a *snowshoe*, and ultimately to an Indo-European base meaning *to cut* (*Encarta® World English Dictionary*, 1999, p. 1757).

Conclusion

Together with the development of the society and the civilization as the whole new concepts are constantly created and new names have to be found for them. The concepts transfer from the language of their origin to other languages, and the words (terms) assigned to them seek their equivalents in the language to which the concepts were transferred. The description of a certain concept may vary from speaker to speaker, from author to author. The more the descriptions overlap, the better the understanding between the speakers. The standardization of terminology in any professional field or in any scientific discipline is the focus of linguists, experts and scientists from the fields or scientific disciplines in question. This process should be managed with outmost accuracy and care in order to develop the system of concepts, together with the corresponding terminology assigned to those concepts , but the process should not be limited to one language only. The concepts and terminology should be comparable to the same concepts and terminology assigned to them in other languages. The history of language and of the particular field should be investigated and always addressed when considering the generation of new terms.

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TOLERANCE AND POSITIVE DISCRIMINATION IN SPORT*

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Abstract

Intolerance and discrimination are born from the same family, they are the father and the mother, and violence is their child. This is why raising awareness of problems brought about social dynamics is important.

Sport is the mirror of society. It can be the area or even the source of discrimination, intolerance and violence. At the same time the opposite can also be experienced through sport, namely tolerance and involvement. Consequently, the fact that sport is considered a moral playground, where we can learn a lot, transfer our knowledge outside sports sphere and improve ourselves, is well substantiated.

***Key words*:** *society, ethics, tolerance, discrimination, well-being*

Sports culture

Sport as we know it today reflects its inner characteristics and the state of mind of societies at the same time. Movement, play and competition are the basic categories of sport that in the times of the infamous globalised capitalism easily contaminate the inhabitants of cities. Work is becoming less and less physically demanding, various transport facilities enable us to save our own sources of energy, urban environment, as compared to the natural environment, provides us with a safe shelter, which ensures a comfortable life and so on. Meanwhile natural needs remain the same and it is necessary to satisfy them as it used to be satisfied centuries ago. The need for movement is nowadays demonstrated as sports culture. In this way sport can be interpreted as hygiene, as the wisdom of body, as the return to nature which governs the equilibrium of the human organism. On the other hand, sport can also be of service to social hygiene.

The apparent autonomy of sport renders it possible for the relationships in sport to reflect and sometimes, by reinforcing the intensity, emphasise or even caricature the picture of society. And in the same way a mirror reflects a picture, sport co-creates the social climate and is, owing to this fact, recognised as a potential educationally positive practice. Further on, we will try to demonstrate briefly the value of sport as the indicator of general cultural and quite often political state of mind. Two values have been chosen, positive discrimination and tolerance, which are built into the foundations of every democratic society, whose task is to enforce them, thus creating a positive attitude among the members of any community.

Positive discrimination

Equality and equal rights for everybody are two mottos which legal order and political ideology have always fed off. Certainly equality and the equal opportunity policy are two distinct categories. Equality refers to one individual being as valuable as the next, which is ascribed to the fact of belonging to mankind. These are the foundations from which we derive the acknowledgement that we are all different (own/special genotype and phenotype). Equal rights for everybody applies to the relative social (political, economic, social) treatment of individuals (or groups), their status and the possibility of taking part in various organisations, the right to a share of goods provided by society and so on. Discrimination is about enforcing prejudices: social, racial, religious, sexual, economic and other types of differentiation and exclusion of groups. It is usually related to the position of power, namely to the size of a certain group that does not enable others to have equal opportunities, denies them certain basic rights and does not allow them to enjoy the goods of the community in full.

Positive discrimination, as summarised by Flander, has firmly established itself as a legal instrument which is supposed to prevent less favourable position of certain groups that are placed at the margin of society, discriminated, impeded or even excluded. Positive discrimination stands for the encouragement of equal opportunities and prevention of exploitation on the part of the privileged groups.

In sport, we are used to speaking about discrimination with reference to racist outbursts in arenas or of equal position of women. However, a trained eye can notice discrimination in numerous areas. Selection, for instance, is a natural

* *Young researcher award*

phenomenon which can be implemented in various ways in society. In sport, where it is primarily about comparing motor skills and physical abilities, the selection on the basis of these criteria is justified and fair in principle. However, we frequently bear witness, primarily in organised sport, to selection based on economic and social criteria. Consequently, certain sports are status-tainted and inaccessible to the lower and middle class that are directed to other, more "folk" sports. It is not only sport that is subjected to this logic; the above should merely be considered an example of potential discriminations in sport. It is by far more important to enforce positive discrimination in the situations where those placed at the social margin and those excluded cannot help themselves.

Such enforcement refers to involving individuals with special needs at different levels: involving them in an established order or organising interest groups. The purpose of this classification is merely the analysis of potential approaches to positive measures in sport. The easiest measure at first sight, yet the most difficult in practice is to involve individuals with special needs in the established sports order. How to involve a sportsman, a child with special needs in a group is a challenge for all concerned: to involve them in such a manner as not to impede the normal dynamics, namely so as to make them feel useful to the community. In this case it is worth considering the adaptation of the rules of the game to suit the individual in question; consequently, exclusive competitive orientation may prove to be an obstacle as the former does not allow for tolerance to clumsiness. Involving with assistance is one of the methods of involving an individual in the established order. Many handicapped sportsmen, the blind and others have achieved top level results with the assistance of their attendants who enable them to train and perform. Sometimes assistance is enough for all involved to satisfy their need for movement. Recreational sport, to wit, allows for the adaptability of rules which can be concurrently adapted to the abilities and to the degree to which sportsmen are in tune with their attendants. Moreover, this is the way to follow in creating interest groups of individuals with similar or the same special needs that become irrelevant within the group. In this case, para-Olympic games being a shining example of it, the same laws apply as in top level sport. The game pushes the players into the world of physical skill, emotions, commitment, competitiveness, responsibility and so on. This may be the most valuable attribute in sport that we can offer, to wit, physical identity, which more often than not is the reason for being different, becomes important and valuable. In creating a fair sports community we will achieve a lot if we are capable of involving individuals with special needs and give them an opportunity to prove themselves in those physical techniques that they are able to perform. Thus, it is necessary to look beyond our own interests and beyond the other side of the fence and possibly start methodically to introduce unconventional sports in order to involve "others". What is more, organising interest groups where "otherness" becomes equality, it stands for equal opportunities themselves.

Tolerance

Tolerance is one of those virtues we usually find it difficult to relate to. There is no problem when well-intendedness is in question: we all know what it is all about and we all side with it. In contrast, we are numbed by tolerance. We do not know what exactly is meant by being tolerant. It may be easier to comprehend the signification of tolerance if we put ourselves in a situation where tolerance can prove itself. Sport, wit to, is an ideal sanctuary for tolerance and intolerance. Setting the limits is what tolerance is basically about. Needless to say, this is also what sport is about. There is no leaving the arena; everyone has been granted the right to "live" and at the same time everyone fights for their space as best they know how. Life in the arena is characterised by certain dynamics which no one can escape from as the very dynamics is brought about by the relationship among the players. In the philosophy of sport, this dynamics is called the ethos of the game or the spirit of sport. This spirit can change with time and space. In the beginning of the game when we are getting to know the opponent, it could be said that we are tolerant, we let the opponent show what they can do and prepare ourselves for an efficient setting of limits which must be clear and solid so that in the critical moment they can ensure victory. Towards the end tolerance starts to wear off, which is particularly the case if the seems to be no winner. We are alert to every mistake the opponent makes and we punish them. Thus the spirit of sport hovers over the arena and its face reflects the changes below. Other types of dynamics are created in view of various arenas. With the attack players (for instance, in soccer) the defence quickly sets the limits of tolerance while midfield players are granted a broader area when expressing their "opinion". Tolerance allows others to be, this is unquestionable, but it does not allow a complete freedom of action. Translated into the language of sport, this reads: "Of course you can play, nobody can prevent you from doing it, but we have to agree upon how we are going to play and the limits we are going to set are the limits of tolerance. Beyond the set limits we are intolerant and we are going to impose our will one way or another." This could be called a positive tolerance which differs from the generally recognised intolerance which does not understand otherness, oppresses it and imposes itself as the only possible position without equivalent alternatives.

Let us mention another example which is pertinent to modern sport: doping. The problem of doping is actually a problem of tolerance. Modern sport is caught in a trap which is difficult to disentangle - citius, altius, fortius, the snare which is a result of the general social state of mind and the structure of competition in sport. Spectators as well as the sportsmen wish for ever better results which lead - we bear witness to it again and again – to exaggeration that has already become all but the motto of the modern world. In satisfying the requirements that the system of competitive sport raises, sportsmen make use of various methods ranging from scientific research, looking for optimum methods of training and developing new technology, massage, psychological counselling to taking various stimulants some of which are permitted

and others are not. Sport has to do with the comparison of physical capabilities and skills; it is clear to all of us that there are many other things involved. The system of competitive sport with its rules of competition sets the limit of tolerance; massage and a large steak are admissible, however a small dose of THG is not. These are the rules of the game we play. Nobody limits you to play your game but you must not do it in our arena. This is more or less what the spirit of the modern Olympic Games system is saying.

Thus tolerance is a virtue that man who knows the proper measure in the relationship with others feels comfortable with. In the first case, where we mention the life in arena, tolerance is the implementation of the rules of the game. Primarily in recreational sport we allow for the flexibility of the rules to the extent where we can still accept the spirit of the game. When the game becomes unbearable we either set the limits more rigidly or suspend the game. As far as doping is concerned, the situation is similar. Stimulants and medicaments have become a matter of man's everyday life and as long as they keep within the acceptable we never even think about them. But when the matters get out of control, when they lead to addiction, exaggeration and selfdestruction we need to take a stand and enforce it. When it is enough we set the limit. Nevertheless, in connection with top level sport we might ask ourselves why the limit has been set here and not elsewhere. What if doping is the result of something else? Would it then not be better to set the limits at the source of the problems and not with the symptoms? How can we advocate demanding physical exercise and overcoming the exertion at the limit of capabilities in children? After we have caught them in the net of achievement we tear their knee tendons and squeeze their invertebral disks as if they were indestructible diamonds! Maybe the answer lies in the fact that we misunderstand tolerance that does not dare to set limits? As a consequence, too often such tolerance assumes the mask of a defence mechanism nowadays because we dare not face the truth.

Let us not ask ourselves merely about tolerance in sport, let us ask ourselves about tolerance to sport? Since tolerance is much like health: in both cases we take measures when it is already too late.

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THE RELATIONSHIP AMONG JOB STRESS, ORGANIZATIONAL EFFECTIVENESS, AND TURNOVER OF THE SPORTS INSTRUCTORS

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Abstract

The aim of this study was to examine the relationship among job stress, organizational effectiveness, and turnover of the leisure sports instructors. Specifically, the relations among employees' job stress (job characteristics, personal relationship, communication), social support (emotional support, informational support), organizational structural characteristics (formalization, centralization, decision making), organizational effectiveness (job performance, job satisfaction, organizational commitment), and turnover (intention to turnover, attempt to turnover, staying) were examined. Data were collected from 215 male and female leisure sports instructors in the public/private sport facilities located in Seoul City and Kyunggi Province. There was evidence that employees' job stress had both direct and indirect effects (via social support and organizational structural characteristics) on the organizational effectiveness and turnover.

Key words: *Leisure sports, social support, job characteristics, job satisfaction.*

Introduction

In recent years employee stress has become an increasingly important concern for many organizations. Some employees are more vulnerable to stress than others. There are many studies concerning on the turnover in the field of private businessmen, nurses, and bankers as well as sport related jobs. And the job stress, which has effects on the turnover, is one of the crucial topics in the organizational management recently.

It is suggested that the job satisfaction become low with increasing the stress (Kim, 1994; Kwon, 1991; Parasuraman & Alluto, 1984). But some studies (Karasek, 1979; Schuler, 1980) showed the positive effects of stresses on the job satisfaction. These studies mean that the job stresses give negative effects on the organization, and these phenomena results in the employee turnover, and the employees who could not meet the needs of the employers should quit their job inevitably.

It is generally said that facilities, organizations, and programs are important to expend and activate the leisure sports activities, but one of the most essential factors is the instructors who teach the general public participating in many kinds of sport and leisure activities.

According to the data published by the Ministry of Culture and Tourism (2000), the number of leisure sports instructors is a total of 53,352 (first division: 197, second division: 3,451, and third division: 49,704 respectively), and the numbers are increasing continuously. But notwithstanding the importance of the role of leisure sports instructors, due to the lack of understanding on the sports activities, the studies on them did not perform diversely.

The purpose of this study was 1) to verify the direct relationships between job stress, organizational effectiveness, and turnover, 2) to examine the indirect relationships between job stress, organizational effectiveness, and turnover via social support and organizational structural characteristics.

Methods

Participants

The subjects of this study were the leisure sports instructors who worked in the public/private sports facilities which were located in the Seoul City and Kyunggi province. A number of 300 subjects were participated in this study originally, but 85 cases were deleted for the improper to the occasion, and 215 data were computed for the study finally.

Instruments

Job stress. The questionnaire developed by Cooper, Inancevich and Matteson (1976) was revised by Lee (1996) into Korean and used to measure the job stress of the leisure sports instructors. It consists of 9 items.

Social support. To measure the social support of the leisure sports instructors, the questionnaire developed by Beehr (1978) was revised by Hong (1996) into Korean and used in this study.

Organizational and structural characteristics. To measure the organizational structural characteristics of organizations, the questionnaire developed by Kim (1996) was used in the study. It consists of 11 items.

Organizational effectiveness. The organizational effectiveness developed by Beehr (1984) was applied in this study. This revised instrument consists of 12 items (Kwon, 1991).

Turnover. To measure the turnover, the instrument developed by Lee (1997) was used in the study.

Data Analysis

Data were analyzed using the package SPSS Win 10.0 and AMOS. To evaluate the effects of job stress on organizational effectiveness and turnover, the covariance structure analysis was carried out. The statistical significant level of this study was .05.

Results and Discussion

Correlation analysis and regression analysis were conducted to investigate the relationship among all variables and the effect of job stress, social support, and organizational structural characteristics on organizational effectiveness and turnover among leisure sports instructors (See Table 1 and 2).

Table 1. Correlation analysis among all variables

Variables	1	2	3	4	5
1	1.00	.81*	.81*	.87*	.75*
2			.75*	.71*	.80*
3				.69*	.66*
4					.53*
5					1.00
M	3.23	2.90	3.31	2.61	2.47
SD	.87	.76	.72	.69	.74

*p<.001
1: Job stress; 2: Social support; 3: organizational structural characteristics;
4: Organizational effectiveness; and 5: Turnover.

Table 2. Regression analysis of independent variables on organizational effectiveness and turnover

Variables	Organizational effectiveness (β)	Turnover (β)	R^2
Job stress	0.98*	0.80*	0.54
Social support	0.71*	0.82*	
Organizational structural characteristics	0.76*	0.67*	

*p<.001

According to Table 1 and 2, there was evidence of direct effects of social support and organizational structural characteristics on the organizational effectiveness and turnover. These results showed that the observed variables in this study were correctly chosen to examine the causal relations between job stress and the dependant variables such as organizational effectiveness and turnover. In addition to the direct effects to social support, organizational structural characteristics, organizational effectiveness, and turnover, the job stress revealed considerable evidence of indirect links between organizational effectiveness and turnover through social support and organizational structural characteristics.

According to the result of this study, there was significant relationship between job stress and social support. In general, it was known that the social support increases or decreases before or during the job stress process. And the excessive job stress of the sport and leisure instructors had the effects on the organizational structural characteristics negatively and it resulted in the difficulty to formalization, centralization, and communication factors. Schuler (1980) suggested that the job performance was high in the smooth communication group. On the other hand, it was low in the bad communication group. This result supports the finding of the preceding study, and it also indicated that it was necessarily needed the smooth communication atmosphere among the employees such partners as juniors or seniors in the organizational situation.

One of the key findings of this study was that the job stress had the positive relations with intention to turnover and attempt to turnover but it had negative relations with staying. The preceding studies suggested that the income had the effect on the employees' turnover.

Specific results of the study revealed that there were relationships between subjects' job stress and their concurrent levels of organizational effectiveness and turnover. In accord with suggestions that studies should avoid making simplistic

assumptions about the proposed effects of job stress, these relationships were complex. For example, there was evidence that the social support had positive relations with concurrent levels of both organizational effectiveness and turnover, although the latter relationship was evident only when the situation was appraised as having some potential for control.

The study also revealed that the level of social support had some effects on the organizational effectiveness. Specifically, the social support had the effects on the job satisfaction and organizational commitment significantly, but there was no significant difference on the job performance. This result indicates that the social support is one of the influential variables to the organizational effectiveness. This finding is supported by Hong (1996), suggesting that career, internalization, emotional support, and informational factors had the effects on the organizational effectiveness.

Conclusion

Overall, the results of the present study contribute to the general stress and job stress literatures concerned with the development of comprehensive and robust models that specify the interplay among the variables intervening in the job stress and organizational effectiveness process. In the specific context of job stress, our findings can also be regarded as important, given that the study focused upon the stressful encounters, thus facilitating consideration of the effects of social support and organizational structural characteristics.

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DIFFERENCES IN SPORT INTERESTS IN FEMALE ADOLESCENTS WITH VARIOUS OCCUPATIONAL CHOICES

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Abstract

On the sample of 327 nature science high school female students, aged 17 to 20 years, attending five different high school vocational programs (cosmeticians, ecology technicians, geology technicians, chemical laboratory assistants and chemical industrial technicians) sport preference questionnaire was applied. Questionnaire consists of list of 25 sports chosen to be representatives of five sport interest factors: (1) factor of traditional sports, defined by swimming, skiing, sports gymnastics, athletics, and cycling; (2) team sports factor, including volleyball, basketball, football, handball, and field hockey; (3) combat sports factor, including judo, box, taekwondo, wrestling and karate; (4) factor of sports with marked aesthetic component, including skating, rhythmic gymnastics, dance, diving and synchronised swimming, and (5) factor of outdoor and adventurous sports, defined by scuba diving, mountaineering, watter skiing, surfing and parachuting. The difference in sport interests in groups defined by five vocational programs was established by canonical discriminant analysis of orthogonalised factor scores from confirmatory factor analysis. Two statistically significant discriminant functions were found identified as general rejectance and acceptance of sport, and team sports oposed to traditional and outdoor sports dimension. First dimension differ ecology technicians attending elite educational program at the accepting sports side of the discriminant function from the other groups. Second dimension differs, in Holland's terms, investigative chemical laboratory assistants on traditional and outdoor sports side, and realistic geology technicians at the team sports side of discriminant function.

Key words: *factor analysis, discriminant analysis, high school students*

Introduction

The interests could be simply defined as likes or dislikes attached to specific activities or objects (Greenhaus et al., 2000). As Super and Crites state, interests are the products of interaction of inherited factors involved in personality development and exogenous factors as opportunity and social evaluation (Super and Crites, 1962). Vocational interests are the most researched in the field of interests, being recognized as most important in human behavior prediction. Holland's theory of vocational choice (Holland, 1985) is contemporary leading theoretical frame in occupational interests research as well as applied occupational psychology. By now, sport interests were researched sporadically (Bosnar and Prot, 2003). More research in the field could be expected following increased positive evaluation of physical activity in all parts of population.

The aim of this work is to measure sport interests of female adolescents attending five different high school vocational programs and to determine the differences in interests among groups.

Methods

The sample of this research consists of 327 nature science high school female students aged 17 to 20 years. They attended five different high school vocational programs, preparing students to be cosmeticians (n=116), ecology technicians (39), geology technicians (21), chemical laboratory assistants (83) and chemical industrial technicians (68). Programs, as well as following careers differ significantly. Future ecology technicians have elite program, with highest academic demands, expecting that students are able to solve scientific problems and to be socially responsible at the same time. Vocational programs for geology technicians and chemical industrial technicians could be recognized as belonging to realistic, and program for chemical laboratory assistants to investigative factor in Holland's terms. Future cosmeticians have less academic, but various other demands. They are educated for working with people and develop artistic and enterprising career.

The students were given sport preference questionnaire consisting of the list of 25 sports to be evaluated on the five-point scale (Prot et al., 2003). By confirmatory multiple-group factor analysis results were transformed to five-factor solution. The following five factors were determined: (1) factor of traditional sports, defined by swimming, skiing, sports

gymnastics, athletics, and cycling; (2) team sports factor, including volleyball, basketball, football, handball, and field hockey; (3) combat sports factor, including judo, box, taekwondo, wrestling and karate; (4) factor of sports with marked aesthetic component, including skating, rhythmic gymnastics, dance, diving and synchronised swimming, and (5) factor of outdoor and adventurous sports, defined by scuba diving, mountaineering, watter skiing, surfing and parachuting.

The difference in sport interests in groups defined by five vocational programs was established by canonical discriminant analysis of orthogonalised factor scores from confirmatory factor analysis.

Results and discussion

The pattern and factor structure of five factors obrained by confirmative multi-group procedure is in Table 1. The factors are well defined and can undoubtedly be identified as factors of traditional sports, team sports, combat sports, aesthetic sports and outdoor sports. Correlations of factors are in Table 2. Traditional and aesthetic sport factors have highest correlation, sharing 35 per cents of common variance. Aesthetic and team sports factors have lowest correlation and share only 3.3 per cents of common variance.

Table 1. The pattern (A) and factor structure (F) of five factors of traditional sports, team sports, combat sports, aesthetic sports and outdoor sports, obrained by confirmative multi-group procedure

Sport factors / Sports	Traditional sports		Team sports		Combat sports		Aesthetic sports		Outdoor sports	
	A	**F**	**A**	**F**	**A**	**F**	**A**	**F**	**A**	**F**
swimming	**.589**	**.623**	-.021	.157	-.070	.181	.088	.430	.029	.334
skiing	**.525**	**.529**	.143	.283	-.106	.217	-.206	.216	.237	.396
sports gymnastics	**.544**	**.639**	-.194	.042	.109	.240	.329	.568	-.157	.279
athletics	**.750**	**.685**	.035	.234	.003	.232	.000	.382	-.150	.245
cycling	**.612**	**.545**	.037	.225	.065	.283	-.211	.193	.041	.297
volleyball	-.122	.089	**.561**	**.493**	-.123	.072	.205	.172	-.074	.036
basketball	.001	.103	**.596**	**.554**	-.054	.162	-.098	-.005	-.010	.065
football	.040	.243	**.619**	**.662**	.078	.354	-.085	.098	.061	.229
handball	.095	.215	**.639**	**.639**	.012	.248	-.051	.077	-.105	.082
field hockey	-.014	.259	**.501**	**.568**	.087	.354	.029	.192	.129	.298
judo	.001	.322	-.020	.304	**.751**	**.774**	.022	.219	.054	.416
box	-.071	.187	.037	.298	**.701**	**.690**	-.064	.080	.033	.308
taekwondo	-.019	.323	-.048	.301	**.858**	**.827**	.098	.252	-.056	.375
karate	.038	.312	-.012	.323	**.843**	**.810**	.004	.179	-.091	.327
wrestling	.051	.289	.043	.308	**.602**	**.653**	-.059	.147	.059	.354
skating	.042	.345	-.150	-.035	.008	.074	**.667**	**.623**	-.095	.203
rhythmic gymnastics	.113	.428	-.056	.065	-.006	.095	**.731**	**.698**	-.190	.189
dance	-.125	.276	.109	.172	.015	.102	**.778**	**.638**	-.194	.135
diving	.045	.517	-.007	.190	.013	.317	**.459**	**.665**	.384	.624
synchron. swimming	-.076	.405	.103	.218	-.030	.191	**.694**	**.705**	.095	.388
scuba diving	-.033	.386	-.029	.161	.034	.360	.105	.406	**.688**	**.729**
mountaineering	.142	.373	.030	.186	-.065	.299	-.226	.191	**.740**	**.685**
watter skiing	.026	.434	-.068	.154	.075	.404	.075	.416	**.694**	**.761**
surfing	-.095	.397	.090	.280	.052	.425	.119	.428	**.727**	**.779**
parachuting	-.040	.287	-.023	.109	-.096	.245	-.073	.250	**.806**	**.700**

Mean values of factor scores standardized over whole sample (Table 3) show that ecology technicians, chemical laboratory assistants and cosmeticians have more positive overall interests in sports than other two groups.

Table 2. Correlations of multi-group factors of traditional sports, team sports, combat sports, aesthetic sports and outdoor sports

	traditional sports	team sports	combat sports	aesthetic sports	outdoor sports
traditional sports	1.000				
team sports	.312	1.000			
combat sports	.382	.408	1.000		
aesthetic sports	.592	.183	.234	1.000	
outdoor sports	.513	.243	.474	.462	1.000

Table 3. Mean values of factor scores standardized over whole sample, on the groups of students - cosmeticians (n=116), ecology technicians (39), geology technicians (21), chemical laboratory assistants (83) and chemical industrial technicians

	cosmeticians	ecology technicians	geology technicians	chemical laboratory assistants	chemical industrial technicians
traditional sports	.032	.031	-.391	.183	-.175
team sports	.099	.376	-.188	-.083	-.225
combat sports	.050	.414	-.444	.014	-.203
aesthetic sports	.121	-.079	-.217	.065	-.174
outdoor sports	.020	.227	-.167	.145	-.289

Table 4. Correlations of standardized factor values and orthogonalized factor values

	traditional sports	team sports	combat sports	aesthetic sports	outdoor sports
traditional sports	.909	.131	.155	.287	.224
team sports	.131	.967	.191	.060	.085
combat sports	.155	.191	.941	.071	.219
aesthetic sports	.287	.060	.071	.931	.204
outdoor sports	.224	.085	.219	.204	.924

The differences of five groups in sport interests factors was established by canonical discriminant analysis of orthogonalised factor scores from confirmatory factor analysis. The correlations of standardized factor values and orthogonalized factor values are in Table 4. The results of canonical discriminant analysis are in table 5. Two significant discriminant functions were obtained. The first discriminant function could be recognized as general rejection at the negative and general acceptance of sports at positive side (Table 6). The second discriminant function is defined by team sports factor at the negative side oposed to others at the positive side, with traditional and outdoor sports factors having highest values (Table 6).

Table 5. The results of canonical discriminant analysis: canonical correlations (R), F values and significance of F - tests.

Roots removed	R	F - value	p
0	.236	19.143	.000
1	.157	8.219	.004
2	.111	4.070	.044
3	.103	3.472	.063

Table 6. Structure of significant discriminant functions in ortogonalised space (M) and standardized factor space (S)

	M 1	S 1	M 2	S 2
traditional sports	-.091	-.373	.820	.812
team sports	-.610	-.767	-.420	-.254
combat sports	-.664	-.851	.030	.165
aesthetic sports	-.047	-.240	.118	.397
outdoor sports	-.421	-.616	.371	.521

Table 7. Group centroids on discriminant functions (D) for the group of cosmeticians, ecology technicians, geology technicians, chemical laboratory assistants and chemical industrial technicians

Group of students	D 1	D 2
cosmeticians	-.074	-.047
ecology technicians	-.495	-.132
geology technicians	.332	-.255
chemical laboratory assistants	.016	.254
chemical industrial technicians	.288	-.076

Group centroids on discriminant functions (Table 7, Figure 1) show that first dimension differ ecology technicians attending elite educational program at the accepting sports side of the discriminant function from the other groups. Second dimension differs, in Holland's terms, investigative chemical laboratory assistants on traditional and outdoor sports side, and realistic geology technicians at the team sports side of discriminant function. Cosmeticians are near origin point of functions. It seams that realistic vocational orientation means low overall interest in sport and only relatively higher interests in most popular team sports. Investigative and more complex vocational orientations seam to be followed by more positive sport interests.

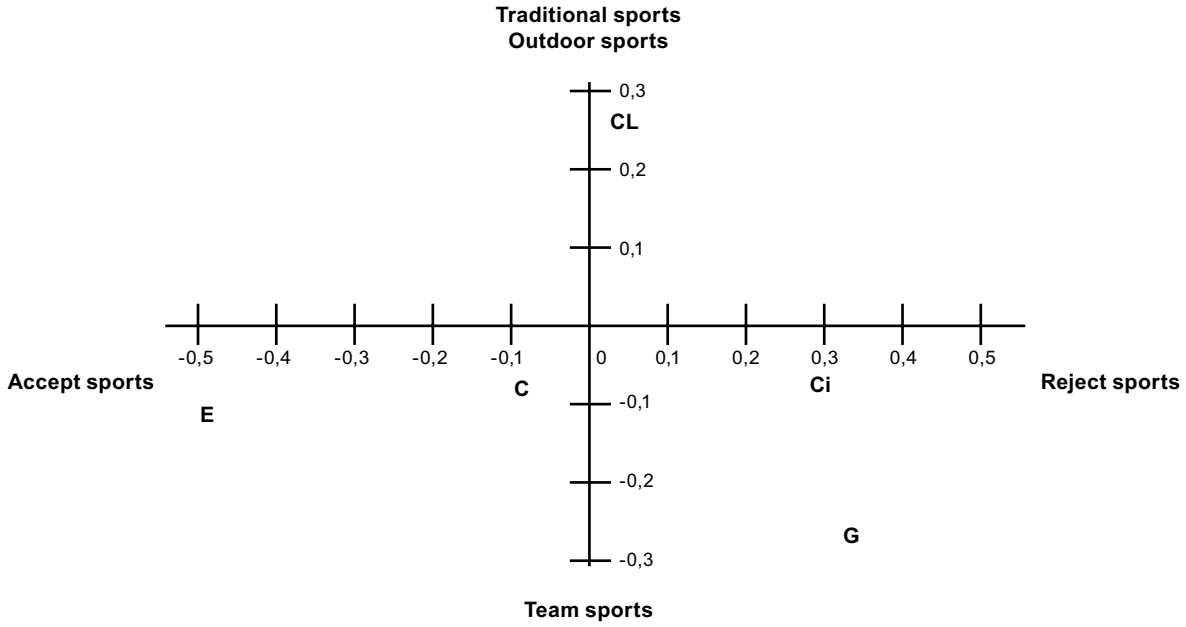

*Figure 1. Group centroids on discriminant functions for the group of students preparing to be cosmeticians (***C***), ecology technicians (***E***), geology technicians (***G***), chemical laboratory assistants (***CL***) and chemical industrial technicians (***Ci***).*

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GENDER AND PROFESSIONAL INTERESTS AS FACTORS IN SPORT RELATED KNOWLEDGE ACQUISITION

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Abstract

Paper-and-pencil soccer, volleyball, handball and basketball-related knowledge test was given to four samples: 146 male and 68 female students of kinesiology, and 110 male and 30 female students from different other departments of University of Zagreb. Canonical discriminant analysis was applied and resulted in three significant discriminant functions. First function was defined by result in volleyball test and discriminate kinesiology at positive side, from non-kinesiology students at negative side. Second function was defined by handball and soccer knowledge and discriminate males at positive from females at negative side. Third function is defined by basketball and soccer scales and discriminate female non-kinesiology students from other groups. It shows that in this group the knowledge of basketball is relatively better comparing to relatively lower result on soccer scale, than knowledge of these two sports in other three groups is. The results show that relationship of gender, professional interests and knowledge about sport games is not the simple one.

Key words: *undergraduate students, soccer, volleyball, handball, basketball*

Introduction

It is well established fact that men outnumber women in sport participation (Plaisted, 1995). Participation rates of males and females in our society show that men outnumber women by two to one. Less than 20% of female university students and less than 40% of male university students were ever engaged in some sport team of any level (Gošnik et al., 2002). The reason could be find in a number of social factors defining gender role and having impact on male and female behavior (Oglesby and Hill, 1993). Eccles and Harold (1991) found that elementary school girls by the end of the first grade develop lower expectations and perceived their ability to achieve success in sport and exercise less positively than boys. Martin et al. found that adolescent male athletes were more likely than female to believe that they could play at the college, Olympic games, or professional levels. The gender differences were found not only in participation but in attitudes and sport related knowledge (Busch et al., 2002). An exception was research by Babić et al. (2002), where no gender differences have been found neither in attitude nor in knowledge about soccer, but in a very specific sample consisting of students of theology. Knowledge about sport can be the factor influencing interests and sport related behavior. It could be expected that students of kinesiology should know more about different sports than other students. At the same time, it could be expected that male students know more than female. The aim of this research is to find the differences in soccer, volleyball, handball and basketball-related knowledge test, in male and female students of kinesiology and university students of other subjects.

Methods

The sample of this study consists of 146 male and 68 female students of kinesiology, and 110 male and 30 female students from different other departments of University of Zagreb, with total of 354 freshman students. The students were given the paper-and-pencil knowledge test having 40 questions about history, official rules, organisation, competitions and competitors, etc., of soccer, volleyball, handball and basketball. Each sport was represented by 10 questions forming four subscales of test. The total result in each scale was calculated as the sum of correct answers. Test results were analysed by canonical discriminant analysis where four groups were defined by gender and being kinesiology student or not.

Results and Discussion

Means and standard deviations of results on knowledge about soccer, handball, volleyball, and basketball scales in the group of male students of kinesiology, female students of kinesiology, male students of other faculties, female students of other faculties, and in total sample are in Table 1. It can be seen that kinesiology students have better results than others, with exception of male soccer result being better than female kinesiology student result. It can also be seen that male students have better results than female, with exception of the best result in volleyball scale in kinesiology female students, and female "other" students being better in basketball scale than their male colleagues are. Standard deviations

notably vary. Leaving out volleyball, they are lower for kinesiological students indicating that same professional interest form more homogenous group.

The product-moment correlations of results in scales of knowledge about four sport games obtained on total sample are in Table 2. They are all positive and statistically significant, explaining from 11 per cent of common variance of volleyball and soccer, to 22 per cent of common variance of soccer and basketball. All knowledge scales evidently belong to the same space. The values in correlation matrix suggest the existence of general factor of sport games knowledge.

Table 1. Means (M) and standard deviations (SD) of results on knowledge about soccer scale, knowledge about handball scale, knowledge about volleyball scale, and knowledge about basketball scale in the group of male students of Faculty of Kinesiology (MK), female students of Faculty of Kinesiology (FK), male students of other faculties (MO), female students of other faculties (FO), and on total sample (n=354).

group	number of subjects	soccer		handball		volleyball		basketball	
		M	SD	M	SD	M	SD	M	SD
MK	146	8,644	0,820	7,884	1,377	7,178	1,353	7,705	1,249
FK	68	7,515	1,139	5,912	1,463	7,794	0,939	7,162	1,561
MO	110	8,018	1,465	5,500	1,464	4,791	1,314	6,309	1,537
FO	30	7,100	1,373	4,667	1,539	4,433	1,104	6,467	1,634
TOTAL	354	8,102	1,271	6,492	1,870	6,322	1,818	7,062	1,560

Table 2. The matrix (lower triangle) of product-moment correlations of results on knowledge about soccer scale, knowledge about handball scale (H), knowledge about volleyball scale (V), and knowledge about basketball scale (B)

	soccer	handball	volleyball	basketball
soccer	1.000			
handball	0.419	1.000		
volleyball	0.334	0.476	1.000	
basketball	0.473	0.442	0.488	1.000

Table 3. The results of dicriminant analysis: eigenvalues (E), canonical correlations (R), Wilks' Lambda (λ), chi-squared value, degrees of freedom (df), and level of significance (p)

Roots removed	E	R	λ	x^2	df	p
0	1,32115	0,75444	0,27223	454,084	12	0,00000
1	0,53074	0,58883	0,63189	160,204	6	0,00000
2	0,03384	0,18093	0,96726	11,616	2	0,00300

The results of canonical discriminant analysis are in Table 3. All three discriminant functions proved to be statistically significant. First function is dominantly defined by knowledge about volleyball scale and than with modest value of knowledge about handball scale (Table 4). Second discriminant function is defined by handball and then soccer on the positive, and volleyball scale on the negative side of function. The third function has high value of basketball scale on positive and high value of soccer accompanied with moderate value of volleyball on negative side of discriminant function (Table 4). Group centroids on discriminant functions are in Table 5. First function discriminate kinesiology students having high results at positive side, from non-kinesiology students at negative side. The first discrimination is based on professional interests which are shown primarily in volleyball knowledge. Second function discriminate males at positive from females at negative side, showing that handball and soccer knowledge are more gender influenced than induced by professional interests. The Figure 1 shows the position of four groups on the first and second discriminant functions.

Table 4. Standardized coefficients for canonical variables (W) and discriminant factor structure (F) of variables knowledge about soccer, knowledge about handball, knowledge about volleyball, and knowledge about basketball.

variable	W1	F1	W2	F2	W3	F3
soccer	-0,296	0,154	0,594	0,561	-0,800	-0,457
handball	0,344	0,545	0,805	0,775	0,277	0,230
volleyball	0,923	0,921	-0,542	-0,114	-0,375	-0,244
basketball	0,021	0,341	-0,090	0,206	0,929	0,516

The results of canonical discriminant analysis are in Table 3. All three discriminant functions proved to be statistically significant. First function is dominantly defined by knowledge about volleyball scale and than with modest value of knowledge about handball scale (Table 4).

Second discriminant function is defined by handball and then soccer scale result on the positive, and volleyball scale result on the negative side of function. The third function has high value of basketball scale on positive and high value of soccer accompanied with moderate value of volleyball on negative side of discriminant function.

Table 5. Group centroids on discriminant functions (D) for the group of male students of Faculty of Kinesiology (MK), female students of Faculty of Kinesiology (FK), male students of other faculties (MO), and female students of other faculties (FO).

group	D1	D2	D3
MK	0,83707	0,64673	0,05524
FK	1,09813	-1,26874	-0,08484
MO	-1,35755	0,11138	-0,16193
FO	-1,58515	-0,67996	0,51724

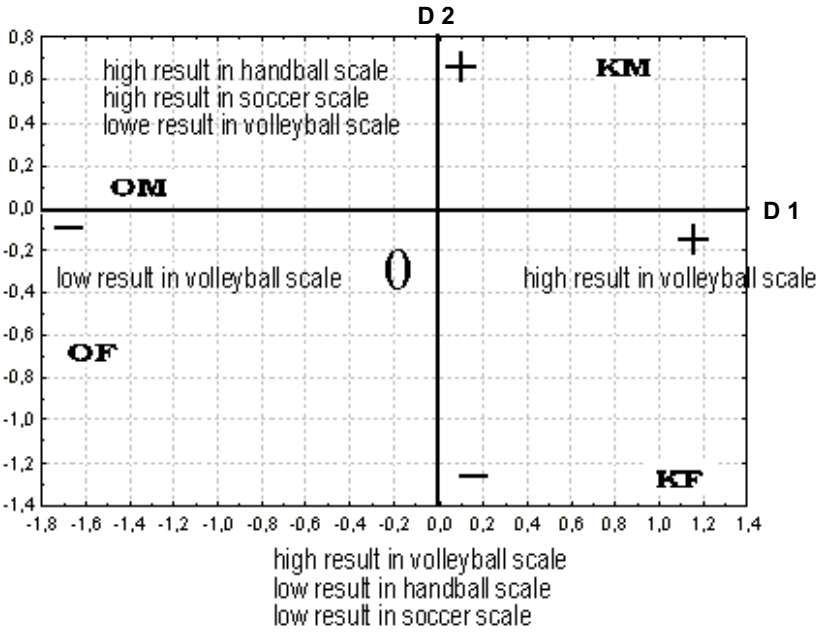

Figure 1. Group centroids on the first and second discriminant functions (D) for the group of male students of Faculty of Kinesiology (MK), female students of Faculty of Kinesiology (FK), male students of other faculties (MO), and female students of other faculties (FO).

The third function discriminate female non-kinesiology students from other groups, showing that in this group the knowledge of basketball is relatively better and knowledge of soccer relatively inferior than it is in other groups. The results show that relationship of gender, professional interests and knowledge about sport games is not the simple one. All possible three discriminant functions were found significant and both, gender and professional choice were factors of discrimination. The third discrimination was found on the group the least interested in sport, female non-kinesiology students, showing that the members of the group know relatively more about basketball and relatively less about soccer than other three groups.

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EARLY BEGINNINGS OF PHYSICAL EDUCATION IN CROATIA

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Abstract

The oldest sources concerning organised physical exercise of school children in the territory of Croatia have not been thoroughly explored yet. The aim of this study is to analyse activities and events in Croatian education system concerning Physical Education from its first occurrence until arrival of Friedrich Singer to Croatia in 1855. The main source used is a work by Antun Cuvaj written in the early beginning of the 20th century. A number of archive and library documents were also used. It has been found that in 1844, Captain Carl von Klinggraff proposed a PE curriculum for the school youth to the Supreme Principle of Croatian Schools Josip Schrott. Only four years later, an act that specified compulsory PE classes in elementary and secondary schools was written. The first PE teacher in Croatia was the Viennese Friedrich Singer who played a crucial role in the development of the entire movement of physical exercise in the than Croatia.

Key words: *Physical education history, PE teacher, Croatian schooling system*

Introduction

Since 1527 Croatia was a part of Habsburg Empire. In the time of Maria Theresa (1740-1780), the schooling system in Croatia, as well as in Hungary and other parts of Habsburg Empire, was organized since 1777 by the document "Ratio educationis". Later, two decrees – "Ratio educationis publicae" in 1806 and "Systema scholarum elementarium" in 1845 also regulated questions concerning education in Habsburg Empire (Petris-Martinčić, 1992). These documents were not comprehensive laws on education, but just administrative orders, which did not address physical education (PE) at all. The law on Organisation of Elementary Schools and Teacher Training Schools in the kingdom of Croatia and Slavonia ("Zakon ob ustroju pučkih školah i preparandijah za pučko učiteljstvo u kraljevinah Hrvatskoj i Slavoniji") was passed in 1874 as the first Croatian law on education drawn entirely by the Croatian educators and approved by the Croatian Sabor (Parliament). The Law stipulated, among other things, the compulsory PE classes in all elementary schools and teacher training schools (preparandija) across Civil Croatia (the Banska Croatia).

The aim of this study is to analyse activities and events in Croatian education system concerning Physical Education from its first occurrence until arrival of Friedrich Singer, the first great figure in the Croatian history of PE and exercise, to Croatia in 1855.

The main primary source used is a work by Antun Cuvaj "Građa za povijest školstva kraljevina Hrvatske i Slavonije od najstarijih vremena do danas" ["Sources of the history of education in the kingdoms of Croatia and Slavonija from the ancient times till nowadays"], 2nd edition, volumes I-XI, 1910-1913, the most comprehensive and most frequently used source in national history studies on education. Archive and library documents from the Croatian State Archives and the National and University Library of Zagreb were also used.

First Signs of Organised Physical Exercise of School Children in Croatia

The oldest sources concerning organised physical exercise of school children in the territory of Croatia is Zagreb County decision from 1797 by which public works were approved to build playgrounds for "recreationi iuventutis scholastiea" (recreation of the school youth). However, the circumstances that preceded the construction of sport recreational facilities for school children in the municipality of Zagreb at the end of the 18th century are still a mystery to us. We do not know whether this "recreation" was actually in operation or not, who was responsible for organisation and control, and what were the exercise contents and modes. The concept of constructing sports facilities "for recreation of school youth" in 1797 is an astonishingly progressive one for the time. In the than Croatia only few people were involved in some sort of organized physical exercise. There were no traces of any kind of gymnastics movements and a decade earlier the first sports associations in Croatia were organized The Osijek Civil Shooting Society, established in Osijek in 1784, and the Zagreb Civil Shooting Society established in Zagreb in 1786. At this moment we do not have any other sources concerning Zagreb County decision from 1797. Further historical investigations should focus on the conformation of the decision and analyses of circumstances related to this decision.

Captain Carl von Klinggraff, sent a letter on May 16, 1844 to the Supreme Principle of Croatian Schools Josip Schrott in which a PE curriculum for the school youth is proposed (Croatian State Archives). The letter was forwarded to the Hungarian Regency Council with a recommendation to be accepted. Carl von Klinggraff proposed to include youngsters

from 8 to 24 years of age in exercise sessions, consisting of running, jumping and gymnastic drills, on scheduled days and hours. The proposal was corroborated by the fact that over 500 exercise drills had already been conducted during the last two years and that no incidence had been registered. We have not yet found any other source to confirm Klinggraff`s information on physical exercise of the school youth in Zagreb in the period 1842-1844, neither we know what was the answer of the authorities or what was the destiny of the exercise sessions. Carl von Klinggraff was born in Prussia in 1778. He came to Zagreb in 1826. It is feasible to assume that, prior to his arrival to Zagreb, he had had an opportunity to get in touch with physical exercises movement of Friedrich Ludvig Jahn and German gymnastic system, and that consequently, he tried to promote similar concepts in Zagreb. Further investigation of Captain Carl von Klinggraff activities could give us a whole new perspective on early beginnings of PE movement in Croatia.

First serious attempt to organise an advance education in Croatia occurred in the Civil Croatia in 1848. The Croatian Sabor appointed a committee with the task to prepare a proposal of the law which will regulate the schooling system in the Civil Croatia. The proposal of the law on education, "Basics of Principal Rules for Public Instruction in Croatia and Slavonia" ("Osnove temeljnih pravila javnog obučavanja za Hrvatsku i Slavoniju") was prepared in very short time (Cuvaj, 1910). This act specified compulsory PE classes in elementary and secondary schools, but due to political developments in 1848, the war against Magyars and the Octroyed Constitution enactment in the Habsburg Monarchy in March 1849, the details were neither elaborated nor the act was ever implemented. Nevertheless, the "Basics" from 1848 are the first so far known written source on compulsory PE teaching in the schools of the Civil Croatia. The education public criticised the proposed "Basics" severely, but no objection was registered for the concept of the PE (Cuvaj, 1910). From the text of the "Basics" we cannot recognize how the implementation of PE classes was planned; we do not know anything of the probable form of the instruction and weekly time allocation, neither we know who should have been teachers (in the then Croatia there were no trained PE teachers). The law was probably written according to the Prussian model where compulsory PE classes were introduced in the schools in 1842. Of all the Habsburg Monarchy states, only in Austria the non-compulsory PE classes were provided since 1848. The "Basics" were the first autonomous legislative attempt to organise schooling in Croatia.

Friedrich Singer

Correspondence between the High Grammar School and military authorities reveals that the School required a teacher of PE and calligraphy in 1857. It seems that the than principal of the High Grammar School in Zagreb Josip Premru wanted to introduce non-compulsory classes in his school. As can be read in the letter from October 19, 1857, the military authorities recommended Adalbert Brüll, assistant teacher who "taught physical exercise in High Schulcompagni with a success" (Radović, 1974). A. Brüll stayed in Zagreb for just two months. After his departure, no PE classes were held anymore in that Zagreb secondary (grammar) school. We do not know why A. Brüll left Zagreb so soon. M. Radović supposes that there were two probable reasons - low income of a teacher teaching non-compulsory subject and safer, more attractive stationary appointment in the army, to which he returned.

Two reasons probably motivated the principle Josip Premru, a Slovene by birth and an addicted Germanophil by conviction (Cuvaj, 1910), to introduce non-compulsory PE classes in his school. His ideal schools were those of Prussia and Austria – and they had PE classes. And further, one German teacher more among the personnel of High Grammar School, who spoke no Croatian and who instructed his students in German, was advantageous to absolutistic regimen, strong Germanization and demise of the Croatian language in Croatian schools. Professional, pedagogical, but also the political reasons obviously motivated the arrival of A. Brüll and the attempted introduction of non-compulsory PE in Zagreb schools in 1857.

In Rijeka the Viennese Friedrich Singer, the first PE teacher in the Croatia, taught non-compulsory PE at the Lower Modern School since May 1855. At this moment we do not know the reasons, ways or circumstances that had brought F. Singer, PE teacher, to Rijeka. A little is known also about him as a person. In Budapest Municipal Archives there are 49 documents, from 1857 and 1858, related to F. Singer and his request to be transferred to Budapest (Radović, 1974). The applications reveal he was living in poverty. Principals of two Zagreb grammar schools wrote to F. Singer at the beginning of 1859 and ask him to come to Zagreb and teach PE in their schools (Cuvaj, 1910; Radović, 1974). Singer accepted the invitation and on March 15, 1859, he started to give his PE instructions three times a weak to 104 grammar school students who were divided in three groups. The gymnasium was in the Modern Secondary School. Due to low income, he was forced to live in a part of the gymnasium until his death on November 4, 1876.

In the Croatian Official Gazette (Narodne novine), No.170, from July 28, 1874, on the page 3, in the article "Gombalačka škola" ["Exercise school"] there are statistical records saying that in the 1873/1874 school year the PE instructions embraced 115 students of High Grammar School, 93 students of Modern Secondary School, 53 students of other schools, 12 girls and 34 adult men (Radan, 1971). In the 1873/1874 school year the two Zagreb secondary schools had 450 students in total (Cuvaj, 1910), so 46.2% of the secondary school students were participating in optional PE classes. Friedrich Singer, obviously well settled in Zagreb played a tremendous, crucial role in the development of not only PE, but of the entire movement of physical exercise of the than Croatia as well. He was among the founding members

of the Croatian Sokol. This association was, until the occurrence of modern sport, the core around which the Croatian youth interested in exercising gathered. But even more importantly, Sokol promoted strong national feelings against ever growing Magyarisation and Germanisation. Friedrich Singer made up the rules of the society and was the first instructor in the Croatian Sokol. The gym in the Modern Secondary School, in which F. Singer held his PE instructions, was the first gym used by the Croatian Sokol. He was entirely assimilated in the Croatian national body (he changed his German name Friedrich into its Croatian variant Miroslav), and he was active in the Croatian Sokol promoting the Bohemian (Czech) gymnastic system as opposed to the German one. Singer's associate Andrija Hajdinjak adjusted the German exercise terminology to the Croatian language in 1875. Undoubtedly, Friedrich Miroslav Singer is the first great figure in the Croatian history of PE and exercise.

The first issue of the first an the oldest educational journal in Croatia "Napredak" (Progress) occurred on October 1, 1859, close to the end of the Bach's absolutism and just a few months after the arrival of F. Singer to Zagreb. In it one can find the article by J. Macuna "Skerb o telesnom blagostanju školske mladeži" ["Care for the physical well-being of the school youth"]. The author accentuated the importance of physical exercise in schools:

"It should be arranged… that one physical exercise class should follow one intellectual class… It is a secret duty to introduce gymnastics wherever it is possible" (Macun, 1859).

Such an article in the first issue of the professional education journal is evidence that Croatian teachers were aware of how important PE is within general curricula. During the forthcoming 15-year period (until 1874) the Croatian civil society, pedagogy, schooling and people awareness of benefits of physical exercise for children would grow intensively.

Conclusion

Early beginnings of Physical Education in Croatia should be seen and discussed in a wider social and political sense. Constitutional (state right) position of Croatia and unfavourable political circumstances in the 19th century influenced powerfully the process of introducing PE classes in the than educational system. Due to the fact that the territories of Dalmatia, Istria and Military Frontier did not belong administratively to Croatia, all the decrees and laws in operation in the regions, were imposed from the outside and did not express the will of Croatian inhabitants. The efforts of Croats regarding introduction of the PE in the educational system can be best illustrated by events taking place in the Civil Croatia, i.e. in the region in which Croatian Sabor and Ban (Vice-Roy) had authority to autonomously (to a certain extend) control various areas of public life, the field of education included.

The first autonomous legislative attempt to organise schooling in Croatia occurred in Civil Croatia in turbulent 1848. During 1848 and revolution in Habsburg Empire Croatian Sabor had opportunity to pass acts independently and with out instructions from Vienna for the first time after many years. Proposal of the law on education, "Basics of Principal Rules for Public Instruction in Croatia and Slavonia" is testimony that the movements in the than Croatia on the field of education were progressive and similar to other countries in Europe, i.e. Prussia, Denmark, Sweden etc. Due to political developments in 1848 the act was never implemented. Nevertheless, the "Basics" from 1848 are the first so far known written source on compulsory PE classes in the schools of the Civil Croatia. Namely, if Croatia had been autonomous enough, that is if Croatian educators had been free to decide on the matters of education autonomously, the educational system in the then Croatia would have been legally put in order in 1848, meaning that compulsory PE would have been introduced into elementary and secondary schools even then.

Influence of political circumstances on the process of introducing PE classes in the Croatian educational system is particularly evident in the period of Bach's Absolutism (1850-1860). Dominant political motives in relation with strong Germanization process during 1850s conditioned the appearance of non-compulsory PE and arrival of first teachers of PE in Croatia - Adalbert Brüll and Friedrich Singer. The PE classes were held only on German language and according to the principles of German gymnastic system. Nevertheless, arrival of Friedrich Singer had tremendous influence on history of PE and exercise movement in Croatia. He changed his name, and during time he was entirely assimilated in the Croatian national body. As one of the founding members and first instructor in the Croatian Sokol, Friedrich Singer, played crucial role in the development of not only PE, but of the entire movement of physical exercise of the than Croatia as well.

In the period of the Bach's Absolutism (1850-1860) Croatian sport and exercise movement was not yet alive and very few people were aware of benefits of physical exercise. In that circumstances Croatian teachers were generators of the motion and eager advocates for inclusion of PE in the curricula. Proposal of the law on education in 1848 and article in the first issue of the first professional journal on pedagogy in Croatia "Napredak" from 1859 is evidence that were very well aware of how important PE is within general curricula.

Although we do not have enough knowledge about Zagreb County decision from 1797 and Captain Carl von Klinggraff activities in Zagreb during 1840s existence of such sources and activities during 1850s indicate rich and interesting early years of PE movement in Croatia.

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THE SOCIOLOGY OF SPORT IN CROATIA - THEMES AND PERSPECTIVES*

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Abstract

The aim of this article is to outline the genesis of the sociology of sport in the Croatian context. It shows the significance of the roles that some people (Miro Mihovilović) and institutions (Faculty of Kinesiology) were playing with regard to the development of this discipline in Croatia. It also provides a chronology of major events in the history of the subject and current problems respectively. This article deals with the present-day situation in the sociology of sport and also with some of the new themes and perspectives in the scientific orientation and research activities on the Croatian sociological scene.

Key words: *sociology of sport, Croatia, sociological aspects of sports*

The sociology of sport in the Croatian context

Since science and sport do not exist in the vacuum (Heinila, 1987) but are considerably set by the society whose part they are, before an attempt to describe the development of the sociology of sport in Croatia, it is necessary to say something about the connections of physical exercises, sport and its scientific research. The first data on physical training in this region dates from the Ancient World while the data on organized physical training dates from the second half of the 19th century when the first associations for physical training were formed, like Hrvatski sokol.

Professional training of staff was organized in several phases, from the foundation of Two-year College for Physical Training in Zagreb in 1940 through Four-year College for Physical Training established in 1958 towards the Faculty for Physical Training in 1973 and in the end to Faculty of Kinesiology in 2001.

Sport has always had the important role in the history of Croatian society and its search for the national identity, therefore, we are interested which and what place does the sociology of sport take in Croatia within the broader social context. Even though we find the first texts at the beginning of 19th century with the classics of sociology (M. Weber, W. G. Sumner) "sport was discussed in them in the context of a sociological analysis of some wider issue" (Coakley & Dunning, 2004). The process of institutionalization of the discipline started in the mid 60s of the 20th century when university professors of physical training realized the importance of sport as a social creation and its cultural and historical conditions and started giving importance to these dimensions. At that time the sociology of sport was taught at universities in many Western countries.

Miro A. Mihovilović – originator of the sociology of sport in Croatia

In his book The sociology of sport, first university textbook in Croatia on this subject, the author, Zoran Žugić, states that the first domestic research in the sociology of sport appears at the beginning of the 70s not as original studies with their own subjects and methods but among the broader field of kinesiology (Žugić, 1996). This information is not completely accurate. Hence, the first research of this type will appear *twenty years earlier* in papers of Miro A. Mihovilović, founder of the sociology of sport in Croatia. His personal contribution to the development of this science is manifold, from the first research that indicates social condition of sport, connecting with international researchers and institutions, establishing associations and help in constituting the sociology of sport as a sub discipline of the science on society.

Miro A. Mihovilović – cosmopolite, erudite, successful sportsman and scientist is the oldest living Croatian sociologist. Upon his initiative, after the study he wrote (*Report on physical education in Faculty of Philosophy in Zagreb for the school year 1948/49*) physical education is implemented in the first year of all faculties of the University of Zagreb. He is one of the founders of the Institute for Physical Education in Zagreb in 1952 and Four-year College for Physical Training, forerunner of the present Faculty of Kinesiology. With the education and research on physical training and sport, within the Institute i.e. the Faculty auxiliary disciplines were also under research, like "sport's medicine, psychology of sport and recreation, pedagogy, *the sociology of sport and recreation*, (italics S. B.) and town planning, area planning for the purpose of building sport facilities, recreational centers and children playgrounds". (Afrić, 2000)

In the fifties with his research (*The rising curve of athletics and swimming: from 1945 till 1954*) he paves the path to sociological thinking of sport as a social phenomenon. Numerous participations at international conferences and

* *Young researcher award*

presenting results of conducted researches (in 1954 on International Congress of sociologists in Beaunne in France he presents a paper on *Social system of basic sport organizations and the role of sport in contemporary society*; in 1959 in Paris on International Conference Journees d'etudes internationales he presents papers on *The systematization of funds for physical education*, *The role of physical education with female working class youth of some professions* and *The social system of basic sport organizations in NR Croatia* and *The role of sport in contemporary society*; in 1958 in Bruxelles on the World Congress for Physical Education he presents the paper on *Psychosocial and other motives that affect sport activities*) will show how "in countries of then 'socialistic storage' there are scientific papers which are with their basic characteristics an integral part of the international science" (Afrić, 2000). Mihovilović conducts first sociopsychological research in Croatia: *Sociometric research in sport teams* (1957), *Change of generations in sport: sociopsychological study* (1959), *The influence of home fields on sport results* (1960), *The influence of psychosocial factors on preparations of sport teams* (1960), *Research in small groups in sport* (1966). He is the founder and head of the Group for sociology of leisure time, recreation and tourism (since 1964) within the Institute for social research and Association for sociology of former country (JUS).

Of a special interest are his papers written as a part of the research project of biological, psychological, sociological, economic and sport elements from lives and performances of champion sportsmen in Yugoslavia, like the paper *The Status of Former Sportsmen* published in 1968 in IRSS. He is considered to be the founder of the sociology of leisure time and the sociology of youth. With his work he also contributed to the foundation and development of sociology of tourism. He lectured at some European and American Universities. A large number of papers (about 400) and projects indicate to an early perception of the sociology of sport in Croatia.

It could be said that the papers from sociology of sport in Croatia precede those from general sociology. Even though it has been lectured at Law and Business Schools at University of Zagreb since 1953, only in 1963 Rudi Supek will found the Department for sociology at the Faculty of Philosophy and in 1964 the Institute for social research.

Even though he never lectured the sociology of sport (the course enters the curriculum in the academic year 1970/71 when Mihovilović works in the Institute for social research in Zagreb) his papers could be considered the first attempt in elaborating social problems related to physical exercises, sport and recreation.

Themes in the sociology of sport in Croatia

Even though he first papers date from twenty years earlier, the course the sociology of sport enters the university curriculum in the academic year 1970/71. The first lecturers were Krešimir Petrović (1970-1978) and Ankica Hošek-Momirović (1978-1992) that taught the following courses: Kinesiological sociology, Sociology of leisure time, The sociology of sport and Sociology of recreation. As a result of the cooperation of these two authors the book *Toward the sociology of sport I and II* was published in 1996 and it covers all research conducted in the period from 1970 till 1986.

Prevalent research can be divided into four areas. In the first place these are the social structure researches which were defining the influence of social demographic characteristics on development of anthropological dimensions, then research of influence of kinesiological activities on the process of socialization and papers on sociometrics, i. e. research on defining inner structure and dynamics of groups involved in kinesiologiocal activities in general, and especially small groups who are dealing in organized manner with the championship sport (Žugić, 1996).

The fourth, separated group are researches of stadium audience i.e. behavior of football fans. Precisely these papers represent the basis for research conducted in the last fifteen years. Mentioning the problem of football hooliganism as a manifested phenomenon of contemporary society, psychological and sociological characteristics of supporters were researched (Buzov, Magdalenić, Perasović & Radin 1988; Fanuko, Magdalenić, Radin & Žugić, 1991; Lalić,1993). During that period of time Srđan Vrcan writes his studies where he elaborates on connection between sport and violence in the Croatian context (*Sport and violence at present in Croatia and other studies from the sociology of sport*, 1990), the problem of supporters' hooliganism as the most manifested expression of social dissatisfaction of wider social masses (*Dal tifo aggressivo alla crisi del pubblico calcistico: il caso jugoslavo*, 1992; *From Ends to Trenches, and Back: Football in the Former Yugoslavia*, 1999, /co-author with Dražen Lalić) and connection of sport with politics (*The Curious Drama of the President of a Republic versus a Football Fan Tribe: A Symptomatic Case in the Post-Communist Transition in Croatia,* 2002; *Football – politics – violence. Models from the sociology of football,* 2003*).*

Perspectives of the sociology of sport in Croatia

In order to move towards the future, following predecessors, we have to give credits to scientists on whose shoulders we stand today. Without this first pursuit in the field of the sociology of sport we would not have science today. Sociological research of physical education, competitive sport and recreation started in the 50s of the last century, developing as a component part of social science on sport. In that sense the role of the founder, Miro A. Mihovilović, is immense, and his role has been neglected for years.

Sociologists of sport are the best critics and evaluators of the problem related to sport and physical exercises. As challengers of traditional, ingrained attitudes towards sport they contribute the creation of new understanding and relation (of politics) towards sport. A brief reference to last research shows how was the past development of the sociology of sport inhomogeneous and connected to a very small number of segments of this wide area.

In the foundation and development of the sociology of sport the lecturers from the Faculty of Kinesiology had the great role (Petrović, Hošek-Momirović, Žugić) and their associates from the Institute for social research at the University of Zagreb (Buzov, Fanuko, Radin, Perasović) and a few researchers outside these institutions (Vrcan, Lalić). Today the sociology of sport is not only lectured at University of Zagreb but at the University of Split. Its future is seen not only in the reception of elementary knowledge acquired during studies yet in raising awareness of masses on the importance of studying social phenomenon of sport and problems related to it – media, politics, gender roles, etc.

With the continuous, even though, relatively modest range, the sociology of sport in Croatia managed to solidify as an academic discipline. Provided that we look at sport as the mirror image of present society we could make conclusions that major investments are necessary to research this area. The best example for this are so-called third i.e extreme sports as the image of present society which is trying to go over the limits of their own capabilities.

For the reason of influence of sport on the benefits of society as a whole and the importance of its research it is necessary to establish the section for the sociology of sport within the Croatian sociological association and introduce the course of the sociology of sport in courses of general sociology in university centers of the Republic of Croatia. That would represent the first step in creating awareness of social conditioning of sport and their interrelation. Through observation and following the phenomenon of sport we would be able to understand and influence the development of present global society.

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ESCALATION OF VIOLENCE AT THE MAKSIMIR STADIUM IN 1990 – THE BEGINNING OF WAR IN EX-YUGOSLAVIA?*

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Abstract

A day after the first democratic election results in Croatia after World War II were announced, the football match between FC Dinamo, Zagreb, and FC Red Star, Belgrade, was to be held in Zagreb at the Maksimir Stadium. The match has never been played. Main purpose of the paper is to explain historical circumstances connected with the political moment of the never played football match on 13th of May, 1990. Hooligan riots and escalation of violence, intervention of police, as well as social and historical significance of the mentioned match will be investigated. Everything that happened at the Maksimir stadium on 13th of May, 1990, points to only one conclusion – the Red Star supporters were politically manipulated, instructed to provoke the supporters of Dinamo and they acted under the protection of communist's police. Their aim was to present Dinamo's supporters as violent, aggressive, full of hate and nationalistic people who supported the Croatian Democratic Union (CDU), fought against police, law and social order, and, consequently, against Yugoslavia. There are enough indices to conclude that main purpose of the provoked hooligan riots at the Maksimir stadium was destabilization of political scene in Croatia and prevention of peaceful and democratic transition of communist government to the new, democratically elected government of CDU.

Key words: *football, politics, Croatia, Serbia, hooligan riots*

Introduction

With the occurrence of social changes in communist Yugoslavia in the second half of 1980s and in the beginning of 1990s, Serbian nationalism in Yugoslavia grew rapidly. Simultaneously, in Croatia, one of the states in the then Yugoslavia, the old idea of a more liberal and more independent position of Croatia within the more democratic and more civil oriented Yugoslavia became, again, a political issue. However, president of the Socialist Republic of Serbia and the president of the Serbian Communist Party Slobodan Milošević had different plans. His political agenda was simple - Serbian hegemony within Yugoslavia. Nevertheless, similar to the processes in other communist countries, during 1989 the first political parties in Croatia were organized. Decision to organizing free and plural elections was reached in the Croatian Parliament in February and the first democratic elections in Croatia after World War II were held at the beginning of May 1990. Election results were announced on the 12th of May and the victory of the Croatian Democratic Union (CDU) was declared (Pavličević, 2000:519-520). It was a Saturday. The next day football match between FC Dinamo Zagreb and FC Red Star Belgrade was to be held in Zagreb at the Maksimir stadium. This match has never been played.

There were four biggest and most popular football clubs in the then Yugoslavia. Two of them were from Serbia: FC Red Star Belgrade and FC Partizan Belgrade, whereas the other two were from Croatia: FC Dinamo Zagreb and FC Hajduk Split. In most cases football clubs in Yugoslavia were closely linked with and financially dependent on certain political groups and they were in turn identified with that group's political views. FC Partizan Belgrade was tied to the Yugoslav People's Army and strongly identified with Yugoslav nationalism. FC Red Star Belgrade had strong links to the political elite of the Socialist Republic of Serbia and was therefore often seen as a club of Serbian nationalists. FC Hajduk Split was identified with the Dalmatian regional identity and FC Dinamo Zagreb was often characterized as a representative of the Croatian national identity. Although every match between the mentioned clubs was a big derby, the mentioned event was to happen only two series before end of the season 1989/1990 and FC Red Star Belgrade already assured the champion's title. Therefore, in sport terms, the forthcoming match between FC Dinamo Zagreb and FC Red Star Belgrade was only a matter of prestige. Unfortunately, it turned out to be much more then just a football match.

The main purpose of this paper is to explain historical circumstances linked with a political moment of the never played football match between FC Dinamo Zagreb and FC Red Star Belgrade on the 13th of May 1990. The hooligan riots and escalation of violence, intervention of police as well as social and historical significance of the mentioned match will be investigated. The thesis that this never played match symbolized beginning of the war between Croatia and Serbia will be questioned. In the paper the primary and secondary sources will be used, that is, a copy of TV broadcasting and articles from Sports News, the leading daily sport's paper in Croatia.

* *Young researcher award*

Supporters

FC Dinamo Zagreb has always had a big army of followers. Still, the first organized group of followers emerged in 1986. The most hard-core and faithful followers, imitating similar groups from abroad, formed the Bad Blue Boys. At the beginning of the 1990's, the first organized Bad Blue Boys Fan Club was established. Just a few groups have ever played as provocative role in the Croatian public life over the past decade and a half as the Bad Blue Boys (BBB). They were the forefront of the Croatian nationalist reawakening in the late 1980's and early 1990's, and they wholeheartedly supported the newly elected President of Croatia Franjo Tudjman (President of CDU) and his independence bid. Members of BBB were also among the first Croatian volunteers in the 1991-1995 war for freedom.

On the other side were Delije, which is the most popular name for the supporters of FC Red Star Belgrade. Similar to BBB, Delije started with organized supporting at the end of 1980's and declared themselves as extreme Serbian nationalists. It is very significant that in Zagreb on the 13th of May their leader had been Željko Ražnjatović "Arkan", who later became a commander of the most notorious paramilitary groups, the Serbian Volunteer Guard and White Eagles, very well- known for their war crimes in Croatia and Bosnia and Herzegovina.

In the second half of 1980's Croatian and Yugoslav sociologists detected for the first time football hooliganism in Yugoslavia as a social problem. The pioneer research appeared in 1984 (see Žugić, 2000:170) and before 1991 there were two more great and important studies on the mentioned topic: Buzov and associates "Social and psychological aspects of violent behaviour of sport fans" in 1988 and Vrcan "Sport and violence" in 1990 (Žugić, 2000:171-174). Analysing violent behaviour of young people connected with sport in Yugoslavia Srdjan Vrcan said in the tenth conclusion of his study: "Violence of sport supporters is an indicator of roughness and of detachment from the actual social institutions, social value system, social icons and others … Simultaneously, violence makes this detachment deeper and more radical. In that sense, as a symbol of disconnection from the actual system, it is also a means of an attempt to collectively redefine the reality and to remould social reality" (according to Žugić, 2000:174). It was for the first time that one sociologist has connected violent behaviour of sports supporters in Yugoslavia with politics or political changes in the state. Although Žugić opposed to that thesis by claiming that hooligans do not represent political or cultural alternative (Žugić, 2000: 174), we are of opinion that in this particular case political connotations of hooligan riots at the Maksimir stadium are evident and we will try to prove it.

May 13, 1990

There was no hint in the Croatian newspaper that forthcoming riots were going to happen. "Champions coming to Maksimir" was the main headline in the Sports News form the 12th of May and comments on the forthcoming match were quite soft. They didn't pay too mach attention to the match. "Our championship is finished. Tomorrow is the greatest derby of our sports. Dinamo against Red Star – no real thrill" (Sports News, 12th of May, p.9). All the comments were sport-like. Darko Pančev, a player of the FC Red Star Belgrade and the leading scorer of the championships, said: "Now, when everything is known … the derby in Zagreb can be played with no special tactical dodge. As far as we are concerned, with a goal advantage over Dinamo. It will be a nice game in which I wish as many goals as possible." (Sports News, 12th of May, p. 14). Practically, there was not a single word about animosity or political situation in Yugoslavia. One player of Dinamo said: "When we didn't succeed to win the Championships, it would be nice to say farewell by a victory over Red Star." (Sports News, 12th of May, p. 14). There were 40,000 tickets on sale and later in the official report it was said that only 13,500 were actually sold. Although it would be unreasonable to expect that anybody who wants to organize riots would have announce it in the papers, still everything before the match suggested it would be a peaceful and almost friendly game.

On the Sunday morning of 13th of May the first groups of the Red Star's supporters arrived in Zagreb. Later, the official police reports described their violent behavior from the moment they had come to Zagreb - verbal and physical incidents, demolished shops and tramways and so on. Fifty five of them were arrested before the match and the rest of them (according to the police reports about 2000) were escorted to the stadium at 10 a.m. (Sports News, 15th of May, pp.2-3). Delije, the Red Star supporters, were allocated at the south stand. Most of BBBs (around 2000) were at the north stand and some of them (about 800) were at the east stand. At around 5:35 p.m., 25 minutes before the beginning of the match, Delije started to break down billboards above them and some ten minutes later they managed to crash the fence and entered the south stand sitting area. There were few hundreds supporters of Dinamo. Most of them started to run towards exits while some retaliated. Players of both teams were in the pitch warming up at that time. On the TV broadcast record it is clearly visible, and it was later confirmed in the police report, security and police forces did not react. No one from either the security or the police did even try to stop the Red Star supporters from demolishing the south part of the stadium or did anything to prevent or stop the inevitable clash of opposing supporters. "Fear from greater riots stopped the evacuation of the part of the stadium with the supporters of Red Star. It was noticed that outside the stadium hooligans had organized supply of stones and other objects." (Police Report, Sports News, 15th of May, p. 3). At that moment Bad Blue Boys from the north stand started to throw stones on the police, they demolished the fence and entered the pitch. "We saw some trouble at the south stand and understood that the Red Star supporters were charging fifteen against one of ours and nothing could have stopped us … What were police doing? Why they did not react against that vandalism at

the south stands?" (An interview with the representatives of BBB, Sports News, 15th of May, p.5). The police at the north stand reacted severely and violently towards BBB's. The whole stadium went crazy and BBB from the east standing also broke down the fence and entered the pitch. And massive fight between the supporters of Dinamo and the policemen started. Zvonimir Boban, at that time the Captain of the FC Dinamo Zagreb, came to defend the fans. He jumped and kicked one policeman. Eventually, the police forces managed to take control over the stadium. During that time, the Red Star supporters, undisturbed, continued to demolishing the south part of the stadium. Later that night they were quietly escorted to the train and sent back to Belgrade. "Fifty nine supporters were injured (eight seriously) and seventy nine policemen (eight seriously) … Beside 132 supporters of Red Star and 42 supporters of Dinamo were also took into custody." (Police Report, Sports News, 15th of May, p.3). The official representative of the Football Association at the match between the FC Dinamo Zagreb and FC Red Star Belgrade reported: "A stampede broke out on the south because the Red Star supporters started to pound on billboards and then demolished them, as they also did with seats … The part of standings with the supporters of Dinamo "retaliated with stones" only after the riots had escalated on the south. And when BBBs started from their stands, there were no chance for the match to continue…" (Sports News, 16th of May, p.3). The football match between FC Dinamo Zagreb and FC Red Star Belgrade did not even start.

Consequences // Epilogue

The Yugoslav Football Association registered the match 0:3 in favour of FC Red Star Belgrade. The president of FC Dinamo Zagreb resigned and chiefs of security at the Maksimir stadium were suspended. Zvonimir Boban was suspended for 9 months from football for kicking the policeman and banned from going with the Yugoslav national football team to the FIFA World Cup in Italy. FC Dinamo Zagreb was punished with six games and FC Red Star Belgrade with two matches not to be played at their stadia. Thus, the Season 1989/1990 was successfully ended.

Conclusion

The "Biggest incident in the history of Yugoslav football" (Sports News, 15th of May, p. 3) must be seen and discussed in a wider social and political sense. Nothing on that Sunday afternoon was accidental and nothing did happen spontaneously. In a situation when CDU had won democratic elections with independence of the state of Croatia as its main political platform, when nothing could had stopped fall of communism in Croatia and, consequently, in Yugoslavia, and, on the other hand, when Slobodan Milošević publicly had been speaking about Big Serbia and his idea that "where ever single Serb has lived is Serbia", the football match between the greatest Croatian and the greatest Serbian football teams never had any chance to stay in the boundaries of sport.

From the official police report it is evident that communist police allowed the Red Star supporters "to organise supply of stones and other objects" (Police Report, Sports News, 15th of May, p.3) that are not suitable for football stadia, tolerated their hostile activities against the Dinamo supporters and, finally, protected them. "Our primary goal was to provide a buffer-zone and to protect between 1.000 to 2.000 supporters of Red Star from the aggression of a far greater number of the supporters of Dinamo." (Police Report, Sports News, 15th of May, p. 2). But the Dinamo supporters were not aggressive until the Red Star supporters had started demolishing of the stadium, crashed the fence, entered the part of the stadium where the soft-core Dinamo supporters were situated and started a brutal fight with them. All that lasted for some 20 minutes and the police did not react. They react only when the Dinamo supporters crashed the fence on the other side of the stadium. Željko Ražnjatović Arkan, the person that would become very well known for his close cooperation with Slobodan Milošević in future war crimes in Croatia and Bosnia and Herzegovina, led the Red Star supporters in their marsh through Zagreb. Everything that happened at the Maksimir stadium on 13th of May, 1990, points to only one conclusion – the Red Star supporters were politically manipulated, instructed to provoke the Dinamo supporters and they acted under the protection of communist police. Their aim was to represent the Dinamo supporters as violent, aggressive, full of hate and nationalistic people who had supported CDU, fought against the police, against law and social order and, consequently, against Yugoslavia.

Another fact also speaks in favour of the thesis that the Red Star supporters were very well organised and politically instructed. On that day they did not cause a single incident or fight with the police, although 132 of them were arrested.

We believe that the situation when the Red Star supporters came into Zagreb with instructions to do anything necessary to provoke Dinamo supporters so providing the communist police, just waiting for a reason, with an opportunity to act aggressively and violently towards the Dinamo supporters, had hidden political agenda. There is enough indices to conclude that the main purpose of the provoked hooligan riots at the Maksimir stadium was the destabilization of political scene in Croatia and prevention of peaceful and democratic transition of the communist government to the newly and democratically elected government of CDU.

In that sense, 13th of May, 1990, can be seen as the beginning of the Croatian war for independence and democracy. Nowadays behind the western stands of the Maksimir stadium there is a monument to those Dinamo supporters who lost their lives in the Croatian war for freedom. The epitaph reads: "To all the Dinamo fans for whom the war had started at the Maksimir stadium on the 13th of May, 1990, and ended by them laying their lives on the altar of the Croatian homeland."

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SOCIOLOGY OF SPORT AND FOOTBALL HOOLIGANISM IN CONTEMPORARY CROATIAN CONTEXT

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Abstract

The Croatian sociology of sport was, to a certain degree, divided in two distant fields, with high theoretical level on one side and applied sport research on the other. Football hooliganism appeared not only as an interesting subject of research, nor exclusively as spectacular media product. Research on football hooliganism became, within a perspective of sociology of sport, a point of fruitful cooperation between previously separate sides of research. From the end of the eighties to mid-nineties Croatian authors produced several books on football hooliganism, creating a scientific and rational discourse as opposed to political, ideological or media discourses. Sociology of youth subcultures provided a useful framework for better understanding of the phenomenon. While football hooliganism in the eighties attracted other subcultural actors to the stadium, involving punk, metal and various other identities in the rituals of football tribe, in the nineties the situation changed. Other subcultural identities left the stadium culture, being replaced by the skinheads.

Key words: *youth subcultures, contemporary Croatian society, football and youth culture, skinheads, sociology of sport, football hooliganism*

The sociology of sport is not a developed science discipline in Croatia, like the sociology of religion or the sociology of education, and although it is sometimes limited to a few authors and an effort of a few researchers, it represents inspirational and developed frame for a theoretical and research discussion on key aspects in the relationship between sport and society.

Croatian sociology of sport is characterized with one visible gap, i. e. empty space between the critical approach and macro sociological perspective on one hand, and a sequence of useful, directly applicable researches (like sociometrics) in sport clubs, on the other hand. Football hooliganism represented, in the second half of the 80s, a good example for filling this gap, in the approach to the football hooliganism a critical theory and empirical research met, using quantitative and qualitative methods. That was the moment when an independent scientific discussion appeared on this subject with the expected attempts of different political instrumentalisation or usual media exploitation of symbolic and real violence. Since 1988 (Buzov et al) we can follow how the approach has been developed in some researches and books that represents sociological intervention into the real world of football fans. Vrcan (1990, 2002, 2003), Lalić (1993), Fanuko et al (1991), Perasović (1989, 1995) and Žugić (1996), with a great attention of the media for the topic and sociological studies themselves, have made the creation of one discourse available, which was different from moralistic and sensational paradigms present in the media, as with socialist so with the present capitalistic. This discourse has been created on the tradition of general and critical sociology of sport and on the tradition of the sociology of subculture of the youth because in the middle of the 80s home fans made the step out from the past behavioral frames of fans creating recognizable subcultural style. This step emphasized the separation of younger from older population of fans, in the direction towards the estetization, stylization and ritualization, bringing closer fans to their peers who were getting identities on wider urban scene of adolescent lifestyles. The sociology of sport had to use the inheritance of the sociology of subculture of the youth because fans developed identities that did not disappear after the matches but were present and visible at work, in education and within families. Naturally, in other leisure time locations this subcultural identity was even more visible, shifting borders between until then two separate worlds of rock subcultural styles and football tribe. While the sociology of sport helped in the first clarification of terms and fields from popular stereotypes and prejudices, the sociology of subculture allowed understanding fans that created (among other things) one recognizable subcultural style.

Papers that were made based on the link between inheritage of critical sociology of sport and the sociology of subculture of youth have not only enriched our understanding of past transformations of stadium rituals and fans' behavior but also our understanding of the subculture of the young, therefore, at present, we can find much more articles on football fans than on followers of punk and heavy metal subcultural styles. However, the most of these papers were written ten years ago, and in the meantime the main protagonists of the fans' world and social context have passed through different transformations. The mid 90s were labeled by the wide resound of the conflict among Bad Blue Boys, fans of Zagreb's Dinamo (which was not permitted to keep that name at that time) and representatives of the government, especially president Tuđman. Except the works written by Srđan Vrcan (2002, 2003) which are directly related to this subject and in the context of wider sociology of football, there are no any other papers on this subject, neither papers related to changes in the fans' world in the last ten years.

Except the changes within the fans' world (as change of generations, tides of violent behavior, types of expressivity) there were changes in social context, especially in the light of the Act on sport fans that tried to solve the problem of violence with restrictions and repression. The phenomenon of violent behavior has not ceased to exist, it appeared on places where it had never been presented before, expanded to bizarre details (for example, skiing and behavior of Croatian fans during competition for the World Cup in Slovenia, or attacks on players of their club during friendly match of Dinamo in Austria, many heavy injuries, knife stabs, burning cars) which with the media sensationalism became the 'key social problem'. Media world and decision politics based their thesis on public opinion and stereotypes on violence, so it is not accident that repression appeared as a saving formula in the situation when the public demands a firm hand and visible results in the fight against violence. Croatian public was offered 'English model', within the media suggestion that the firm hand solved the problem of football hooliganism in that country. Indeed, the strong repression can temporarily remove violent protagonists from the stadiums but this does not make them less violent, nor the fact that one controlled zone can prevent other zone from appearance of violence. Violent behavioral pattern in the culture of young people cannot be out rooted while it is present in the culture of adults. In addition, it is not possible to amnest completely the sport itself, i.e. clubs, players, referees, sports' journalists and other participants in sports, from the violence happening around sport, as much as we see extreme violence far from sport, at least as far as from family, courts, education and shopping malls. It is hard to think about the sociology of sport without at least one of its part related to the behavior of sports' audience and it is harder to think about the sports' audience without supporters and different subculture of the young. Many times has football hooliganism been noticed outside football; supporters' groups have with their stadium ritual arrived to basketball, handball, ice hockey and water polo matches, and as we could see on skiing competitions attracted by the success of Croatian ski team. At the same time, with the exception of papers done by Vrcan, the research faded away and the interest of scientific society disappeared. The social context became labeled, like textbook examples from sociology, with moral panic and escalation of control and restrictive laws. Changes in social and legal context can be easily followed, discourse on media and political world on violence, deviation, pathology and punishments, which can remove unhealthy from healthy, can be analyzed, we can interpret changes of political parties in power, influences of economic power-wielders in some clubs, but we cannot easily follow the dynamic field of subcultural adolescent affiliations unless we are satisfied with newspaper reports. Therefore, it is evident that this field remains without one part of scientific insight into reality of fans' world. Let us try, however, based on the previous experience and new interviews with influential supporters, reconstruct at least some change aspects within the fans' world itself.

The conflict between Bad Blue Boys and the government ended, name Dinamo was returned, but, naturally, violent behavior has not disappeared. Those who were surprised at the beginning of 90s why there was a conflict between Croatian fans and Croatian police, thinking that in changed political situation, in independent country, these conflict should not be happening, stay on the level of petty politics and ideological blindness, and those who were analyzing violent behavior of Bad Blue Boys group exclusively through conflict with Tuđman and frustration for the taken name are also on the level of superficial political determinates, significantly below understanding allowed with the minimum knowledge for past research in the sociology of sport in this field. Public discourse which was created after the change of government in the year 2000 did not take into consideration notion on some mutual characteristics of football tribe around Europe and outside it, nor it took into consideration permanence of forms of violent behavior, so sociological insight was mostly outside the main stream of media articulations on this problem, as in the past period. Bad Blue Boys as a big, powerful and permanent subcultural group, which does not disappear as generations pass, was in different period labeled differently. That is a specific and for sociology instructive path of labeling from nationalism and hooliganism of the 80s, to national heroism and knights at the beginning of the 90s, across Yugonostalgics and Soros's hirelings from the period of fighting for the return of the name Dinamo, to urban protagonists who are saving city values before ruralisation, to become once again – simple football hooligans.

From the perspective of the sociology of subculture of youth (where in present time instead of the term subculture the following terms are used: neo (tribes), affective allies and expressive communities) there have been significant changes on the fans' scene. While, at the end of the 80s, two most common groups, Torcida and Bad Blue Boys, were gathering wide protagonists of different music preferences, including punk followers, in the 90s the situation changed. The punk scene of the 90s brought closer the usual music and dancing rituals to the actions of new social movements, which is understandable compared to the world scene and consequences of hard core movement, so within the value system of ecology, feminism, vegetarianism, anarchism and pacifism, fans' rituals became more masculine and right oriented for the modern punkers. Naturally, punkers like these became unacceptable, too feminist and left oriented for the majority of fans. In the mid 90s there is one of the first waves of appearance of skinheads in the stadiums, especially in Zagreb, where they represent skinheads who are not related to ska and Oi punk as the first skinhead generations in our country but are related to the stadium ritual, extreme right wing and violent behavior.

Regardless of the changed political conditions, transition from socialism to capitalism, 4 types of fans, which were described by Lalić (1993) researching Torcida, remained until today, with a slightly different emphasis: fan - fan, fan - bully, fan - political activist and trendy fan.

As the example of Bad Blue Boys, where the media picture was created in accordance with the daily political directions, Torcida can also be the example of misunderstanding and lack of sociological insight in the public discourse. The transformations within this known fan protagonist were very painful for the change of generation that was in lead for a long time, as well as for temporary political and media picture about good boys from Split against hooligans, their competition from Zagreb. Younger generation tried again to gain subcultural capital which is still at high appreciation on the scene of football tribe, and that is violent behavior, so the expert on inner life of Torcida could prove it as a fact, but, as the stronger violent behavior of Torcida coincided with the change of government in the year 2000 the majority of media was in consent with the idea that it was about secret services, instrumentalization of fans for the purpose of rebellion and change of legally elected government. It was evident, at that time, that we obviously lack insight into football tribes, and especially after the new wave of violence in the last two years, the authentic sociological intervention seems necessary. As in the end of the 80s, interdisciplinary and methodological diversity can help the sociology of sport in understanding this phenomenon. The wave of research could allow at least competition to media discourse where stereotypes and prejudices gain strength when the scientific influence on social policy is not possible.

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Adapted Physical Activity and Sport for the Disabled

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ADAPTED PHYSICAL ACTIVITY UNIVERSITY STUDY IN CENTRAL EUROPE: DEVELOPMENT AND RECENT SITUATION

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Abstract

The presented article explain the historical background since Jan Amos Commenius period up to special education and adapted physical activities development in 20. century in Central European countries. Main part of article is oriented on description APA university study in recent CE universities (example of Olomouc University) and APA university study program within European or world cooperation: CEEPUS, DEUAPA, EMDAPA, Erasmus-Mundus. Challenge for future research is mentioned in the end.

Key words: *APA history, APA study program, CEEPUS, DEUAPA, EMDAPA, Erasmus Mundus APA network*

The education system in Central European region is known with long tradition – since 9th century (Cyrillus-Methods script, 12-14 century - monastery education, first universities in Padova, Bologna, Charles University, after that systematic education due to "imperial education law" issued in 1869).

Related to physical activities (and later Adapted Physical Activities) we can discover the first sources in Johann Amos Commenius (Jan Amos Komenský) teaching work.

J.A.K. – called teacher of nations, born in Moravian region 28.3.1592, died in Naarden 15.11.1670. As an exultant due to Thirty years war he travelled from Moravian region through Poland (Leszno), Hungary (Sarisz Patak), Scandinavian countries and England to Netherland.

He stressed the importance of the games, particularly *movement games for child* development and success in education (Scholas Ludus) and *the right of education for all*: poor – rich, clever – week. His idea – *all individuals are educable* – can be considered as the starting point in approach equal right for education persons with disabilities (Didactica Magna). (Compare former recognition of children in categories "educable" or only "trainable" who had to be officially excluded from education.)

The second half of the 19 century was important with founding of the first residential homes for persons with disabilities (the region of recent Switzerland was the first, after that other CE countries under umbrella of Habsburg monarchy). No specialists were involved in the physical activities of persons with disabilities. Leading role in applying manual motor exercises, physical exercises played enthusiasts, mainly philosophers or medical staff. Among them there is necessary to remember memory of J.B.Riedel (1844, composer of the first official P.E. program in CE), Jan Ev. Purkyně (1787-1869, biologist, physiologist, anthropologist, discoverer of the cell). The idea of the importance of self-service and job-chance improving for persons with disabilities supported the attention to motor activities in these homes. In spite of this progressive starting point "charity approach" was leading approach in this period.

The year 1969 was very important: the imperial education law involved 2 obligatory P.E. lessons per week in all school levels. Besides public schools special institutions, special schools were founded, but system of professionals education in P.E. or special schools had not been established yet. The end of 19. century and the beginning of the 20. century first sport activities and clubs are reported (e.g. chess of blind, International Deaf Sports Federation - 1924).

The situation after the World War Ist caused the attention to "disability" domain. After 1918 (the year when Czechoslovakia was established) controlled P.E. programs were included into schools and special schools. More variable spectrum of special (or supportive) schools, homes and institutions. It was the reason for attention to professionals education: an extra exam was required (after participation in a part time course) for eligibility to teach P.E. and other extra exam was necessary to obtain a licence for P.E. teaching at special institutions. (Women were excluded from teaching profession. Only single women accepting life in celibate can ask teaching profession.)

World War IInd interrupted university and high school education, exclusion of persons with disabilities was one of the principle of the population selection. ***After 1945/6*** (after this very sad European period) the attention was turn again to persons with disabilities (as the reaction on war experience). A special branch of study for professionals interested in the education of persons disability – called "defectology". (The term survived up to this days in some countries.) Minimum attention to P.E. was paid generally. P.E. teachers had to pass a special exam following a short course. The system of education was strictly unified not only in determined country but completely in the framework of the Soviet block.

In 70 ies the term "defectology" was changed with more polite, clear and extend term – "special education". Quite long extensive as well as intensive period of this study started in early 79ies in all CE countries. This universities programs were included in a lot of university programs at pedagogical faculties (Teacher´s Training Colleges). University students education lasted usually 4-5 years at Master´s level. Study program was usually oriented either on the teaching or educating stream. Basic "special education" disciplines were included in the program: psychopedy, tyflopedy, surdopedy, somatopedy, etopedy. P.E. disciplines were involved only with 2lessons per week but in the second phase of Master program students could choose optional programs in P.E., Music, Arts or Polytechnics/Crafts. In spite of the fact the prevalence of study program was "academic" the program was quite O.K. for elementary school level graduates but somewhat insufficient for future professionals at secondary or higher level. Teacher´s stream was focused on compulsory P.E. lessons in special schools, stream for educators was focused on physical activities in residential homes.

Education – in general – was strictly separated, it means at the level of universities, at the level of primary/secondary schools. Competitive sports was developed parallel to the development of education (the ***UNESCO Charter for 80ies*** was quite important for disability sports development). National sports competitions of special schools were supported by government, started in 60ies and some of the survived up to this years and became very traditional. Unfortunately lack of international contacts in this period seemed to inhibit the sports development

Recent situation is CE university study is influenced by national education law/legislation, national tradition and activity in cooperation on the field of international contacts. Lisboa and Bologna or other European agreements acceptance influenced the process of PE and APA development and its timing. Special education usually remains as a part of university study in a lot of Pedagogical faculties in CE universities. The term "defectology" is now perceived as "old fashioned", vulgar, non-accepted.

Adapted Physical Activity started as the completely innovated study and professional branch of Humann Movement Sciencies (or Sports Sciencies or Kinanthropology). The term APA started in the USA in 50ies (last century) and moved from Scandinavian countries (mainly Norway) to CE context. Now – the term "Adapted Physical Activity" is fully accepted in European University study context (including national languages translation) and other terminology is not accepted.

CE countries were influenced with very well developed "corrective physical education" or special educated based on Ling health exercise system and very good system of rehabilitation and physiotherapy. It means APA university study programs are developed in the ***three main streams:***

- rehabilitation basis with additional sports and pedagogy modul (Belgium, Poland),
- P.E. basis with modules special education and APA didactics (Czech Republic),
- "sandwich" system – composing special study modules, one of them APA.

APA study program at Faculty of Physical Culture, Palacky University in Olomouc seems to be an example of successful European study program related to vertical structured program (level Bc., Mgr., Ph.D) and horizontal modul approach (pedagogy/psychology modul, P.E. modul, special education modul, APA didactic modul). Olomouc university program composes the part of all European APA networks. Students with disability (but with so called sports mobility) are accepted in adapted university study and they are successful in their profession. All APA graduates are accepted as P.E. teacher in general\schools, special schools and asking in integrative school P.E. lessons. They are employed in residential homes and centres for persons with disability, at leading positions in municipalities and communal policy as well as instructors, coaches for sports/disability federations. Study program was developed due to experience with P.E. and special education experience at academic level and field experience in 70.-80. last century, and frequent and intensive international cooperation with IFAPA (International Federation of Adapted Physical Activities), EARAPA (European Association for Research in Adapted Physical Activities) and EMDAPA (European Master Degree in Adapted Physical Activities).

CE process in the improvement of APA has been influenced with ***CEEPUS*** (Central European Exchange project of University Study), APA network lasted from 1997 up to this days, coordinated by Olomouc university. All partners offers the best 1 months credit program for students from other CE countries. Teachers mobility for improving the international study program is very available as well. Recent countries and universities:

Czech Republic: Olomouc, Brno, České Budějovice,
Slovak Republic: Banská Bystrica, Bratislava
Poland: Poznaň, Wroclaw
Slovenia: Ljubljana, Koper
Croatia: Zagreb
Bulgaria: Sofia
Serbia-Montenegro: Niš

Recent CEEPUS (after EU inclusion new countries) is dramatically changed for Socrates/Erasmus design, it means – obligatory credit system, one semester (minimum three months study), joint diploma or certificate study. Official language is English, other – Slavonic languages for general communication and general living purpose are acceptable.

CE students can go to pass ***DEU APA study*** program (leading and co-ordinating university is Paris-Nantereé X) is oriented more for "field purpose", available either for Bc. or MA level students with APA experience. Study program lasts either one semester or one year which depends on agreement between home and host university on the Socrates/ Erasmus network. Students study first period (6 weeks) in Paris and next semester either at bargain European University or at home university. First language is French, English is only additional language. Recent situation is changed – for more e-learning ongoing study after 6 week direct teaching in Paris.

Traditional ***EMDAPA*** study (lasting since 1989) is opened to CE countries students in case of Socrates bilateral agreement between University in Leuven (Belgium) and home university. One semester or one year study is oriented on "academic" and research Master level, only Bc. PE/Sports graduates (or relevant study program) with good English communicative skills can be included in this program. Mobility is realized on principle:

1st phase – APA study at home university (preparation for international study), 2nd and 3rd phase in Leuven (academic study), 4th phase field practice at other European selected university, 5th phase – Ma thesis at selected university.

EMDAPA remains but the traditional program is innovated with ***ERASMUS MUNDUS APA*** program. Program is typically oriented on students from NON-EU countries.

Challenges of E-M APA program are, e.g.:

- prepare citizens for global society,
- ensure world-wide recognition of European universities as centre of excellence,
- contribute to cultural understanding and improve duality of higher education in Europe.

Erasmus-Mundus APA started this year in August with the first world group. Recent consortium of universities is composed from:

- University in Leuven (coordinator)
- and participants:
  - University in Limerick,
  - University in Olomouc,
  - University in Oslo.

Representatives of the third countries are: Queensland University, Virginia University and Stellenbosch University.

Chances for CE student? To pass home APA program on the Bc level (or CEEPUS in case no relevant study program at home university). To insure Socrates/Erasmus agreements within European universities. To achieve English language skills. To be enthusiastic in academic study and practice in APA. To be brave and fill all admission forms and go to abroad.

The picture of chances for CE students, teachers, universities cannot be completed in case of missing international chances for ***Joint Action or research programs***. European program THENAPA – Thematic network for APA (specially for integration and inclusion, 2000-2004) was finished with recommendation of available European APA curricula for Bc-MA level in the domain of rehabilitation, recreology, PE and competitive sport. Results are published and teaching CD-room can dramatically influenced education and formation of APA graduates in CE. Recent situation in APA Joint Action is – unfortunately full for next two or three years. Joint Action programs are a little on the border between development and typical research. Research part is typically analytic/synthetic and comparative, developmental part is program formation, realization and evaluation. Ongoing THENAPA program (Joint Action) is divided in three main arms:

- paralympic education,
- aging and disability,
- APA inclusion, sport and employment.

International APA research is the challenge standing in front of the CE countries. Long education and research tradition as well as experience in the PE and sports framework seems to be very well basis for future co-operation in 7 EU research programs.

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SWIMMING TOWARDS INDEPENDENCE

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Abstract

Swimming is widely recognised as an activity of particular importance for people with special needs because it could ensure them independence and freedom in movement. Swimming is an integral part of physical education in Slovenian National Curriculum which gives the right to all children, regardless of their physical or mental abilities, to have an opportunity to learn and improve their swimming skills. The number of physical education teachers involved in Halliwick swimming programme for people with special needs does not exceed five percent of those who have attended and completed these specialised swimming courses. Physical education teachers are professionals with high potential of sport and swimming knowledge and therefore they seem to be an ideal solution for teaching swimming to people with special needs. Some concerns were expressed which, in our opinion, cause obstacles preventing a more significant involvement of physical education teachers in swimming, especially for those children in the integrated school classes.

Key words: *swimming, people with special needs, integration, physical education teacher*

Introduction

Sport for the people with special needs is nowadays a fact and a recognised part of any theory of sport participation. Such sport activities are either followed with a mixture of enthusiasm, empathy, and admiration, or do not attract any significant interest. Most of the people involved in such sports agree with its excitement and demands. This is, in our point of view, a turbulent sporting area where different interests and expectations take place. Besides persons with special needs themselves others who have direct or indirect influence in this specific area of sport involvement are in some situations their parents, then local community leaders and the school authorities and teaching staff. Physical education teachers, despite their specialised knowledge, often find themselves with insufficient experience for this kind of work and are therefore unable to fulfil the highest expectations, various requests, as well as the wishes and legal obligations towards school children and youth with whom we are involved. Modern society has forced ideas of freedom and democracy where tolerance and acceptance of such minority groups have been considered. Governmental documents concerning children and youth with special needs increased care for integration processes in schools. In these processes physical education plays a significant role. Sport related activities indicate in many cases their benefits to enrich quality of life of the participants. Swimming is widely recognised as an activity of particular importance and is among many sporting activities the one which could ensure independence and freedom in movement for persons with special needs. Teaching protocol and safety regulations should be considered when persons with special needs take part in sports activities, particularly when swimming is in question. Benefits of independence in the water for such persons go far beyond the physical practice and technical elements. In this paper we will take a closer look into declared rights for people with special needs according to education and sport. We will also focus on the role of physical education teachers and others involved in swimming for children with special needs, and the contribution of physical education and swimming to the integration of these children into regular school classes.

Level of declared rights or level of promises

The higher the level of an issued document declaring the rights of the persons with special needs the better and more promising it sounds. The Council of Europe document R86 (18) considers that in the member states nearly one person in every ten suffers from a variety of impairment, disability or handicap. The document underlines that every individual shall have the right to participate in sport; therefore participation in sport should be encouraged among people with special needs. Sport is recognised as a vital factor in rehabilitation and integration, and therefore sports activities should be intensified and their further development encouraged by appropriate public relations methods, the training of staff, the planning of sport centres and the promotion of associations. In accordance with such ethical principles and the respect of each human being, the promotion and development of sport and physical recreation for all people with special needs is an important means of improving the quality of their life as well as contributing to their rehabilitation and integration into society. European Charter on Sport for All: Disabled Persons includes recommendations that are necessary to take steps to ensure that all relevant public authorities and private organisations are aware of the sporting and recreational wants and needs, including education, of all disabled persons, not only those who are physically or sensory disabled and mentally handicapped, but also those who suffer from an organic or psychosomatic disorder. An important recommendation is to

encourage educational authorities to take sufficient steps to provide adequate and real physical education for disabled children in schools, and to train to the required level those who may teach these children also to encourage the provision of training of disabled and able bodied instructors to work with recognised competent sport organisations. To ensure that when sports policy is being decided the interests and views of disabled persons are given due consideration. Disabled children face considerable problems at home, in the school and in the community. The potential role of sport and physical education in ameliorating this situation needs researching, documenting and publishing.

In Europe one child in ten now requires special education. Physical education teachers should therefore receive some specialised training in educating this substantial proportion of the population. If the principle of gradual integration of disabled persons is accepted, and if a coherent policy is applied, all teachers, irrespective of their specialisation or the level at which they are qualified, should receive at least a basic training in teaching persons with handicaps and impairments and in the educational principles applicable to such cases. The significant role of adapted physical activities in education, re-education and leisure activities should be recognised. Although initially some physical activity teachers may favour specific objectives which are in themselves therapeutic or educational, they should also be conscious of the need to move towards autonomy for the disabled person, who is a full member of society and can demand a form of physical activity adapted to his motivations. However, in practice, the promotion and earliest applications of physical activities for disabled persons were often the work of people with a fund of goodwill but little knowledge of physical activities. The educational and re-educational aspects were thus usually ignored. Who is to blame ? It is, however, important to underline the growing needs for qualified physical activity leaders so that they can adapt the activities to a particular disability group. These leaders should also have an initial training leading to a professional qualification. The comprehensive training of any future teacher of physical education should include a sound knowledge of the adaptation of physical activities-like educational methods and techniques of adaptations. Furthermore, teacher training cannot be limited to a knowledge of children only; a teacher should be capable of taking activities for disabled or health impaired adults as well.

The number of people with special needs is growing despite all medical progress in recent years. To be part of this group one should have their physical or other vital abilities decreased for thirty percent or more. Ageing population with some typical syndromes could be added to those with cerebral palsy, spinal injuries, amputations, multiple sclerosis, etc. The need to obtain or maintain ability to walk, to be independent, is a big issue among those involved in special needs issues. To keep body strong, flexible, maintain cardiovascular and respiratory systems on optimal level are important key factors in physical fitness of a person, regardless of his or her abilities. Sport activities could fulfil such needs if they are properly conducted. Our faculties of sport, education or rehabilitation, prepare future physical education teachers, coaches, elementary school teachers, special educators, etc. A wide range of life segments are covered with sport related activities, from pre-school children to seniors. Adaptation is a need in sport application for all, children and seniors with special needs are just part of this same population. New challenges are created within new orientation to promote integration of children with special needs into regular schools. Physical education standards in regular schools, along with teachers, should lead into a new era where all children attend physical education classes.

Benefits of sport participation for persons with special needs are recognised by theory and practice. We believe that physical education teachers could be the ambassadors for promoting previously mentioned activities on different levels, from physical education, recreation, top competitive sport to rehabilitation related sport activities. We should be aware that persons with special needs are integrated into cited segments of sport participation and therefore belong to the same sport family as anybody else. Only misunderstanding of the complexity of the whole situation leads us to accept that people with special needs are isolated in reserved segment of sport just for them only. Creation of special segment of sport for the disabled on one hand and sport for others on the other hand, could separate persons with special needs into dangerous isolation situations. Nowadays integration efforts in schools open their doors to an increasing number of children with special needs, concerning physical disability, who can follow the regular school programme. Physical education is perhaps the subject in school curriculum that asks for most adaptations and specific knowledge from its teachers. Gaining the benefits from sport is possible only through active participation. Those positive effects of integration are also on the parents' expectation list when their child is in the regular school programme. Physical education with proper adaptations and prepared teachers could play a very important role in the integration process which is among society's priorities in education

Physical education as a part of The National Curriculum is the only subject which is concerned exclusively with the "physical" child. Consequently it is extremely important that all children, regardless of their physical or mental abilities, are given a broad and balanced physical education curriculum. The correct approach of physical education teacher will minimise the physical inactivity of young people. The most important experience of any physical education programme is that it gives children with various abilities exercises which are important and essential for their physical and mental growth, and which influence the development of the healthy functions of all the body systems. Priorities in the programmes of the study of physical education need not only help children exercise, but also help them build up positive attitudes to exercise as well. Therefore teachers should make physical education lessons enjoyable and satisfying. In this way children could develop self-esteem and adopt the sport as habit for life. Unquestionably, swimming is a crucial survival skill for all children and an essential prerequisite for participation in a wide range of activities in and around the water.

Swimming has also a very special meaning to help in the mobility problems of many children with special needs. It leads toward independent movement in water environment. Schools must be cognisant of the fact that teaching swimming is a statutory requirement in our educational system.

Intervention level or level of chances for physical education teacher

Swimming is recognised as an important life skill for all of us. For many, swimming is not just manoeuvring oneself through the water, but also about being in water and with water. We can derive benefits from its properties of buoyancy, fluidity, and density; the properties that allow us to float, to flow, and to swim. Fighting with the water is not a recommended perspective. Co-operation with it, exploring our relationship to it, understanding and valuing its qualities, can be the basis of a far more productive approach, (Shaw, D'Angour, 1996). Halliwick swimming concept for people with special needs was developed by James McMillan in early fifties and is based on scientific principles of hydrostatics, hydrodynamics and body mechanics. Its aims are to teach water happiness, pool safety and to encourage people with special needs to use the water. No flotation or artificial buoyancy aids are used in teaching process. It is also not a static set of principles; it grows and progresses as it members develop their own skills and share their knowledge and discoveries. In Slovenia first official Halliwick swimming seminar, led by one of the pioneers of this concept dr. Joan Martin from London, was organised in 1996. The ten point programme is the basis of the Halliwick swimming concept, (Association of Swimming Therapy, 1992). It follows the logical pattern, therefore all must be mastered to produce a swimmer who is truly competent in water. The ten point programme consists of 1. Mental Adjustment, 2. Disengagement, 3. Transversal Rotation, 4. Sagittal Rotation, 5. Longitudinal Rotation, 6. Combined Rotation, 7. Upthrust, 8. Balance in stillness, 9. Turbolent Gliding and 10. Elementary Propulsion and Basic Swimming Stroke. Through the Ten Points we can see a progress of development through mental adjustment, balance control and movement which lead to personal independence in the water. These three concepts, Mental Adjustment, Balance Control and Movement, are the essential component of motor learning. Swimmers are taught on a one-to-one ratio of instructor to swimmer until the time when complete independence is achieved. The swimmer instructor pair becomes a unit within a group activity, so that the swimmer gains the advantages of social interaction with his peers, whilst at the same time enjoying the unobtrusive but constant attention of an individual instructor. Through the medium of games appropriate to age and ability, groups are made aware of the properties and behaviour of water and of how to control their own imbalance problems. The giving of correct support by the instructor enables the swimmer to experience mobility possibly not experienced on land. After the initial mental adjustments to water are made and balance control principles are learned, the swimmers reach the stage where they are prepared to disengage from instructor contact. Now, perhaps for the first time in their lives, they can experience complete independence of movement. Swimmers are taught how to maintain a safe breathing position, how to regain such a position from any other position, and how to control exhalation whenever the face is immersed in water. They are made familiar with all conceivable body rotations and learn how to initiate, control, and arrest such rotations at will. The powers of upthrust, turbulence, and impedence to movement are studied, together with metacentric effects. The result is a secure swimmer whose confidence is based upon sound knowledge of water and the ability to control his or her own movements in water.

Halliwick swimming concept itself, although highly recommended and with rich international tradition, could not be a guarantee for success. The leaders of swimming classes play the role of vital importance in this process. Years of experiences and data base in Halliwick Slovenia Swimming Association (established in 1996) show us that individuals who take part in the official Halliwick courses come mainly from the professions of physiotherapy, special education and elementary school education. The number of physical education teachers involved in Halliwick swimming does not exceed five percent of the total who have attended and completed the courses to date. Physical education teachers are among those professions with the highest potential of sport and swimming knowledge; therefore the low number in participation in teaching swimming to children and adults with special needs is far beyond our expectations.

Parents of children with special needs are among those who attended the Halliwick courses and after completing them took an active part in swimming programmes. Parent participation in swimming has proved a very productive contribution, especially when their children are pre-schoolers. It is known that many of children with or without special needs experienced their first swimming skills with their parents. However, many parents with children with special needs rarely had an opportunity to be with them in the water, or even teach them swimming skills. Although parents may not feel qualified to teach some swimming skills, they can create a supportive environment in which children can practice and learn. Spending time with their child developing swimming skills can be a rewarding experience for both, parents and children. Despite same good examples, it is known that parents are not the best teachers in sport and in swimming, particularly. Even parents who have been athletes or are still active in competitive sports may know the skills but not understand the ways children with special needs best learn skills. Far too often adults expect children to learn from their own perspective.

Special education teachers, elementary school teachers, and kindergarten teachers are among those professionally involved in educational processes where movement and physical education are included to some extend. Physiotherapists and occupation therapists covers various aspects of therapeutic work where movement applications are vital too. The fore

mentioned teachers and therapists are forming the majority in the Halliwick swimming movement in our country. We are fully aware of advantages and disadvantages of such teaching structure. The strong side of those swimming instructors are in the detailed knowledge of the specifics of persons with special needs, while the mastering of the swimming skills does indicate the lower standards (Vute, 1999). Balance between different professional groups can be reached with supplementary education. In Halliwick Slovenia Swimming Association we do have positive experiences with individuals from either professional group involved in teaching swimming. Our effort to attract more physical education teachers to be involved in swimming for the persons with special needs will not reduce the importance of the positive personal approach of the leader.

Various situations and concerns influence the role of physical education teachers and their effects on the wide area of sport for the people with special needs. Attitudes towards people with special needs and their sport participation are important factors in the teaching processes which include swimming. Study "Differences Between Male and Female Students of Four Higher Education Institutions in Their Attitude Towards the Sport for the Disabled" (Ažman, Berčič, 1997) assessed on sample of 287 male and female students of the Faculty of Sport, Faculty of Education, Faculty of Medicine and Higher School of Health from Ljubljana, indicate that the students are generally in favour of the sport for the disabled, that women's attitudes are more positive than men's and that the lowest level of approval was found with the entire sample of the students from the Faculty of Sport. Karaskova, 1998, recommends to the teachers of physical education at special schools to monitor the development and innovation of sport disciplines, to limit the dominance in controlling the pupils' activities and to eliminate the preference in chosen pupils. Through the university study programmes the future physical education teachers should have a chance to become familiar with society efforts for inclusion of children with special needs into regular schools, with the ways of adapting sporting skills, how to identify strategies for inclusion children with movement difficulties, how to identify different types of special needs and how these affect children's ability to respond in physical education lessons, how to provide activities and prepare individual programmes for children with special needs, how to ensure safe environment for practice, etc. Adapted physical education means physical activities modified or changed to meet the unique needs of students with disabilities. Physical educators also need to maintain permanent communication with other professionals about students with special needs. Multidisciplinary team consists of parents, physiotherapist, occupational therapist, a school psychologist, a special education teacher, a student with special needs when it is appropriate and a medical doctor, could provide those types of information and ideas which help physical education teacher to eliminate the potential risks and assure safe and successful participation of children with special needs in swimming lessons. It is essential that records be kept on the poolside to keep track of any problems which swimmers with special needs might have, and the progress they make. No matter how experienced a teacher may be, there is always more to learn about teaching swimming. The most important attributes are a genuine desire to support the persons with special needs and a firm belief in the value of activity in water. Halliwick swimming method itself is used by professionals as well as volunteers. It is important for the physical education teacher to understand the nature of the volunteer to use effectively that person to meet programme goals. The use of volunteers in the swimming programme can greatly enhance the opportunities that can be given to children with special needs. Training is also an essential part of the swimming programme, otherwise neither the swimmers nor the instructors will make any progress. The natural progression is from club to regional competition and eventually to national selection. This attractive programme of swimming may get attention from those physical education teachers who have preferences in competitive sport. A top disabled swimmer requires a competent coach to train and develop his swimming ability to perfection. Paralympic games are the good example that such effort has solid ground. Nevertheless Paralympic games are one of world's biggest sporting events with proper media attention. On the other hand, helping the children to fill confident in the water is crucial if they are to feel happy in the water. Physical education teachers play an important role in this procedure because of their knowledge of swimming skills which could take children through the sensitive stages of introducing them to the swimming and water activities.

Independence level or swimming within the mainstream

A major issue in mainstream school provision for children with special needs is the extent to which these children are actually included in such schools as opposed to being educated in special schools and institutions. Relevant documents calls to adopt the principles of inclusive education, enrolling all children in regular schools unless there are compelling reasons for doing otherwise. However, special schools and units will continue to be needed in order to provide for children whose special needs cannot be met in mainstream schools (Stakes, Hornby, 2000). As a result of the increased emphasis on the inclusion of children with special educational needs in mainstream schools the number of these children is increasing as are the severity and variety of such needs. Children with a far wider range of learning difficulties and a variety of medical conditions, as well as sensory difficulties and physical disabilities, are now in the mainstream classes. The implication of this is that mainstream school teachers need to expand their knowledge and skills with regard to the trends and needs nowadays. The process of including children with special needs in general physical education classes and in swimming has become a reality. Teachers of physical education have been obligated to include those children into regular classes with the best intention rather than the best information about the integration. Without knowledge of the legal requirements

and experiences in practical applications physical education teachers can easily stay away from the classroom inclusion of children with special needs. Communication with other professionals helps to ensure safe realisation of the swimming programme. Teachers are responsible for the swimmer's safety, but should also continually aim to make children aware of safety principles for themselves. Swimming is one of the activities in physical education that is potentially hazardous unless due care and attention is paid to their planning, organisation and performance. In swimming classes it is important to ensure good discipline at all times, not allow children to enter the water until permission is given, to be acquainted with emergency requirements and be aware of each individual swimmer's ability.

It is important that future physical education teachers will be prepared to include individuals with disabilities in general physical education settings. Inclusion means that the general physical education teacher will make the necessary changes in didactics, pedagogy, and curriculum to assure that all students will achieve their physical education goals and feel safe, happy, comfortable, and successful in the physical education setting (Kudlaček, Valkova, 2002).

The importance of swimming skills cannot be overlooked at any age. Swimming and the ability to participate in enjoyable water activities are imperative for the quality of life at the school age level and far beyond. We believe that a properly educated and motivated physical education teacher is the best guarantee that their students with special needs reach an independent level through mastering the swimming skills. Independence and confidence gained in the water could extend into other areas of school life and life in general. Therefore we recommend physical education teachers to attend at least a foundation course on the Halliwick swimming method. Supplement of knowledge from the complex area of teaching people with special needs how to swim will help him and them to make significant progress in an enjoyable, pleasant and secure way. Competent instructors need to know the basic principles and philosophy of the proposed swimming concept: the use of games and groups, a one-to-one ratio, the importance of communication and the absence of artificial flotation aids, etc. The courses themselves are conducted only by accredited Halliwick lecturers. The foundation course lasts four days and consists of Module A and Module B. Module A includes topics regarding an introduction to the practice and theory of the Halliwick method, an outline of the Ten Point Programme, the philosophy of the method, the effects of water, and swimming pool safety. During the four, one hour pool sessions, we include entries and exits, method of supporting the swimmer and activities based on the Ten Point Programme. In Module B the course develops the topics introduced in Module A and covers the teaching of the Halliwick method. Theory and practical sessions include teaching techniques, programme planning, group work, the use of the games and music, proficiency tests and competition (Halliwick Association of Swimming Therapy, 2002). With the presented method we could combine the idea of swimming well and enjoy the water with swimming to achieve the results in competing with itself or with others. It is also a place for a creative approach to the water which is part of a creative approach to life.

Conclusions

This paper provides some information, practical tips and suggestions for physical education teachers and their involvement in swimming for persons with special needs. We hope that by being presented as an idea, it will bridge the gap between the physical education teacher and children with special needs, and help teachers to understand better the needs and expectations of these children in the swimming process. The presenting swimming programme is based on Halliwick swimming concept, designed primarily for persons with various special needs. Appropriate swimming lessons should be fully accessible to all children and tailored to meet their needs in school and elsewhere. We do expect that physical education teachers and students of this profession will take advantage of the statutory order of including children with special needs into regular schools and become protagonists in introducing swimming skills to those children. Swimming is the way to independence for which we need to fight for.

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In memory of Professor Miloš Mraković and Professor Konstantin Momirović. I was privileged that they were my teachers in kinesiology.

KAYAK TRAINING IN PARAPLEGICS – EFFECTS ON ENDURANCE CAPACITY AND BALANCE

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Abstract

The purpose was to investigate open sea kayaking as a training regimen for persons with spinal cord injury (SCI). Twelve volunteers (9 M and 3 F; 40 ± 11 years) participated. Injury levels ranged from T2-T11 and post-injury time 4-32 years. During 8 weeks 20 sessions of 60 min supervised progressive kayak training were performed. Maximal aerobic capacity (VO_2peak) was measured on a kayak ergometer. 3D trunk movements and centre of pressure displacement were analysed in response to balance perturbations caused by arm movements in 6 of the subjects. VO_2peak significantly increased (4%) with training, whereas balance parameters were unaffected. The results indicate that kayak training is beneficial for persons with SCI, improving their aerobic capacity and quality of life, whereas perceived gains in balance could not be verified by the tests applied.

Key words: *spinal cord injury, maximal oxygen uptake, balance control, quality of life*

Introduction

Spinal cord injury results in impaired motor and sensory function below the injury level. Due to muscle paralysis many persons with SCI remain wheelchair-dependent even after rehabilitation. Limited mobility can lead to a sedentary life-style and increased risk for cardiovascular and respiratory diseases (Davies & McColl, 2002). Therefore, it is essential to find effective, and attractive, physical activities that can be continued over a life span.

Kayaking is a leisure activity that is accessible for individuals with SCI and appears to have a potential to develop various desirable physical capacities, such as endurance and balance. In able-bodied persons kayaking has been shown to engage most of the upper body musculature and being able to provoke high levels of aerobic power when paddling both on water and kayak ergometer (cf. Shephard, 1987). Furthermore, the balance control system is challenged, since maintaining the sitting posture requires continuous compensation for perturbations to the upper body by motion of the kayak and paddle in the water, as well as of the arms and paddle in the air. Additionally, kayaking should provide smooth movements, different from propelling a wheelchair, and thus decrease the otherwise high risk for shoulder overload problems.

The purpose of this study was to investigate the effects of progressive open sea kayak training on aerobic power, balance control, and quality of life in post-rehabilitation persons with thoracic spinal cord injury.

Methods

Subjects. Twelve volunteers with spinal cord injury (9 M and 3 F; 40 ± 11 years, 1.77 ± 0.08 m, 80.3 ± 11.4 kg) participated in the study and in the tests of maximal oxygen uptake (Table 1). Balance control was studied in a sub-sample of 6 persons (5 M and 1 F; 37 ± 9 years, 1.77 ± 0.10 m, 81.1 ± 13.0 kg) marked with * in Table 1.

All subjects were given both written and oral information before the study started. They were free to withdraw at any point.

The Ethical Committee of the Karolinska Institutet approved the study and all subjects gave their consent to participate.

Training. The training procedure and equipment used have been described in detail previously (Grigorenko et al. 2004). Briefly, after sessions with familiarization to the paddling technique, subjects were kayaking 2-3 times a week, in small groups under supervision, during an 8-week training period. Total number of sessions was 19-23. Each session lasted about 60 min and included a warm up, interval or distance training, and a tapering off at the end. Care was taken to progressively increase intensity and distance over the training period. Also gradual increase of the demands for independency and balance was provided in that subjects could proceed from a stable to a more advanced double kayak, and further to a single kayak with or without inflatable pontoons.

Testing. Before and after the training period, maximal oxygen uptake (VO_2peak) and heart rate (HR) were measured during paddling on a kayak ergometer (Dansprint, Denmark) using an ergo-spirometry system (AMIS 2001, Innovision A/S, Denmark). Before the test, the subjects performed 20 min of low-intensity paddling on the ergometer. During the

Table 1. Description of the subjects with spinal cord injury, in accordance with International Standards for Neurological and Functional Classification of Spinal Cord Injury (ASIA) (cf. Grigorenko et al. 2004). Highest scores represent least impairment and "A" most impairment, respectively.

Subject	Age	Years post-injury	Gender	Neurologic lesion level	Sensory pin prick score (max 112)	Sensory light touch score (max 112)	Motor score (max 100)	Impair-ment scale
I	29	13	M	T 2	112	112	50	B
II	22*	5	M	T 3	42	42	50	A
III	39	19	M	T 4	48	48	50	A
IV	38	17	F	T 4	78	78	50	B
V	38	22	M	T 5	48	48	50	A
VI	57	4	M	T 6	52	52	50	A
VII	35*	15	M	T 6	52	66	50	B
VIII	40*	17	M	T 9	51	52	50	A
IX	47*	27	F	T 9	90	88	52	B
X	47	23	F	T 9	88	90	71	C
XI	46*	32	M	T 10	73	72	50	A
XII	33*	13	M	T 11	78	83	50	B

test, the load was increased with 5 W every minute until exhaustion. The VO_2peak was calculated as the average of the three highest 10-s consecutive VO_2 measurement periods.

During the balance tests, the subjects were seated in a special chair (Slimskate, Sweden; also used in the kayaks) mounted onto an AMTI force platform (Advanced Medical Technology Inc., USA) (Grigorenko et al., 2004), which provided the location of the centre of pressure (CoP), i.e. the point of application of the resultant ground reaction force vector. All data were collected and digitised at a sampling rate of 100 Hz using a 1401 Plus device (Cambridge Electronics Design, UK).

Movement data were obtained using an optoelectronic system (Selspot, Selcom, Sweden) with three cameras placed at a distance of 2 m to the left, right and behind the subject. Three active markers (10x15 mm triads of infra-red light emitting diodes) were attached to the skin over the left elbow, the left shoulder and the spine at C7-level. Marker positions were sampled at 100 Hz and automatically converted to 3D-coordinates. Transformed data were digitally low-pass filtered using a zero-lag 4th order Butterworth filter at 20 Hz.

Subjects performed two different voluntary straight arm movements, bilateral shoulder flexion and unilateral horizontal shoulder abduction (both with a 90^{o} range of motion) causing perturbations either in the sagittal plane alone or in both the sagittal and frontal planes. The velocity of the movement was steered by a metronome giving an approximate average angular velocity of 180^{o}·s^{-1}. After 2-3 familiarization trials each movement was repeated 5 times, with a rest period of about 30 s between repetitions.

Questionnaire. A written questionnaire was distributed one year after the cessation of the training study to evaluate subjective experiences of short and long-term effects of the kayak training upon, e.g., general well-being, quality of life and ability to cope with everyday activities.

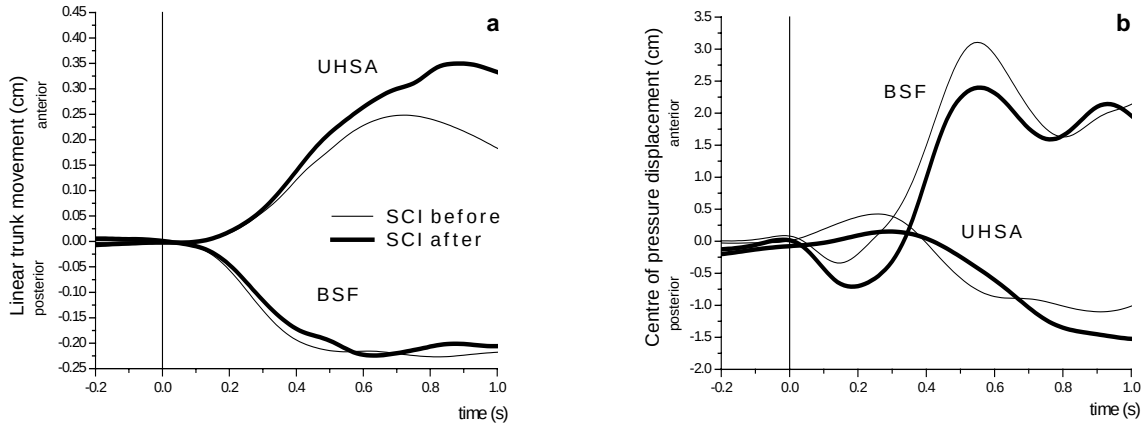

Figure 1. Group mean curves during bilateral shoulder flexion (BSF) and unilateral horizontal shoulder abduction (UHSA) for the group of persons with spinal cord injury (SCI) (n=6) before (thin line) and after (thick line) training are shown for (a) Linear trunk movement (cm) in the sagittal plane and (b) Centre of pressure (CoP) displacement (cm) in the sagittal plane. Zero time indicates onset of arm movement. The durations of the respective arm movements before and after training were: 0.71± 0.19 s and 0.74± 0.19 s for BSF and 0.71±0.28 s and 0.84±0.24 s for UHSA, respectively (ns).

Statistics. Shapiro-Wilk test was applied to determine normality in the distribution of data. Student's t-test was used to determine statistical significance of differences ($p<0.05$) between the values before and after training.

Results

Peak oxygen uptake increased significantly from 1.58 ± 0.39 l·min^{-1} (mean ± 1SD) before to 1.64 ± 0.42 l·min^{-1} after training. The highest heart rates noted during the maximal test were similar before and after training, mean values being 179 (range 150–199) and 181 beats/min (150–196), respectively.

The characteristics of the trunk movements and the displacement of the centre of pressure in response to the balance perturbations caused by two types of voluntary arm movements applied are illustrated in Fig. 1 for the sagittal plane. No significant differences were present with training, neither in peak amplitudes nor in timing of peak amplitudes.

No shoulder or other musculoskeletal problems were registered in the group during the observation period. A clear majority of the subjects reported positive experiences from the training, e.g. on general well-being, sitting stability and manual handling capacity. Being able to enjoy nature as well as the social benefits of the training were highly appreciated.

Discussion

The main finding of this study was that an 8-week period of open sea kayaking caused an improved aerobic capacity and positive effects on perceived well-being and quality of life. Somewhat unexpectedly, no training effects were noted on balance as evidenced by trunk movement and centre of pressure displacement in connection with a voluntary arm movement.

The improvement in aerobic capacity was relatively small but statistically significant. The observed mean increase of 4% is smaller than earlier reported from training studies on paraplegics using wheelchair exercise both for training and evaluation (e.g. Bougenot et al. 2003). Differences in training response could be due to many factors, e.g. different training and testing mode and intensity as well as different proficiencies on the part of the participants. The mean level of aerobic capacity for the participants in this study was similar to or somewhat lower than earlier reported for non-athletic paraplegics tested in wheelchair (cf. Davis, 1993).

The absence of a significant training effect on balance and trunk stability might be due to inadequate training stimulus, indiscriminate tests and/or limited trainability of the subjects. The kayak training appears to provide a serious challenge to balance control in sitting. This is based on the obvious instability of the kayak in the water and the perturbations caused by moving the paddle and the arms, resulting in asymmetric inertial forces and reaction forces from the water. Improvements in balance and stability were indicated by the gradually increased independence in choice of paddling conditions (Grigorenko et al., 2004) but were not transferable to the tests applied, neither in quiet sitting (Grigorenko et al., 2004), nor in the more dynamic perturbations presently applied. The pace of the arm movement was selected to result in a movement speed that was demanding, but manageable for all subjects. Perhaps still more challenging tasks have to be tested to reveal training effects. Also, balance synergies acquired over extended periods of time may generally be hard to modify with training. In this study, the persons with spinal cord injury had finished their rehabilitation long ago, which may have limited their trainability.

Although a year had passed between the training period and the questionnaire, and thus the answers are hampered by limited remembrance, a clear majority of the trainees expressed subjective feelings of improved life quality and balance control in every day activities directly after the kayak training period, some effects even remaining after a year. This, the absence of shoulder problems, and the improvement in aerobic capacity, make kayaking a recommendable activity for persons with spinal injury.

Acknowledgements

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ADAPTED PHYSICAL ACTIVITY IN PSYCHIATRIC CARE SETTINGS

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Abstract

Despite the acknowledged importance of physical activity in promoting psychological benefits, the inclusion of exercise programs in psychiatric care settings is not an applied standard. The aim of this paper is to present a study about the adapted physical activity services organized in psychiatric care setting of Padua district (North East of Italy). An interview with physical activity therapists, nurses, psychologists and psychiatrists, employed in different psychiatric health services was used for this scope. 16 psychiatric structures and 22 adapted physical activity groups, with a total of 150 patients involved, were studied. Three directions to improve the quality of the services were individuated: the amelioration of communication and exchange of information between the different mental health professionals; the concepts of psychiatrists about the effects of exercise and the preparation of adapted physical activity therapists.

Key words: *Exercise, Health Promotion, Mental Illness, Psychological benefits.*

Introduction

A great number of studies support the theme that psychological and physical benefits result from physical exercise. During the last years, different authors have shown that physical activity can reduce both state and trait anxiety. Epidemiological evidences have demonstrated that physical activity is associated with a decreased risk of developing clinically defined depression (Morgan, 1997). Even if with less scientific evidence, involvement in exercise or sport practice might promote self-esteem by enhancing body image, body satisfaction or body acceptance (for example through weight loss or improving muscle tone); enhancing perceived physical competence through improved abilities, prowess and fitness; enhancing sense of autonomy and personal control over the body, its appearance and functioning (Biddle, et al., 2001).

Besides these positive effects on the psychological dimension, the favourable use of physical activity in mental disease treatment must be sought in the comportment of psychiatric patients. These patients usually have a lower fitness level than a non-psychiatric population and an unhealthy lifestyle based on inadequate diet, over a substances abuse, especially tobacco (Brown, et al. 1999). They are sedentary people, who live relationships or group situations with difficulty, such it is difficult to undertake doing something for themselves.

The inclusion of exercise or physical activity, however, in structured rehabilitation programs or as components of care programs is not a nationally applied standard in Italy and in many other European countries. The aim of this paper is to explore the characteristics of adapted physical activity services organized in psychiatric care setting of Padua district (North East of Italy), by means of an interview with physical activity therapists, nurses, psychologists and psychiatrists, employed in the different psychiatric health services.

Methods

The data has been collected by means of a structured interview, addressed to the mental health professionals. The interview foresaw five sections: organizational and structural information, objectives and programmes, spaces and equipments, theoretical approaches, and the opinions of the different professional roles (therapists, nurses, psychologists and psychiatrists) about the utility of physical activity for psychiatric patients.

All over the Padua's territory 16 structures (public and private hospitals, communities and care services) and 22 adapted physical activities groups have been individuated. The patients who usually take part in these groups are more than 150. This number cannot be exact because of the variability of the recovery number of some structures. Each adapted physical activity group was typically composed by a mean of 10 patients, between 17 to over 70 years old (even if more than a half of them were between 30 to 50 years old).

A physical education specialist, often supported by the presence of one or two nurses (75% of the cases) conducted the activity. In more than the 80% of the cases the person responsible for the conduction of the group had a Physical Education Higher Institute (ISEF) degree, and very seldom had further academical specializations such as Psychology or Pedagogy degrees. They felt themselves nearer to a cognitive-behavioural approach in the 57% of the cases, and individuated problem solving and relaxing techniques as the most important therapeutic instrument. A large part of the

interview was directed at the therapist, to find out his way of leading the activity, the characteristic of his therapeutic approach and the objectives he wanted to reach.

The evaluation of how the therapists paid attention to different objectives of the activity has been detected by asking them to value, through a 1 (min. importance) to 5 (max. imp.) scale, each of the nine objective of the LOFOPT, (*Louvain Observation Scale for Objectives in Psychomotor Therapy*) (Van Coppenolle et al., 1989) (see table 1).

Table 1. Mean scores assigned to the nine objectives of LOFOPT by psychomotor therapists

Objectives in LOFOPT Scale	Mean	SD	Range
1. Emotional Relation	4.25	0.97	3-5
2. Verbal Communication	2.75	1.14	1-5
3. Self-Confidence	4.17	0.94	3-5
4. Activity	4.17	0.94	3-5
5. Focusing Attention on the Situation	3.58	1.31	2-5
6. Movement Control	3.17	0.58	2-4
7. Movement Expressivity	3.17	1.40	1-5
8. Social Regulation Ability	3.58	0.70	3-5
9. Relaxation	4.25	0.45	4-5

Table 2. The importance of different therapeutic factors in reaching the objectives of adapted physical activity

	Mean	SD	Range
1. Insight	3.25	1.54	1-5
2. More adequate relation learning	3.75	0.87	3-5
3. Accepting the others and being accepted	4.17	1.03	3-5
4. Mental contents expression	3.83	1.27	2-5
5. Observation mediated learning	3.17	1.0	2-5
6. Group's cohesion	3.92	1.24	1-5

Each of the nine objectives of LOFOPT reached a high value in the scale. The therapist paid attention to a wide range of activity features more than the only movement aspects and the motor skills. However, the self-confidence (the extent to which the patient moves independently from others, in a non anxious way) and the activity (the extent to which the patient actively participates in movement situations) are the two most important features which the therapists pay more attention to. On the other hand the verbal communication and the movement control (the extent to which the patient moves calmly, can control his/her body, and paces his/her efforts) were described as the lower value objectives.

The therapeutic factors, able to reach these objectives, were evaluated too, through another question based on a 1 to 5 value scale (see table 2).

The average of the received score point out that the answers with a higher score were correlated with group features like accepting the others for what they are and being accepted, or the group's harmony and feeling part of it.

Another section of the questionnaire was dedicated to highlight organization, environmental and "historical" characteristics of the different structures. The first time that the adapted physical activity was integrated in a therapeutic program for psychiatric patient in Padua's province goes back to 1984. The interest for this activity increased quickly: in 1995 the number of the structures became 6 and 18 in 2001 (see figure 1)

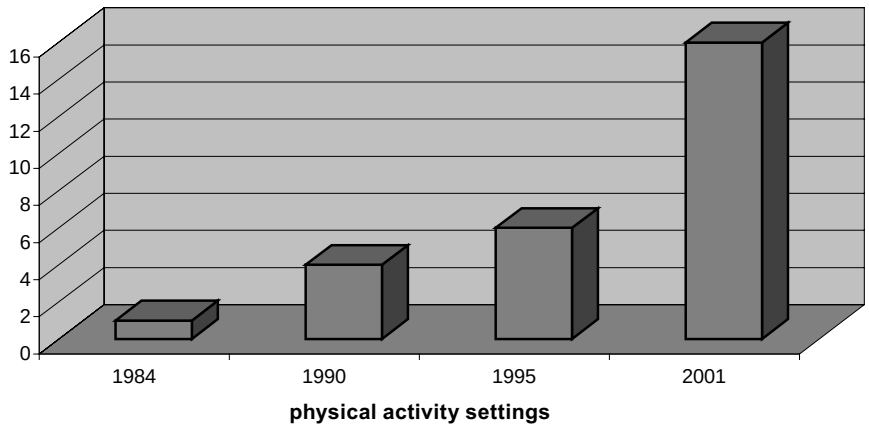

Figure 1. Increase in the number of physical activity settings in Padua's mental health services from 1984 to 2001

In spite of this remarkable interest for such activity, the weekly time dedicated to physical activity was still narrow: the greater number of the groups (over the 60%) met only once a week. The other groups met twice a week and in only one structure groups met more than twice. The average time for every adapted physical activity session was an hour. During a year there was a continuity practice in only one structure, in all the other cases there were an interruption all the summertime long: from June to October, sometime until November).

The rooms dedicated to the physical activity were a non specific room (not a gymnasium) in more than 40% of the cases: the dining room of the structure was a typical example. The presence of a specific room inside the structure, well supplied with apparatus, was quite a rare event. Furthermore, it is interesting to note that very few of the groups (only four) went in the open air to practice according to the weather.

All the nurses interviewed agreed about the importance of this activity to improve the ward ambience and the relationship between the patient themselves and with the nurses. They underlined that , when engaged in physical activity, patients spent less time in dangerous behaviour as smoking and drinking coffee.

The psychiatrists in charge of the therapeutic program answered about the selection method of the patient and the indication degree related to the different pathologies. The answers to this section showed that the different psychopathologies did not appear important features for the selection of the patient who can attend physical activity groups. The patients were selected especially examining their psycho-physical characteristic, and their motivation to take part in the group. The evaluation of indication to physical activity related to the psychopathological condition produced disagreement between the different psychiatrist and, in some cases, there was discordance between the highlights in scientific literature and the features ideas of psychiatrists about the effectiveness of physical activity for psychiatric patients. As regards to the utility of physical activity in the treatment of depression and anxiety disorder, in particular, a clear tendency between indication and contraindication did not emerge.

Figure 2 shows that even if 43% of the answers were about a high indication for physical activity in the depression disorder (value 4), another 43% of the answers were about a contraindication (value 1 and 2).

The opinions of psychiatrists about physical activity and anxiety disorder, panic attack disease and obsessive compulsive disorder were even more confused: the greater part of the answers were around the middle value, and the higher value (number 5) had a very small number of answer (see figure 3).

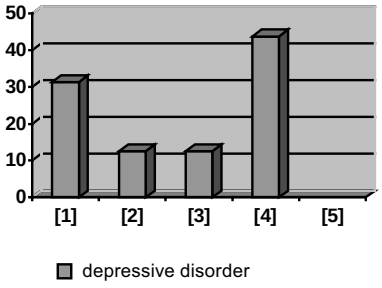

Figure 2. Indication of psychiatrist about physical activity for depressed patients, 1 not useful, 5 very useful.

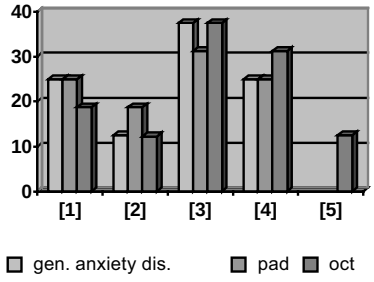

Figure 3. Indication of psychiatrist about physical activity in general anxiety disorder, panic attack disease (PAD) and obsessive compulsive disorder (OCD,) 1 not useful, 5 very useful.

Discussion

This research point out that in spite of physical activity positive effects, and despite the evident territorial expansion in the last years, a wide margin of improvement is possible.

First of all different modification is necessary in the organizational criteria, time, spaces and settings to exalt the potential positive effects of physical activity in the treatment of psychiatric disorders.

We have noted a lack of communication, in general about adapted physical activity groups, between the different professionals (psychiatrist, psychologists and nurses) that work in the same area; frequently they only have a superficial knowledge about the aims, the objectives and the organizational criteria of the physical activity programs proposed to the patients recovered in their structure.

Communication is an important problem also between the physical therapists and the medical equip in different services. This means that the therapists give up having important medical information about the patients they follow, and on the other side, the medical equip give up knowing important behavioural features of their patients.

Moreover the psychiatrists seem to have a generic therapeutic idea of the psychomotor therapy: the psychopathology is seldom a reason to let a patient take part in the groups or not, and this tendency is not in accordance with scientific literature.

A wide margin of improvement can be seen in the therapist professional training as well. It's only a short time that in Italy a specific postgraduate degree in Adapted Physical Activity exists. The institution of these professional courses would mean, in the near future, the identification of more specific professional figures and the definition of higher standard in the practice.

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THE PSYCHOMOTOR DIDACTIC – THE CORPORALITY BETWEEN PREVENTION AND LEARNING

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Abstract

The work exhibited here is the synthesis of a research done on an inter-institutional project denominated 'Schools in net' commissioned by the regional Office of Campania in the year 2004. The project was carried out by Prof. Sibilio and a group of his collaborators of the course 'Theory, techniques and didactics of motor activities for the development years'. The project is about the realisation of school workshops lead by sanitary operators that verify whether the psychomotor activities, 'educating through the body', represents a moment of expressing liberty for the students. This liberty, according to the protocol, should encourage the integration of the disabled and should avoid useless specialised visits to the local sanitary authorities for identifying the pathology.

Key words: *Inter-institutionality, Methodology, Learning, Emotionality, Prevention*

Introduction

The twentieth century has been characterised by a renewed interest in the interdisciplinary importance of the body in the learning mechanisms.

The study of movement in the educational environment has contributed to clarify the potential of corporality in didactical action. Defining the pedagogical profile of the person's education through the body and motor activities. Gradually an epistemological structure of the motor sciences has been built that has a preventive and educational character. In which the biological, biomechanical, sociological and psycho pedagogical could improve the didactics. This research has allowed to look at teaching as a complex process that needs a wide contribution of the sciences.

The research group with whom I am collaborating takes care of field work research. They try to give an original contribution to insert into the epistemological structure of the motor sciences from a preventive and educational prospective.

The work done has opened a new way of viewing education. The body and its abilities are now viewed to be the protagonist of the learning processes and of the preventive actions in schools.

The engagement of the research group is to build a connection among body, movement and didactic in the early childhood, through a plural prospective of the intellectual skills, evidencing the cognitive potential of corporal experience and the preventive potential of workshop didactic.

It is an original and courageous lecture of the real didactical ,educational, and methodological-preventive use of the psychomotor field, using a pedagogical key that does not ignore the complexity of current school models.

Corporality, prevention and learning, in this course, are included in the motor workshop that represents one of the main opportunity in teaching methodology.

The work contributes to make explicit a motility model that can be used in the ordinary didactic, improving the relation teacher-student and building learning environments that evaluate the human potentialities starting from the differences.

Methods

The union between Beings finalized to different "social interventions" today represents a necessary first step so that the "person's service" has no compartmental characteristic but a global and integrative view. You do not perceive the presence of a sum of single and aseptic operative operations, but the profitable interaction that builds less uniform and more adequate interventions to the real users needs.

The Beings united to the project " Schools- net" are *the Town Council of Naples*, *A.S.L. NA1*, the *Second University of Naples, CSA of Naples and the Inter Provincial Group of Work.*

They all signed a protocol where they engaged themselves to realize and to improve the whole course. The course in each school is realized through 16 workshops per year held from sanitary operators. The course is addressed to students (15) who have behavioural and learning difficulties and don't belong to the category of differently able.

To each class 2 teachers formed by the university will be present together with the conductors. They have the role of recording on specific cards the behaviours regarding motricity, non-verbal language and group dynamics.

The project "Schools in net" is a singular example of inter institutional model finalized to the secondary prevention of handicap and to the improving of formative offer of school service.

This intervention hopes that schools diminish their signalling to the local sanitary authorities, avoiding useless visits for those who would otherwise be categorised as 'non- recognisable' L.104/1992 .

The project must not be misinterpreted, it does not aspire to solve or eliminate all school problems. This projects hopes to be like a magnifying glass. Enabling teachers, all staff members and sanitary operators to have a more detailed vision of the real problems. It should allow specialists (psicomotorists and logopedist) to make a distinction between who has real difficulties (psychophysical, sensorial ect…) and those who have cognitive, relational and social difficulties.

After six years of experience, to verify whether the project has given positive results, with sixty schools taking part in the project. The case study methodology was used.

1. Twelve of the sixty schools were analysed
2. Each school was asked to fill in a questionnaire with multiple choices, open ended questions… This questionnaire permitted to the school to know the "story of the project", to examinee the evolution of the workshops development finalized to prevention and formation.
3. Structure of a scheme per group focus. The group to which the open questions were submitted was composed of:

   1) USR teacher; 2) observing teacher; 3) two basic teachers of different classes;4) psychomotorist; 5) logopedist;6) two parents. In vocal regards the attention is on 6 macro areas :a) knowledge of the project ;b)communication and coordination ;c) teachers and operators formation ;d)didactic relapse ;e) economical-financial aspects; f) verification and evaluation.
4. Structure of interviews to do in 12 schools. Interviews represented the system to recuperate informations to complete non sufficient data, manifested during focus group occasions. They have been singly carried out (subject by subject) and it has not always been necessary to realize them. They were composed of open and close questions, multiple choices etc, on the following topics:

   a) knowledge of the project; b) role in the project; c) motivations/expectations; d) rate of satisfaction; e) problematical cruces; f) suggestions.

Results

Through Focus groups we pointed out:

- a **high rate of satisfaction** and appreciation for the monitoring intervention that is considered necessary because it is a feedback instrument and of professional sharing for the constant project review;
- the diffuse recognition of the **child' s central position** and of his growing process;
- the awareness of the to the global development of the child and all **school, social sanitary components**.

For the results, taken from different remark instruments, see Figure 1

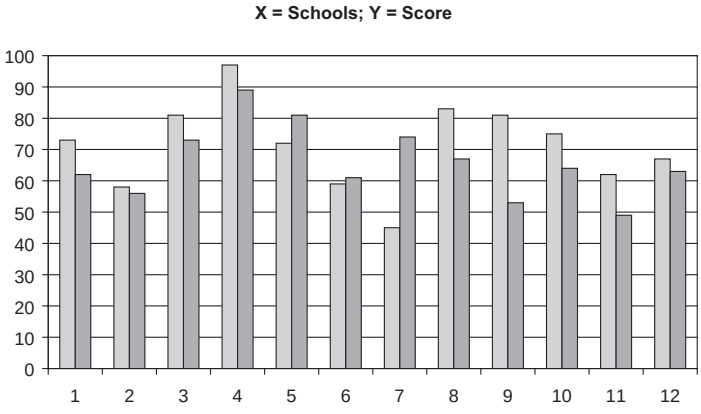

Figure 1. Average of results obtained in the 12 sample schools. Scoring system, from 0 to 100, is the result of an elaborate scheme of classification. See the Discussion below.

Discussion

Before considering the reflections coming from the work results, it is necessary to clarify some points that joint the course of the research.

First of all the work is characterized by an informative-cognitive approach and not by a diagnostical-evaluation one, to realize a qualitative and indicative reading about the project. The collection, assembly and data reading, made the research group interpretate the results in a reflective way, distinguishing strengths and problems. That was dictated from the fact that often some aspects have negative characteristics. The definition of strengths and problematical cruces should be read as an exemplification of a complex situation that can be used to improve the project itself.

Among the strengths we point out:

the **institutional character** of the project that, from one side it is a major opportunity to share more competences and resources. From the other side it creates a difficulty that sometimes can obstruct the correct realization of the project because of the stages that are not the same in different institutions and because of the lack of a real common code of action;

1. the **purposes** showed in the project that are surely accepted which are improving more and more in the ordinary didactic;
2. the **preventive action**, even if sometimes it is perceived as therapeutics;
3. the need of **increasing the number of workshops** and meetings to strengthen the attainment of the project's aim and to satisfy the users request;
4. the evident recognition of the child **wellness** thanks to the workshops;
5. the children **desire of participation** to workshops after the satisfaction manifested from involved class mates;
6. the parents **satisfaction.**

Among the problematical cruces we point out:

1. the **limited involvement and the fair responsible awareness** of the college of teachers;
2. the delimitate **communication and collation** between workshop components (observing teacher and animators) and class teachers (eventually the referent school teacher),with the consequent excess of protagonism of some even if it is aimed to a good project's success;
3. the **different approach** of primary school teachers compared to the one of the infancy school teachers, due to a different care for the ordinary didactic results;
4. the **restricted times** of working because often the activities start later;
5. the role of the **teacher** sometimes not linked to the function of " methodological glue" to develop the project;
6. the reduced investment in the **common formation** of involved project subjects with the risk of a non shared "view" and a non uniform "action";
7. the limited **assignment of funds.**

Considering the research results, the positive results of workshops activities underlined in final relations of the single adhering schools, it is important to evidence the validity of the projectile idea.

It is research group opinion tough, that to improve the project, it is necessary to lightly review the initial text which only in some parts answers the school and users requests. From the results of project' s cards and from the Focus group, it is possible to list the following ideas proposed from the actors project during working: 1) to improve the information and sharing levels ;2) to increase the numbers of workshops and meetings; 3) to provide a rotating schedule for observing teachers; 4) to give more comparison and exchange opportunity between workshops operators and class teachers; 5) to make video projections of the experiences as a way of social communication; 6) to provide the presence of specialists (psycho motorist and logopedist) in the schools; 7) to give to all students the possibility of participating to psychomotor workshops; 8) to consent to schools the use of adequate and equipped facilities; 9) to realize more debate meetings where compare and share with all the subjects involved in the project especially with parents intervention; 10) to create a verification group in the participating schools ;to institute a group of external examiners to avoid auto-references; 11) the providing of funds to integrate the existent ones or substitute the ones provided by the local Being.

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SPORT AS A MEANS TO THE INCLUSION OF PEOPLE WITH HEARING DISABILITY INTO AN INTEGRATED ENVIRONMENT/SOCIETY

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Abstract

In sport for people with disability it has come, in the last decade, at the international level, to a marked development. It is possible to consider Sport to be an ideal communication medium and, at the same time, also a social phenomenon. With changes in our society, the need for specialists with know-how (teachers, educators, coaches), who are active in sport specifically for people with hearing disability in that they lead physical activities, arises. The aim of this contribution is to examine the problematics of psychomotorical development, the methodical and didactical experiences of these people and to make recommendations for the practice of physical activities.

Key words: *education, disability, motoric development, methodology and didactics*

Changes in the population of people with HD

In the last twenty years some changes have appeared in the sphere of education for people with hearing disability (HD). Stewart & Ammons (2001) indicate that, while formerly people with HD started to go in for sport at schools for HD where sign language communication prevailed and they did not take part in competitions with hearing athletes, now the tendency of people with HD to study at normal schools with oral communication prevails. These sportspeople then take part in competitions with hearing sportpeople and may not be in contact with the hearing disabilities community. Stewart (1986, 196) defined this community as "a group of people sharing similar cultural values, sign language, and attitudes toward deafness". Athletes with HD studying at normal schools then take part in competitions with hearing athletes and they do not meet the HD community. In cases where they subsequently start to participate in competitions for athletes with HD, their social isolation among athletes with HD may occur paradoxically because they do not know sign language (SL).

There exist normal schools that offer finger spelling lessons as a voluntary subject. The negative side of this integration of people with HD is that normal schools or also sport clubs do not inform (or do not have information for) these athletes about the possibility to integrate themselves into competitions for athletes with HD. On the other hand competitions with hearing athletes offer a higher quality of competitions (Kurková, 2001).

The acquisition of new budding sportpeople with HD is, at the present time, the basic problem. Here are reflected social changes in society and in the community of people with hearing disability. New technology makes it possible for people with HD to be successfully included starting from pre-school age. Other possibilities of how to attract these integrated HD persons into sport for the hearing disabled are represented by offering information via the media (internet, television, radio, press), which, over the pastt four years, in the Czech republic, provide significantly more information about the sport activities of sportspeople with disabilities.

Examples from practice of the inclusion of sportspeople with HD

On the other hand, no less interesting is integration among sportspeople with HD (although in the cases of some sports there are practically no restrictions; e.g. nordic skiing, swimming, etc.). Sport among sportspeople with HD also serves inclusion, offers acknowledgement, enhancement of self-confidence, a new experience more social contacts, and so on. Good results in sport makes it possible for sportspeople with HD to establish themselves in other spheres. Perhaps sport among hearing sportspeople fails to provide these benefits in the same way, although the sport activity of sportspeople with HD with hearing sportpeople also can motivate these sportspeople to better performance and more competitiveness, while offering new social contacts and experiences. Naturally these experiences are, for sportpeople with HD, not always positive, it may occur that sportsmen/women with HD are rejected and shut themselves up inside.

For example, a swimmer with HD, Terence Parkin (South Africa), who holds a silver medal for the 200 m vent in the breaststroke from the summer Olympics in Sydney in 2000 has got at his disposal, in all competitions, a visual light starting mechanism. Without this light aid he would be handicapped among hearing opponents. If the light mechanism fails during the start, the start must be repeated.

Parkin has this to say about competition with hearing sportspeople: "If I am among disabled people, I find out, that I need assistance, but if I am among hearing people, I do not feel handicapped these days, I feel absolutely O.K.". (http: //www.suntimes.co.za/2000/08/20/insight/in01.htm).

Also our athletic women and skierwomen practise with hearing clubs and take part in normal/regular competitions. This fact reflects very positively on their performance and experience in sport. For hearing sportspeople intercommunication is a benefit, too. Where an exchange of experiences takes place, new knowledge about sport in general as well as for people with HD is obtained.

This inclusion means positive benefits for society, for whom it is a chance to learn tolerance and, in this way, be made better. The inclusion of people with disability into society and generation of conditions for this inclusion is a reflection of the social feeling of a given country and also a measure of the degree of advancement of each society.

Characteristics of people with HD in a sport context

The sport activity of people with a sensory disability means especially a didactical and methodological problem. An injury of audition or sight means not only the absence of important information from the surroundings, this lack works a whole lot more on the personality structure of persons with disability. External signals acquire another degree of importance when people without sensory handicaps surround those with a sensory disability, because they are unlikely to understand the experience of people with a sensory handicap. Also signals from the environment may be interpreted differently by those with a sensory handicap as opposed to by those without such a handicap. The possibilities of communication with other people are considerably limited.

An optical analyser has a dominating function, it plays a role in information perception in excess of 80 %. An auditive analyser plays, in information perception, a role in excess of 10 %. The residual percentage is shared by the perception of information by the olfactory and tactile analysers). In people with HD, when there is damage to the function of the ear, this means of perception is replaced by an information perception compensatory mechanism, which is dominated by optical and tactical-kinesthetic analysers.

The movements of deaf children can be disharmonious and unrhythmical, for reasons of the missing possibility of the rhythmic awareness facilitated by auditory signals. As a result of this missing feedback, conditions for keeping their movement under control are also lacking. We can observe, in some deaf individuals, higher muscle tension in standing and movement. The primary cause is a strong concentration on spatial orientation, especially in the case of unusual movements. In connection with complicated orientation and with the related motoric unrest, all of this has an influence on the resulting faster fatigue. With this, quite often, are associated problems with coordination (a defective vestibulary system).

In persons with HD it is possible to apply the generally known models of learning, from the anthropomotoric as well as the developmental psychological point of view, where the difference between hearing and the HD population in their development is insignificant. It is possible that there will be a certain disproportion in the amount of time needed as opposed to the norm (a delay in psychosocial and motoric development as well as differentiation in balancing abilities as a result of a damaged vestibular apparatus).

For this reason we will further be concerned with the possibility of differences in learning movement skills in the next part of this paper.

Methodological and didactical experience with people who have HD

Not only during leadership of PE lessons, but also during training and other physical activities it is important to plan training in order to bring to fruition our teaching goals. Inductive and deductive experience, as well as various kinds of methods and other types of skills are applied. In the case of hearing disability, optical information dominates, that is why, in the rehearsal of movements an overall method is especially used, in which movement learning is distributed into individual categories of movement and practised step by step.

In the course of competition and games we use, instead of a sound signal, a visual light signal. In case this system is unavailable, we may use a visible flag or a signal given in advance (visual or tactile). At a PE lesson, while performing physical activities, verbal communication must be minimalised and movement maximalised.

Techniques used by the teacher or coach are chosen based on the needs of people with HD, on the age range of the group, on their skill level, on the access to equipment and the possibilities for facilitation/enabling, on access to personal assistance and on the personal preferences of persons with HD.

The choice of applied communication and education methods depends on many factors. In case of the majority of them, Šedivá (2000, 147) agrees with Löwe (1987, 26):

- Intelligence and movement abilities.
- Degree of hearing disability.
- Timelines of diagnosis.
- Quality of rehabilitation.
- Incidence of additional disability.

General recommendations for people with HD in lessons of physical education, training, and competition can be summarized into the following items:

1. Inform people without disabilities how to communicate.
2. Consult with the participating experts the methods of specific communication, use basic signs for control of activities (start, stop, go, repeat, …).
3. Utilize peer tutors to repeat directions for people with HD with a view to what and how they have to do something (in the case, for example, that there is a misunderstanding of the instructions).
4. Providing positions for people with HD in such a way that they can receive instructions in accordance with their hearing abilities.
5. Prepare special demonstrations (pictures, video, slideshows) for people with HD of how to do what and ask them, if they have understood the instructions before you start verbal communication.
6. Take care that there is adequate lighting in the environment (inside, outside).
7. Eliminate noise.
8. For people who use hearing aids, consider their ability to use residual hearing.
9. Take appropriate precautions with people who use hearing aids (in swimming, gymnastics, football, and cycling).

In order to secure safe conditions and a continuous development of the educational and training process, the same principle obtains as for the population without disability. Therefore I have not dealt in detail with them in this contribution.

From the above-mentioned points it follows, that for the development of people with HD and their successful inclusion it is important that there be an early diagnosis of the defect or disability for the successful starting of rehabilitation of the damaged functions. It is desirable in children to enhance the fulfillment of their communication needs, because, in the course of the development of the abilities of the brain, successful development in the area of the emotions is also affected.

To the same degree, mutual cooperation is important, as is trust between the teacher (coach, educator, special education teacher, doctor), and the person with HD as well as their parents. While from the medical aspect the diagnosis of the disability may be the same, it is necessary to use an individualized approach. Only in this way is the successful inclusion of person with HD assured.

As Šedivá (2000, 147) says: „People who have accomplished self-acceptance of themselves as they are take advantage of and enjoy the opportunities available to them, gain feelings of self-confidence and live through and through a happier, more joyful and satisfying life“.

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KAYAK ERGOMETER TRAINING IN PARAPLEGICS - EFFECTS ON SHOULDER STRENGTH AND MOTOR FUNCTION

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Abstract

The purpose was to study the effects of kayak ergometer training on shoulder strength and functional performance in post-rehabilitated persons with spinal cord injury (SCI). Ten persons with SCI (levels T3-T12) performed 60 min kayak ergometer training 3 times a week for 10 weeks. Strength measurements were performed during 6 shoulder movements using an isokinetic dynamometer and functional tests were performed in wheelchair: sit-and-reach-tests, a transfer test, and various propelling tests. A questionnaire was distributed after the last training session to evaluate subjective experiences of the training. The training did not influence shoulder strength. There were clear improvements in all sit-and-reach tests, in the transfer test, and in three out of five propelling tests. A majority of the subjects reported perceived improvements after the training. The results indicate that this type of training can be recommended for persons with SCI to improve functional performance.

Key words: *spinal cord injury, isokinetic, shoulder joint, activities of daily living, wheelchair*

Introduction

Spinal cord injury (SCI) causes an abrupt perturbation of neuro-muscular function, the flow of both descending motor commands and ascending sensory feedback is cut completely or partially due to a lesion in the spinal cord. Many people who have an SCI are forced into totally new living conditions including spending the rest of their life in a wheelchair often resulting in physical inactivity. Therefore, to find effective and attractive activities that can be continued over a life span appears essential. Ideally, such activities should improve not only general physical fitness but also give crossover effects on functional performance

Open sea kayaking has been shown to be a suitable activity for persons with SCI and to have positive effects on endurance and on perceived upper body strength and general well being (Grigorenko et al., 2004, Bjerkefors et al., 2005). Paddling on a kayak ergometer is an alternative to open sea kayaking, having the advantage of making the training independent of outdoor conditions.

The purpose of the study was to investigate the effects of progressive kayak ergometer training on shoulder muscle strength and functional performance in wheelchair in post-rehabilitated persons with thoracic spinal cord injury.

Method

Subjects. Ten persons with SCI (7 M and 3 F; 38 ± 12 years, 1.76 ± 0.09 m and 70.8 ± 13.9 kg) with injury levels ranging from T3 to T12, volunteered for the study. All subjects were given both written and oral information before the study started. They were free to withdraw at any point. The Ethical Committee of the Karolinska Institutet approved the study and all subjects gave their consent to participate.

Training. Subjects performed 60 min of supervised kayak ergometer training 3 times a week for 10 weeks. The ergometer was modified with a special seat and a custom-built adjustable balance demand in the medio-lateral direction. Balance demand and training intensity were individually adjusted and gradually increased as the training progressed.

Testing. Shoulder strength measurements were performed using an isokinetic dynamometer (Biodex System 3, Biodex Medical Systems, USA) during maximal voluntary concentric contractions of the right shoulder muscles at $30^{o} \cdot s^{-1}$. The shoulder strength was measured in: flexion and extension (range of motion 65º), abduction and adduction (65º), and external and internal rotation (60º). Torque (Nm) values were analysed in the middle of the range of the respective movement.

Subjects performed different functional tests in wheelchair: sit-and-reach tests both with unilateral and bilateral arm movements, straight forward and rotated 45° to the side (distance), transferring from the wheelchair to a plank bed (height), propelling the wheelchair 5 m on the rear wheels (time), propelling over a curb (height), propelling five laps in a figure-8 around two cones placed 3 m apart (time), propelling 15 m on a level surface (time) and 50 m on a 3° inclined surface (time).

Questionnaire. A written questionnaire was distributed directly after the last training session. The subjects had to rate their subjective experiences of the training with respect to general well-being, cardiovascular fitness, upper body stability, shoulder muscle strength, and ability to sit-and-reach, propel uphill, transfer into a car and propel over a curb. Registration of the answers was done anonymously.

Statistics. Shapiro-Wilk test was applied to determine normality in the distribution of data. Student's t-test was used to determine statistical significance of differences ($p<0.05$) between the values before and after training.

Results

All 10 subjects completed the study as planned, i.e. all 30 sessions. The average balance demand, intensity and distance were significantly increased from the first three to the last three full training sessions.

There were no improvements after training in shoulder strength in any of the tested movements.

In all sit-and-reach tests there were significant improvements after training. The average increase was 4.8 cm (14 %). There were also significant improvements in height of transferring from the wheelchair to a plank bed (3.3 cm, 4 %), propelling over a curb

(1 cm, 7 %), propelling 15 m on level surface (0.19 s, 3 %) and propelling 50 m on inclined surface (1.06 s, 6 %). In propelling the wheelchair on the rear wheels there was a trend towards an improvement (-9.8 %, $p = 0.059$) whereas in a figure-8 there were no statistical differences with training.

A majority of the subjects reported perceived improvements after the training. No one experienced any deterioration. The mode value, defined as the answer selected by most subjects, was highest, i.e. "large improvement", for "general well-being", "cardiovascular fitness" and "upper body stability".

Discussion

Persons with SCI increased their performance in the kayak ergometer both with respect to intensity and balance over a 10-week period of kayak ergometer training, and there were substantial crossover effects onto functional tests in wheelchair. After training they could perform more challenging tasks of daily living, which, in turn, should lead to a greater independence. Accordingly, the participants experienced positive effects on their quality of life. However, the kayak ergometer training did not significantly influence the measured shoulder muscle strength. This could be due to its endurance character, with relatively low strength demands, providing insufficient stimulus for a gain in muscle strength. In this context, it is noteworthy that the shoulder strength in all movements tested were on the same level as for able-bodied persons. The functional improvements and the positive subjective experiences of the training promote kayak ergometer training as a suitable activity for persons with SCI.

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SEXUALITY AND (THE) DISABILITY

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Abstract

The disabled are people, and people are sexual. Much of our sense of personhood comes from our ability to play a sexual role. The disabled share with the rest of us the misfortune of living a society that has traditionally avoided and censured sex, but this hits the disabled harder then orders.

They have been subjected, like the old, to castrating black magic: "Of course they wouldn't want to talk about it; they'd be embarrassed. It is rather unsuitable; doesn't do to raise false hopes."

Nobody knows this better than disabled. In addition to their disability and the limits it impose, they have the problems of getting through the heads of their able fellow-citizens that they are people with the same kinds of human desires and impulses.

Key words: *sexuality, disability*

Introduction

Generations of disabled have been focussed out of sexual personhood by much hogwash, other people's embarrassment, the pattern of institutions, and society's tendency to suppress any sex that is suppressible. When we talk of sexuality, we are talking about how people express themselves, of their maleness or femaleness. People's sexuality is shown in the way they present themselves, in the way they carry themselves, in their body image, and in their grooming habits (Hubscher, 1999).Sex, on the other hand, is the physical interaction of two people. It may or may not be a very intimate interaction experience. It may or may not be with someone of the opposite sex. It does, however, express sexuality (Richards, Lloyd, James, 1992).

The disabled person's first hurdle in overcoming the obstacles is self-deprogramming – rejecting the idea that he or she is not a potentially sexual person and is not loveable by any person. The second is effective militancy – doing something about it. Here the most liberating strategy is open discussion. For couples with a disablement problem, the most helpful first step is discussion with other individuals or couples who share the problem and counselling of each other. In institutions, despite the embarrassment of the staff, patients should demand that the matter be talked out, that privacy be available, that sexual segregation be ended, and that disabled children be given adequate sex education and helped to realize their sexual potential. The able-bodied have projected the embarrassment on the disabled; now the disabled are learning to ignore red faces and speak out. Almost all disabled people can be made sexually functional with special counselling and a minimum of physical help. European researchers, who have seen the lives of severely disabled people transformed by the introduction of tender sexuality, are addressing most of their efforts to reprogramming people who have contact with the disabled.

A handicap more grievous and disabling than disease or injury is self-programming into invalidism, which makes a disabled person distrust his own personhood and suspect other peoples` affection as pity. Once this obstacle, as well as the others mentioned, are transcended (and this one has to do for oneself), one has opened himself or herself to an exploration of his or her sexuality. This exploration is the subject of this paper. The authors suggest techniques and procedures for sexual exploration and fulfilment. In the last resort sexual expression must be tailormade for the individual, disabled or not, although the disabled have to try harder to find what works for them and how to achieve it. It has the most to do with personhood and with the full discovery that one is a loving, loveable, interacting human being – a participant rather than an onlooker.

Is there sex after spinal cord injury?

No so long ago, ignorance was a wide spread problem in the World. Today, although it is still a mayor disability for many people, one thing has been learned. Spinal cord injury does not automatically banish a person to "The World that Forgot About Sex". In fact, with a little badgering, society as a whole now can accept that sex, marriage, and being a parent can be part of anyone's life. This means with or without disability! It is your one choice.

Spinal cord injured persons, along with research, have shown two things: One can lead a sexual active life, and maintain intimate relationships if he or she choose to do so. To do this, though, it will be helpful for him/her to read about the topics listed below (Richards, Lloyd, James, 1992)

1. Societal “myths and misconceptions” about sexuality and disability
2. How his/hers injury affects his/hers sexual functioning
3. Personal adjustments he/she can make to deal with these changes
4. People and places in the community and in the rehab facility that he/she can turn to if he/she have more questions

In the long run, the effect of spinal cord injury on ones sexuality has a lot to do with how he/she feel about himself/herself (self-esteem), his/hers skill and confidence in close relationship make up part of his/hers ability to function sexually. One must accept himself/herself as a sexual being and use his/hers learned skills. In doing so, he/she can obtain sexual satisfaction for himself/herself and the partner. Here are some simple guidelines that might be helpful.

1. The presence of spinal cord injury does not mean the absence of desire.
2. Inability to move does not mean inability to please or be pleased.
3. Absence of sensation does not mean absence of feelings
4. Loss of genital function and/or sensation does not mean loss of sexuality.

What are the changes after spinal cord injury?

The changes after spinal cord injury are by and large in erection, ejaculation and lubrication. The lack of, or decrease in, feeling and movement may also change the sexual experience.

What about erections?

There are two types of erections which for the most part occur at just about the same time (Hubscher, 1999). Since each is produced through different parts of the spinal cord, we need to speak about them one at a time.

1. Psychogenic erections – These erections occur by thinking (fantasy, seeing a good-looking person, or reading sexually explicit material) and then becoming sexually excited. If a spinal cord injury is in the lower lumbar or sacral area and is incomplete, you may be able to have a psychogenic erection. If one have an incomplete injury above the T12 (thoracic 12) level, psychogenic erections may still sometimes occur.
2. Reflexogenic erections – These erections occur through a reflex mechanism in the sacral part of the spinal cord. The brain plays no part in getting this type of erection. All one need is an intact functioning reflex system at Sacral 2, 3 or 4 segments of the spinal cord. This is present in upper motor neuron (UMN) spinal cord injuries. Any type of stimulation of the scrotum, penis, or anus may cause this type of erection.

What about ejaculation?

In order for ejaculation to occur, there must be a fine-tuned coordination of all the different parts of the nervous system. Think about a defensive play in football. When one team member doesn’t do what he’s supposed to do, the play may not come out as planned. The same thing happens in spinal cord injury. Some nerves cannot do what they used to do. Therefore, ejaculation may not happen. Part of the process that allows normal ejaculation is closure of the bladder neck so that semen can flow past the bladder and out of the urethra. In many spinal cord inured men, retrograde ejaculation occurs. This happens when the bladder neck stays open and semen travels the easy, shorter pathway into the bladder rather than the long distance out of the urethra (Sipski, Craig, 1995).In men with an incomplete injury, the ejaculation is more likely to occur than in men with complete injury. But, some spinal cord injured men defy all knowledge of science and ejaculate a good deal of the time.

What about lubrication?

In women, lubrication of the vagina works the same way as erections do in men. An injury to the sacral part of the spinal cord may result in lack of lubrication. An injury above this level may leave reflex lubrication intact. With an upper motor neuron (UMN) injury, stimulations to the genitals and the vagina will most likely cause this reflex (Keirstead, 2005). One may also have psychogenic lubrication if she were injured around or below the T12 or L 2 level of the spinal cord.

In conclusion, the following assumptions are important:

- Weather seems satisfying and pleasurable to a couple is acceptable as long as they mutually agree.
- It is important for people to experiment and discover what is satisfying
- It is important for couples to communicate to each other what they have found pleasing and satisfying

When couples follow these precepts, we believe they find that sexuality can be a healthy and important part of their lives, weather or not a physical disability exists.

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MOTOR AND SPORTING ACTIVITY AS A METHOD OF INTEGRATING CHILDREN WITH SPECIAL NEEDS INTO A WIDER SOCIAL ENVIRONMENT

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Abstract

Because of the speed of perception the eye is man's most important sensory organ. Through sight we observe objects, the processes and the phenomena in our environment. It is the sensory-perceptive area that is most heavily affected in case of sight impairment. Also strong is the impact on the development of the child's motorise and her or his capability of socialization, which is made more difficult by lack of social experience. Blind and weak-sighted children need a lot of suitable movement and recreation. They can take part in various motor and sporting activities in water, on snow and in natural environment. When doing this ophthalmologist's instruction respecting the ophthalmologic diagnosis, the expected course of the eye disease or condition and the individual's capabilities must be taken into account.

The aim of our research is to present the motor games as a means of motor capabilities of all children included with special emphasis on a boy with special needs. Blindness and weak-sightedness as sensory injuries cause limitations in movement, in acquiring new experience, they involve problems in getting included into the world of the seeing and in the use of spare time and spending the surplus energy.

Key words**:** *children with special needs, movement, games, and wider social environment*

Introduction

Because of the speed of perception the eye is man's most important sensory organ. Through sight we observe objects, the processes and the phenomena in our environment. The eye is a very sensitive organ, which makes observing possible in different circumstances: by day, in twilight and at night. The visualization of reality is a composite process in which sensory and motor components of the visual system function mutually. In the presence of and under the control of sight the child is oriented in space, especially after having begun to walk. Forming the sensory cognitive experience in the presence of sight is the foundation for further development of higher forms of cognitive activity. The sight also plays an important role in the forming of the concrete meaning of words and of word categories used in speech and in the development of image thinking. This is why the injury of sight does not only mean partial or total loss of vision. This loss also changes the functioning of the mentally cognitive cognizance. It is on sensory-perceptive area that sight impairment has the heaviest impact. Also strong is the influence on the child's motorics and her or his capability of socialization, which is made more difficult by insufficient social experience. Blindness and weak-sightedness demand a special way of living, which causes a child enormous difficulties in moving. Partial or total loss of sight has the most damaging effect on the child's psycho-motorics. Some weak-sighted children have problems with visual perception and are inefficient in recognizing objects; in front of their eyes they have a foggy, unclear and undifferentiated image. They get tired very quickly and because of this they become nervous, impatient and superficial.

Blindness and weak-sightedness demand a special way of living, which causes a child enormous difficulties in moving. Blindness and weak-sightedness as sensory disturbances have as their consequences limitations in movement, in acquiring new experience, they cause difficulties in the inclusion into the world of the seeing, in the use of spare time and in spending excess energy (Zupančič, 1996).

The child acquires motor skills mainly in three ways:

- the movements are formed instinctively in the course of the child's development and growth;
- acquiring motor knowledge and habits by imitating the environment and the events in it;
- by acting; i.e. through self-activity.

It certainly needs to be emphasised huge inter-individual differences occur between children with sight impairment, that depend to a large extent on the grade of the loss of vision, the time when blindness set in (during the birth, in early childhood, mature period), on the reaction of the environment and first of all her or his family and on other disturbances (loss of hearing, physical disabilities, mental disorder).

In the first place I would like to underline the children are children like all the rest who suffer from no disturbances in their development. This means they develop following the general rules of children's development, but naturally in the course distinctions occur caused by sight impairment. Particularly strongly expressed is passiveness, uninterestedness.

Because of partial or total loss of sight it is the child's motorics that is damaged the heaviest, but also her or his capability of socialization, which is more difficult because of insufficient social experience.

Blind and weak-sighted children need a lot of suitable movement and recreation. They can take part in various motor and sporting activities in water, on snow and in natural environment. When doing this the ophthalmologist's instruction respecting the ophthalmologic diagnosis, the expected course of the eye disease or condition and the individual's capabilities must be considered. For the exercises of a preschool child with sight disturbance the same sport tools and equipment are used as for other children. However, safety must be assured in the activities. For the stimulation of optimal motor development of a blind or weak-sighted child inclusion into swimming, hippo-therapy, and various forms of corrective exercise and other forms of recreation is recommended. All activities carried out by a blind or weak-sighted child ought to be accompanied by verbal description. The children must have enough time for them to carry out the activities by themselves, as autonomously as possible.

Along with sport tools the child is offered musical toys (balls, balloons with little bells or rice in them), toys to be pushed by the child (a perambulator, a wheelbarrow), a tricycle, a bicycle, a scooter, roller skates, roller blades. Weak-sighted children are also offered toys in suitable intensive and contrasting colours (Debevc, 2005).

The blind and weak-sighted children with sight disturbances practice their senses of hearing, touching, smelling and tasting, which helps them in learning their environment and in better orientation. Experts believe the children who have lost their sight before the third or fifth year of age have no residual visual images and neither any notion of colours.

Methodology

17 children from the first grade of the nine-year primary schools in the Municipality of Koper were included in the research. A weak-sighted boy with a milder form of cerebral paralysis was also included in the group. In the course of the school year, in November 2004 a heart-noise was diagnosed too. By agreement between the parents and the specialist the boy took regular exercise. In the school year 2004/05 the children frequented the school of athletics Zajček (= *the Bunny*) organized by the Athletic Club Koper. Exercise was organized on the athletic grounds in Koper on two afternoons a week from September 2004 to June 2005.

Other children accepted the boy without any difficulties; they always helped him and played with him. They understood he was different, but they did not exclude him. We believe being in the group together with him was a very important experience for each member of the group.

The aim of our research is to present the motor games as a means of improving motor capabilities of all children included into the group with special emphasis on including the boy with special needs.

During the exercises the boy was accompanied by one of his parents. Together with the parents we decided they should only help him in situations in which he was unable to perform a more demanding task by himself (e.g.: jumping to a lower level, walking on obstacles of various heights,) The boy kept his glasses on even during the exercise.

Contents from athletics, ABC of gymnastics, motorics with the ball, elementary games were included into the exercise. In choosing the elementary games we focused on the games for developing the coordination of movement, orientation in space, cooperation with others, keeping the balance, strength, understanding and keeping to the rules, the fighting spirit. To make the exercise more variegated we used small musical instruments: the triangle, the flute, the tambourine, and prattlers.

Discussion

The data and their values were obtained as the children performed the sport/motor tasks chosen for them throughout the entire school year. The boy was included into all the games and participated actively.

He never wished to participate in the game called "The fight for the hen house".

The aim of the game is to develop the feeling of balance and to stimulate the fighting spirit. Two children, with their arms crossed on the chest, fight by jumping on one leg, trying to make the adversary step on both legs. In spite of begging him, he never wished to "fight" even with his parents. When he first saw the course of the game he asked his father in tears whether such a play hurt the children. The parents warned me he was very tender and attentive to his schoolmates and to pets and that he was very much affected by shouting, hustling and other forms of "aggressive" behaviour. When they boy could see the game, the fear slowly diminished, he rewarded a girl for winning by applauding and laughing in a loud voice.

The caterpillar

In the game, by means of which the coordination of the whole body is developed, the children form lines. Holding each other's shoulders or arms, the "head" of the caterpillar (a child) leads the file (the caterpillar) around the room, past the obstacles. All children in turn take the role of the head. A file consists of maximum 4 children.

The game was repeated six times during the school year. The boy took part with parents twice with his mother leading him at the side of the caterpillar. In the subsequent games the boy participated in the game also as the head or as the tail of the caterpillar. In both of these roles he wished the presence of his father, but this time not holding his hand. When he was in the role of the head he always expressed the wish, his father should verbally lead him around the room.

Find an empty ring

The children run freely, hop, leap with legs together, and walk squatting, crawl etc. around the room with the teacher choosing the mode of movement. On teacher's signal (the blow of a whistle, raising a kerchief, the sound of the tambourine, the flute) each child must find an empty ring and sit into it. The game was repeated eight times during the school year. At first the boy had troubles with orientation in space and he moved around the room slower than other children. He wished to have his parents by his side three times, he grabbed them by the hand at the sound of the signal and together they ran into an empty ring together. Repeating the game through the whole year the boy learnt how to perform the movement by himself and also how to find a ring by himself. The use of the playroom in which the boy moved increased. Imitating the movement and the sounds of animals also variegated the game. Of all the animals the boy liked to imitate his cat and his dog with greatest pleasure.

Save me, brother

Is a game of catching fugitive children, through which the orientation in space, responsiveness and coordination of movement are developed? The child who catches the fleeing children must be marked (with a kerchief, a ribbon, a plush toy). The room too must be suitably large, depending on the number of the children and their knowledge of the game.

All children had known the game. They had learnt the rules in PE classes. The game was repeated on ten occasions. The boy actively participated in the game three times, with the help of his parents. His mother called my attention to the fact that also in PE classes he wishes to have a teacher close to him. In March he expressed the wish to play the role of the catcher. With my help he touched a girl. He was extremely pleased with the success.

Walking on a perch

In the playground the high steeples for 3000 m hurdle race can be used. These have a very broad supporting surface, on which children with assistance fight fear and develop balance. The boy examined the water hurdle by touching and watching. With his father's assistance he sat on the hurdle with his legs together. The second attempt was already "riding a horse". When the children moved to the next exercise point, he tried the hurdle moving on all four. His father held him over the abdomen part with both hands. In the next sessions he took the courage and walked on the hurdle with his body in half erected position. In the month of May, when there was a competition in the athletic polygon, for which athletic tools and equipment were used, he walked over the hurdle with his mother's help. She assisted him with just one hand.

Marionettes

The children play this game in pairs. One is a puppet on a string (a marionette), the other leading it. The puppet lies on the ground and the leader pulls the invisible strings. The marionette must follow the movements (lifting and lowering a leg, an arm, the head, the abdomen). The children change their roles after some time. The boy participated in this game autonomously.

Athletic contents

is the best means of developing physical capabilities, which are an important element of a weak-sighted child. Walking, running, jumping, throwing is very simple and natural forms of movement. It is our task to provide as much opportunity as possible for correct formation of basic motorics by giving as much opportunity for walking, running, jumping and throwing as possible.

At the conclusion of the athletic school Zajček the boy took part in Bunny's triathlon. Autonomously he walked/ran the 50-meter distance did the long jump and threw ball at a target.

Discussion

A child with special needs should take part in all activities performed by the group and be included in all the areas defined by the curriculum. Among these, movement has a very important role as it has a positive effect on the children's physical and mental development. The parents were very pleased with the boy's progress. They were convinced additional practice contributed to his feeling even better and to being accepted by the group. It can be claimed sporting/motor activity is of vital importance for children with special needs as for them it is not just a means of satisfying the need for playing, pleasure and better physical condition, but it also means a way to self-confidence and towards participation in a wider social environment.

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COMPUTERIZED SEARCH OF SCIENTIFIC LITERATURE IN APA

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Abstract

The aim of this study was to assess progress achieved in the study of people with disability over five years (from 2000-2004). It was also important to find out and analyze the most common issues in the field of APA and Disability Sport research, and to interpret the current journal publications regarding new findings in the field of APA. EBSCO host research was the primary used bibliographic database. Years of publications were constrained to 2000-2004. Only journal publications were included. Electronic search of journals from 2000-2004 produced 225 publications. According to this investigation, approximately 37 papers per year were based on original data. An analysis of these records by topic, disability and sport discipline indicated that all publications investigated seven disability categories, with notice on difference in top and recreational sport. The obtained results appear to be insufficient productivity to advance the field of disability sport significantly, and likely reflect the small number of sport scientists actively studying disability sport.

Key words: *electronic search, adapted physical activity, disability sport*

Introductions

The European Association for Research into Adapted Physical Activity defines Adapted Physical Activity (APA) as "a cross-disciplinary body of knowledge directed towards the identification and solution of individual differences in physical activity. It is a service delivery profession and an academic field of study, which supports an attitude of acceptance of individual differences, advocates enhancing access to active lifestyles and sports, promotes innovation and cooperative service delivery and empowerment systems. Adapted Physical Activity includes, but is not limited to, physical education, sports, recreation, dance and creative arts, nutrition, medicine and rehabilitation". Individual with disabilities have participated in sport for at least 100 years (DePauw & Gravon, 1995). Yet, only in the last decade has the term disability sport become common. Disability sport is "meant to give equal weight to each word and *disability* is not meant as an adjective to Sport" (Doll-Tepper & Scoretz, 1997). It is a currently acceptable term and appears in a number of recent publications (Reid & Prupas, 1998).

The aim of this study was to assess progress achieved in the study of people with disability over five years (from 2000-2004). It was also important to find out and analyze the most common issues in the field of APA and Disability Sport research, and to interpret the current journal publications regarding new findings in the field of APA, for that purpose, electronic search of journals was used. Assessing research progress in the mentioned fields may be historically relevant as well as helpful to contemporary researchers.

Methods

EBSCO host research was the primary used bibliographic database. EBSCO Publishing offers a broad range of full text and bibliographic databases designed to meet the reference needs of all library types worldwide (academic, biomedical, government, school, corporate and public libraries). EBSCO has designed its research interfaces to seamlessly interact with other electronic resources held in a library's collection effectively creating a one-stop research environment. The databases used were: Academic Search Premier, Medline, ERIC, and MasterFILE Premier. Key words used in this search were adapted physical activity, disability, disability sport, sport for disabled, Special Olympics and Paralympics. Years of publications were constrained to 2000-2004. Only journal publications were included. Research presented at conferences was not included since it may have been subsequently published. Publications were categorized as complete papers and abstracts. Digests of abstracts of a recently published work form around the world, primarily found as publications of a special section of the journal Adapted Physical Activity Quarterly were not included in the research's results. The found articles were also divided into original scientific papers and reviews. Only articles published in english were processed. Further more, for the current investigation, articles were categorized under "disability sport" and "sport" if subjects with disability were specifically referred to as athletes or involved in sport competition or training.

Results and discussion

Electronic search of journals from 2000-2004 produced 225 publications. In sum, 23,85% of the publications were categorized as complete papers, while 76,15% of that were abstracts. Original scientific papers made 83,74%, of the sample,

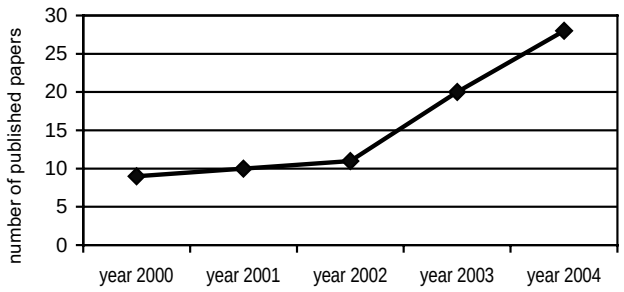
the rest were review papers (16,26%). According to this investigation, 188 original scientific papers were published from 2000-2004. That is, approximately 37 papers per year were based on original data. This seems to be satisfactory, but when we look at it relatively, taking in consideration the disability categories, it shows for example, that in five years, there were only two published papers about people with hearing problems, or that only two papers a year were about people with the down syndrome or mental retardation, which reflects the small number of scientists actively studying the field of adapted physical activity and sport for the disabled (Table 1).

Table 1. Number of publications found with the electronic search of journals per year and the issues they were about.

ISSUE	2000	2001	2002	2003	2004
Amputations	4	7	2	8	4
Deafness	0	0	0	0	2
Development coordination disorders	0	0	0	0	5
Down Syndrome	0	0	2	5	3
Mental retardation	1	0	2	3	4
Spinal cord paralysis	4	3	2	2	8
Visual impairments	0	0	3	2	2
APA education	2	3	7	10	3
Disability sport (intend as recreation)	4	4	7	4	3
Sport (intended as professional sport)	13	8	14	32	8
Other	6	4	4	5	6
TOT.	34	29	43	71	48

Among all electronically found publications, 34,66% investigated seven disability categories, 11,11% treated problems regarding adapted physical activity education, while 43,11% were about disability sport (intended as recreation) or sport (intended as professional sport). When no disabilities were specifically studied, or when the subjects in the study were people with different kinds of disability who were not included in any kind of sport, papers were categorized as «other» (11,11%).

When publications were analyzed according to disability category, the majority were about amputations (32,05%), followed by spinal cord paralysis (24,35%). 12,82% were about Down syndrome and mental retardation, 8,97% studied visual impairments, 6,41% development coordination disorders while only 2,56% were about deafness. In most of the studies, the sample was made of children, without statistically significant difference in gender. The results show a significant improvement in the number of published papers about the 7 investigated disability categories, especially from the year 2002-2004 (Graph1). Increased publishing precisely in this period can be explained with preolympic period when there is an acutance on the scientific issues in disability sport That productivity may predict a significant advance of the field in the incoming years.



Graph 1. Number of published papers about seven disability categories per year

The majority of the papers classified as "APA education" were about supporting and limiting factors for the inclusion of children or students with physical disabilities in a regular full-time school program and about physical educators, their attitude and perceived competence. The constant number of publications per year, with a total of 25 papers in 5 years indicates the researchers interest to improve the environment in which people with disability lives and to develop the teaching methods used in special schools.

For what concerns the most common issues in the field of Disability Sport research, for the needs of this study, the 97 papers about subjects with disability who were involved in the training process were categorized as "disability sport" if the study was about recreational sport. If the subjects were specifically referred to as elite athletes or as participants at the Paralympics, and if level of competition and organizational structure, as well as intensity, duration and frequency of training were high, then, the papers were categorized as "Sport", which means professional sport for people with disability. In sum, 22,68% of the above mentioned papers were about recreational sport, while in 77,31% of the papers subjects were specifically referred to as athletes involved in the Paralympics or Special Olympics.

The most common issue in the field of "disability sport" were social aspects of sport, medical care of people with disability and prevention of mobility loss. For what concern the papers classified as "sport", they were mostly about biomechanical characteristics of amputee runners, biomechanical analysis of a certain sport, medical care at the Paralympics and intensity of training.

The Paralympics sports studied were wheelchair basketball, wheelchair shot-putting, wheelchair racing, wheelchair volleyball, wheelchair hand biking, swimming, running, discus throw and sailing (Figure1).

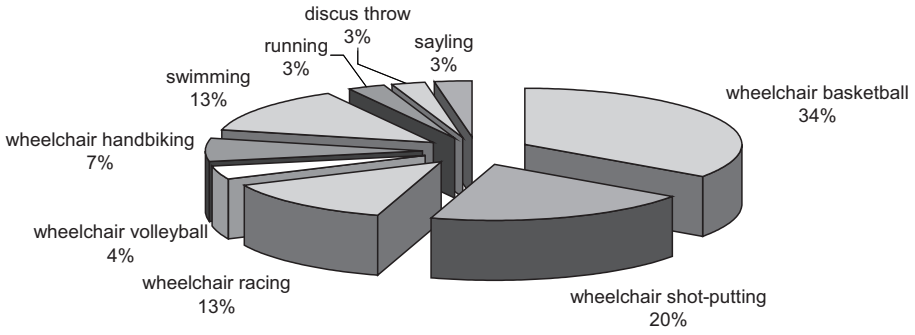
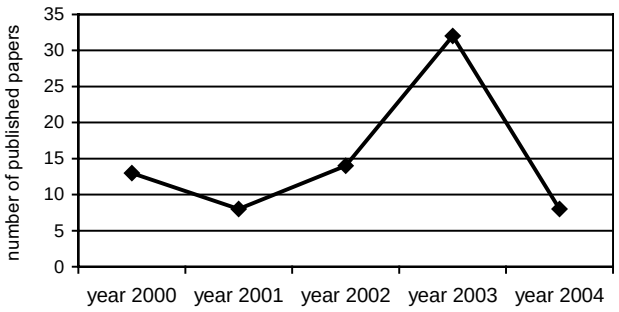


Figure 1. The most common researched Paralympics Sports.

It is easy to notice, that no paper about archery, bocce, equestrian, football 5-a-side, football 7-a-side, power lifting, table tennis, wheelchair fencing, wheelchair tennis or wheelchair rugby were found, although they are all sports included in the last Paralympics Games in Athens, 2004.

There are many studies about wheelchair basketball, but the need to increase the researchers' interest for the rest of the Paralympics sport is obvious, because the obtained results appear to be insufficient productivity to advance the field of disability sport significantly, and likely reflects the small number of sport scientists actively studying disability sport.

Further more, the researchers appear to investigate the Paralympics sport issue only before the Paralympic Games, which shows no constant interest for the field (Graph 2). Such situation does not ensure constant development of the training methods, injury prevention techniques and of disability sport itself, so it should be changed for the benefit of the competing athletes.



Graph 2. Number of publication regarding Paralympics Sports.

A computerized search of literature on APA referenced in the EBSCO host yielded 225 records published between 2000 and 2004. An analysis of these records by topic, disability and sport discipline indicated that all publications investigated seven disability categories, with notice on difference in top and recreational sport. From all Paralympics sports wheelchair basketball is sport with the most published scientific researches. It was concluded that the literature reviews would produce a more complete progress report on the field of APA and Disability sport with defined list of research priorities.

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NEUROMUSCULAR DEVIATION SYMPTOMS

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Abstract

Timely detection of neuro-risk symptoms in infancy and application of kinesiotherapy and rehabilitation procedures can prevent or at least significantly reduce serious development disorders.

Key words: *kinesiotherapy, children prone, neurological risks, symptoms.*

Introduction

1. Various complications, conditions and circumstances during the course of pregnancy, child-birth and early infancy may have adverse effect on the child's neurological development. Such complications are called neuro-risk factors, and children exposed to their influence are called neuro-risk affected children. One child in ten in the developed world falls into this category. (Barac, B.: "Osnovi neurologije", Jugoslavenska medicinska naklada, Zagreb, 1979)

Some neuro-risk factors are quite common (e.g. difficult pregnancy), but seem to have less adverse effect on child development, while the others are less frequent (infant convulsions), but may have serious effect on child development.

The most common neuro-risk factors are:

1. Possibility of miscarriage or premature birth (haemorrhage during the pregnancy, abdominal pains, etc.),
2. Premature birth (earlier than the 37th week),
3. Birth weight of 2500g and below,
4. Oxygen deprivation (asphyxia, low AGPAR score).

The other common neuro-risk factors are:

1. Infant jaundice,
2. Serious disease or infections during the infancy,
3. Low birth weight for the baby's term (dismaturus),
4. Temporary inability to breathe (apnoea),
5. Sucking and swallowing disorders,
6. Family history of neurological illnesses: epilepsy, fever combined with convulsions, fits, thyroid disorders, etc.

The following neuro-risk factors are less common:

1. Infant convulsions,
2. Low blood sugar level (hypoglycaemia),
3. Disorder of calcium metabolism and other compounds.

Neuro-risk factors that often cause development disorders are called high-risk factors.

The high-risk factors are:

1. Infant convulsions,
2. Abnormal state of consciousness,
3. Oxygen deprivation (AGPAR score below 2),
4. Premature birth (earlier than the 32nd week),
5. Birth weight of 1500g and below,
6. Temporary inability to breathe (apnoea),
7. Brain haemorrhage,
8. Flaccidity or increased rigidness of the baby's body.

Children who have experienced high-risk factors must undergo specialist neuro-paediatrician or expert medical examination prior to the third month of life.

Children with other neuro-risk factors should stay under paediatrician's care, who will decide on the best way to conduct regular check-ups.

Occurrence of development disorders

Eighty out of a hundred children with neuro-risk factor experience normal growth and development, substantiating the fact that the presence of neuro-risk factors need not influence the child's development. In other words, the major segment of neuro-risk affected children develops in a normal way.

Twenty out of a hundred children with neuro-risk factor may have temporary or permanent (minor or serious) disorders. Temporary disorders tend to occur up to the 12th month of life, or in the infancy period. A significant number of these disorders shall disappear after the first year, using appropriate medical procedures, while only a smaller number of children who had not received necessary medical help shall suffer from the permanent development disorder.

2. Temporary disorders in the infancy period are the cerebral irritation syndrome (irritation symptom group) and the neuro-development deviation syndrome (dystonia syndrome of the hypotonic type, dystonia syndrome of the spastic type, dystonia syndrome of the mixed type and the spastic syndrome). Twenty out of a hundred neuro-risk affected children suffer from these syndromes). (Drecun, P.: Hipertenzija i radna sposobnost. Beograd, 1979)

Permanent development disorders can take the benign or more serious form. About ten out of a hundred neuro-risk affected children show signs of minimal cerebral dysfunction (MCD), which is a mild form of a permanent disorder. MCD forms a group of various "small deficiencies".

The most serious forms of permanent disorders are called chronic neurological illnesses. These are: cerebral palsy, mental retardation, epilepsy and hydrocephalus. The serious illnesses appear in less than five out of a hundred risk-affected children. All of the children with permanent disorders had neuro-development disorders in infancy.

It is of utmost importance that the parents and other members of the family become aware of the fact that serious development disorders can be hindered or at least significantly reduced if kinesiotherapy and rehabilitation procedures start before the third month of baby's life.

In developed countries, the number of more serious disorders decreases, while at the same time the number of milder forms is on the increase.

The signs of cerebral irritation at the earliest age (infancy) are:

1. Sudden and uncoordinated arms, legs, head or body movements, without external stimulus or nursing actions (bathing, feeding, changing)
2. Sucking and swallowing disorders (refusing to suck or swallow)
3. Trembling (tremor) or arms and legs
4. Constant crying not caused by external stimulus. It can be shrieking and loud, or weak.
5. Bending into an arch while the baby is lying still or while the mother is nursing the baby (during changing, feeding or playtime).
6. Making grimaces, permanent "worried" look on the baby's face with eyes wide open or blank expression
7. Flaccidity or increased rigidness of the baby's body

The aforementioned signs usually disappear up to the third month of baby's life. If they continue, it can be an indication of a temporary or permanent disorder. Therefore parents need to warn the doctor about the existence of irritation signs, and the doctor shall evaluate their significance and advise on further action.

The signs of neuro-development deviation, in terms of dystonia syndromes, are as follows:

1. Irritable behaviour;
2. Short-lasting or absence of directing the eyes towards the person/object;
3. Reaction to sound can be normal, increased, insecure or nonexistent;
4. The child is spontaneous in constant movement;
5. Muscle tension is constant, in some positions the baby's body is flaccid and in some positions it is "rigid";
6. Only later the baby learns to control the head in stomach position or in the position when it is pulled from the lying into sitting position;
7. Only later the baby learns how to sit;
8. The baby can not keep up the "all-fours" position (on its hands and knees);
9. The baby can not learn how to crawl properly (it "slouches" on its stomach or pulls forward with hands only).

There is a significant number of other symptoms that can be recognised by doctors who have specialised in development medicine.

The signs of neuromuscular deviation symptoms in terms of Sy spasticity are as follows:

1. The child is placid and shows no interest in the environment and other people;
2. Stimuli are not followed by eye movement;
3. Reactions are slow (blinking) or non-existent;
4. The baby lies still, with very few spontaneous arms and legs movement;
5. The baby seldom makes noises or it keeps quiet at most times (no gurgling);
6. The child is too "rigid" (often misleading the parents);
7. The hands are usually clenched in fists.

The remaining symptoms of the disorder are usually detected by doctors.

All of the mentioned signs (symptoms) should warn the parents and doctors about the harmful effect of the neuro-risk factors on the baby's brain during the pregnancy or birth. Will these symptoms disappear completely or shift towards mild or serious disorders depends on a series of genetic factors, but more importantly it depends on the appropriate care during the infancy period. It has been proved, scientifically and practically, that brain development in an infant can be stimulated externally, by constant stimulation of proper movements. The series of actions intended for movement stimulation are called the development gymnastics methods (kinesiotherapy).

The treatment technique and the nursing of the child are aimed to achieve active movements in terms of normal positioning reactions.

The basic principle of kinesiotherapy is team work. The team is made up of the doctor, the therapist and the child's mother.

According to physiatrist's instructions, physiotherapist and the kinesiotherapist exercise with the child and teach the mother how to do the exercises on her own. The therapist works with the baby several times a week, in duration of thirty to sixty minutes, depending on the baby's age. When the mother becomes skilled at stimulating appropriate active baby movements, so that they have positive effect on the baby's development, she can do exercises with the baby several times a day.

Experience teaches us that a well-skilled mother can make the most out of the exercises, while the expert-guided exercise alone is not always a guarantee of success. Success would be gradual disappearing of neuromuscular deviation symptoms after the first year of baby's life or leaving just the traces of the mild form of permanent disorder (MCD). Lack of success would mean the development of more serious forms of permanent disorders, but even more retaining the milder forms of disorder in those children who had biological potential to overcome their problems, but have not been treated in an appropriate manner, or rehabilitated during the infancy period.

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Biomechanics

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LATERALITY AND THE EFFECTIVITY OF HUMAN MOVEMENT – THE BIOMECHANICAL POINT OF VIEW

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Abstract

This essay presents a methodological approach to the analysis of human motorics based on the comparison of the performance of movement on the preferred and non-preferred side of the body in two identical movement situations. A kinematic analysis of soccer kicking has been made of a set of soccer players (n = 12, instep kick performed by the preferred and non-preferred leg). Based on the confrontation of results performed by the preferred and non-preferred extremity, the substantial attributes of the movements leading to a higher effectivity of performance has been determined. In the same way, the kinematic analysis of basic human motorics – walking with a unilateral load (n = 26, unilateral load 15% of body weight, walking with and without a load in the preferred and non-preferred arm) produced typical postural characteristics in three observed situations. The analysis of differences between walking with as opposed to without a load in the preferred and non-preferred arm has provided us with information related to a health stance and applicable to the observed motorics.

Key words: *soccer, kicking, preferred, non-preferred extremity, load, walking*

Introduction

Lateral preference in human motorics demonstrates itself in most areas of human movement, especially in situations when one side of the body is used. The problem of laterality was not excessively in the centre of attention by the study of the human motor activities in comparison with psychology, neurology, and ergonomics where laterality is a very frequent subject of study. Only a small number of publications (e.g. Mekota, 1983, Starosta, 1988; Dörge et al., 2002) deal with the laterality problem in sport and human motorics. Very briefly, a feature of the term of laterality in relation to human motorics can be characterized (IIDRISI, internet) in the following way: "Laterality is a relationship to one side, such as a tendency in a voluntary motor act to use preferentially the organs (hand, foot, ear, eye) of the same side." Lateralization refers to the development of lateral dominance (right or left) and the development of specialized centers and such functions in the left and right hemispheres. The right side of the body sends messages to and controlled by the left side of the brain, and the left side of the body by the right side of the brain. Based on the brief characteristics of laterality the results can be that the preferential usage of the organs on one side of the body leads to improvement and effective solution of human movement. From the point of view of methodology of the human movement analysis a very interesting possibility of gaining objective information about the effectiveness of movement, based on the principle of the confrontation of an identical movement act performed on the preferred and non-preferred side of the body suggests itself. We are going to demonstrate this principle based on the example of the biomechanical analysis of two different movement activities from the sport area (soccer kicking) and basic human motorics (walking with a one-sided load).

Soccer kicking

Introduction

Lateral preference is an important factor influencing the quality of kinetics in a wide range of events, especially with those sports where the movement of the upper or lower extremities is crucial (volleyball, tennis, handball, etc.). In the above-mentioned types of sports, the movement quality of the preferred extremity is being developed and the movement performance technique is being improved. The problem of laterality is more complicated in soccer because the player gets into many situations where he or she is forced to use both the preferred and the non-preferred leg. Starosta (1988) states that the most successful goal scorers are those players who are able to score with both feet and he recommends that we direct the training effort at development of both lower extremities and reducing the differences when kicking with the preferred (more skilful) and non-preferred (less skilful) leg. A hardly attainable ideal is a bilateral balance of the movement function of both the extremities. The key to accuracy and optimal velocity also lies in the ability to achieve the maximum velocity of the ball. Asami, Togarie and Kikuchi (1976) state that the highest kick accuracy is achieved at 80% maximum speed. This implies that the higher the speed of the ball a player is able to achieve, the greater variability of speed and accuracy he or she will have. The maximum ball speed at the kick appears to be an important factor of the kick technique for a soccer player. There are many studies dealing with instep kick in relation to the resultant ball speed (e.g. Isokawa & Lees, 1988; Luhtanen, 1974, 1988; Asami & Nolte, 1983, Rodano & Tavana, 1993; Zernicke & Roberts, 1978; Dörge et al., 2002 and others). Lees and Nolan (1998) published a comprehensive survey of these problems.

Information on angular thigh and shank velocity, ankle velocity, and coefficient of restitution and the total weight of the lower extremity are considered to be important indicators of the quality of the kick. Only Dörge et al. (2002) deal with the problems of comparison of the kick when kicked by the preferred and non-preferred leg. Exploring the differences when the ball is being kicked with the preferred (more skilful) and non-preferred (less skilful) leg is considered to be methodologically a more interesting approach to set significant biomechanical features that characterise an effective kick performance. The aim of this study is to find significant differences in the kick performance when being kicked with the preferred and non-preferred leg that correspond to the result of movement, i.e. the ball velocity.

Method

A select set of professional club soccer junior players (n = 12, age: 15.75 ± 0.45 years, body weight: 69.50 ± 7.59 kg, body height: 177.73 ± 5.82 cm) performed an instep kick to a ball to reach the maximal velocity of the ball with the preferred and non-preferred extremity. Two cameras were used, 3D kinematic analysis (APAS and CMAS. 50 Hz) of the 14-link model of body was the output for assessing following variables (more information about the methodology can be found in Vaverka, Janura & Elfmark, 2003):

VBA ($m.s^{-1}$) – Velocity of the ball; LDL (cm) – Lateral distance of the support leg from the ball; TDL (cm) – Total distance of the support leg from the ball; VAN ($m.s^{-1}$) – Velocity of the ankle in the moment of impact; VKN_1 ($m.s^{-1}$) – Maximum velocity of the knee; VKN_2 ($m.s^{-1}$) – Velocity of the knee at impact; AVS_1 ($rad.s^{-1}$) – Maximum angular velocity of the shank; AVS_2 ($rad.s^{-1}$) – Angular velocity of the shank at impact; AVT_1 ($rad.s^{-1}$) – Maximum angular velocity of the thigh during preparation phase; AVT_2 ($rad.s^{-1}$) – Maximum angular velocity of the thigh at impact; RBA – Ratio of the ball and ankle velocity (RBA=VBA/VAN); RST – Ratio of angular velocity of the shank and thigh at impact ($RST=AVS_2/AVT_2$); RAK – Ratio of the velocity of ankle and knee ($RAK=VAN/VKN_2$)

Altogether 26 variables were evaluated (13 variables with the preferred and the non-preferred leg). Symmetry indices were calculated with all the variables (ratio of quantity measured on the preferred and the non-preferred leg). STATGRAPHICS system and non-parametrical methods of variance differences between the preferred and the non-preferred leg (Z-statistic), and Spearman correlation coefficient were used for the statistical analysis.

Results and discussion

Results of the kinematic analysis of the kick performed by the preferred and the non-preferred leg are stated as basic statistical characteristics, a test of the significance of the difference between the kick with the preferred and the non-preferred leg (Z-statistic) as well as correlation between the preferred and the non-preferred leg are also presented in and as symmetry indices in Table 1. It is apparent from the statistical analysis results that the velocity of the ball (VBA) considered to be the criterion of the kick is statistically significantly higher ($p<0.01$) when kicking with the preferred leg. The symmetry index value for VBA equals 1.18. Statistically significant differences between the kick with the preferred and the non-preferred leg were detected with the maximum velocity of the knee (VKN_1, $p<0.05$), maximum angular velocity of the shank (AVS_1, $p<0.05$), angular velocity of the shank in impact (AVS_2, $p<0.05$), maximum angular velocity of the thigh during preparation phase (AVT_1, $p<0.05$) a ratio of the ball and ankle velocity (RBA, $p<0.01$). The differences between the preferred and the non-preferred leg in the case of other measured quantities are statistically insignificant. The symmetry indices calculated for quantities with statistically significant differences vary from 1.06

Table 1. Kinematic analysis of the kick preferred and non-preferred leg – statistical analysis

Variable		Preferred leg			Non-preferred leg			|d|	Z	$r_{P,N}$	Symmetry index
		Mean	S.D.	CV	Mean	S.D.	CV				
1.	**VBA**	27.68	1.32	4.77	23.49	2.05	8.74	4.19	**3.1****	0.35	**1.18**
2.	LDL	5.29	2.37	44.77	8.29	4.68	56.42	3.00	1.84	0.02	0.64
3.	TDL	46.83	6.71	14.33	43.50	7.31	16.79	3.33	1.27	0.24	1.08
4.	VAN	15.30	0.844	5.52	15.37	1.24	8.09	0.07	0.16	-0.27	1.00
5.	**VKN_1**	11.47	0.728	6.357	10.84	0.687	6.34	0.63	**2.36***	0.20	**1.06**
6.	VKN_2	7.75	0.797	10.29	7.86	1.181	15.03	0.11	1.18	0.52	0.99
7.	**AVS_1**	-16.20	1.57	-9.70	-14.69	2.83	-19.28	1.51	**1.92***	0.32	**1.10**
8.	**AVS_2**	20.02	3.09	15.45	17.37	3.07	17.70	2.65	**2.16***	0.45	**1.15**
9.	**AVT_1**	4.91	1.63	33.33	2.88	1.06	36.93	2.03	**2.86****	0.19	**1.70**
10.	AVT_2	-3.56	1.20	-33.82	-3.48	2.03	-58.29	0.08	0.98	0.40	1.02
11.	**RBA**	1.81	0.111	6.15	1.54	0.149	9.67	0.27	**3.1****	-0.12	**1.18**
12.	RST	-6.41	2.80	-43.68	-7.08	4.54	-64.15	0.67	0.12	0.45	0.91
13.	RAK	2.00	0.286	14.28	2.00	0.395	19.69	0.00	0.51	0.40	1.00

* p< 0.05; ** p=0.01

to 1.70, the average value being 1.22 corresponding to the VBA symmetry index (1.18). Symmetry index values of the quantities with statistically insignificant differences in the preferred and the non-preferred leg vary from 0.64 to 1.08, the average value being 0.95. Values of correlation coefficients by no means reach the 5% significance level. The correlation between the preferred and the non-preferred leg for the quantities of the knee velocity and angular shank velocity on impact are the closest to this limit.

In contrast to the previous statement, a difference between both the maximum angular velocity of the shank and the angular velocity of the shank on impact can be found. The given scheme of the course of the angular velocity of the shank raises a question of the principle of higher kick effectiveness with the preferred leg. According to Dörge et al. (2002) the main causes are higher values of the angular velocity of the shank on impact and a higher value of the coefficient of restitution. One important factor that has not been considered yet can also be concluded from the given scheme. Higher value of the angular velocity of the thigh can influence the higher pre-stress of the knee joint extensors (m. quadriceps femoris) before proper knee extension and effective transmission of stronger forces of this muscular group to the shank. It is possible to consider the impact of the stretch-shortening cycle (SSC) mechanism, as it was fundamentally conceived in Komi (1992), which increases the effectiveness of the subsequent concentric contraction. We can hypothetically assume that a long-term training and priority use of the preferred leg during the kick would contribute to the higher effectiveness of the kicks that is characterised by better co-ordination in co-operation of the eccentric and concentric phases of the knee joint extensors. As for kinematic quantities, this factor is manifested as differences between the model of the angular velocity of the thigh and shank with the preferred and non-preferred leg, as it was described in the statistical analysis in Table 1, demonstrated in Fig. 1 and discussed in numerous studies.

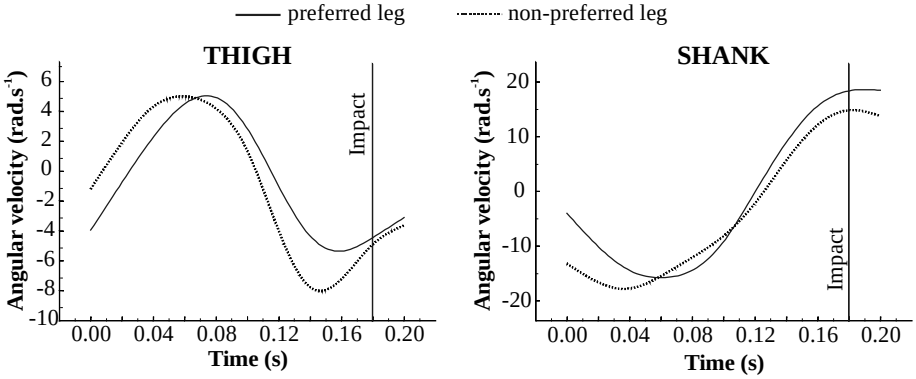

Figure 1. Angular velocity of the thigh and shank of one athlete

Unilateral load and walking

Introduction

Mutual coordination of all segments of the body and their cooperation provide dynamic stability to the walk and each individual has his/her own characteristic, specific, and unique model of the gait cycle. Human walking, an overwhelming majority of the time, is rendered in a natural manner involving free and unencumbered upper extremities. Issues pertaining to the carrying of objects and weights while walking deserve special attention. Symmetrical loading (as is the case with a back pack or the like) has been examined from the point of view of the needs of the army, hiking at high altitudes and the like (e.g. La Fiandra et al., 2002). The influence of a unilateral load on posture while walking in terms of carrying a load in only one hand (for example a shopping bag, a school bag, bags carried over a shoulder, etc.) is a problem which has attracted the interest of doctors and others, and research on this topic has been primarily concentrated on the carriage of such a load on the preferred side of the body (e.g. Crosbie, Flynn, & Rutter, 1994). When walking with a unilateral load, a situation arises whereby the individual, influenced by fatigue, shifts the load more or less regularly from one side to the other. From this perspective the problem of laterality assumes relevancy, since people usually prefer to carry objects on the preferred side. The high frequency of carrying of a load on the preferred side can affect the symmetry of the gait cycle and thus can influence the quality of posture negatively. The goal of this study is to determine whether walking with a unilateral load affects the kinematics of the position of the trunk and the upper limbs in comparison with walking freely and unencumbered. The second question to be dealt with is a comparison of changes in a person's carriage while walking in relationship to a lateral preference of the upper limbs. Hypothetically, we may assume that a lateral preference with regards to the upper limbs influence, in some way, the movement reaction of the trunk while walking with a unilateral load carried on the preferred or the non-preferred extremity.

Methods

We examined a homogenous group of 26 healthy university students (15 men and 11 women, with an average age of 22.6 years) with a lateral preference for the right upper and lower limb. The load to be carried, in the form of a bar bell, was standardized for each participant. Its size was calculated to correspond to 15% of the body mass of the investigated person. The basic body dimensions (BW 71.4±10.9 kg; BH 178.5±9.6 kg) were ascertained in the set of healthy individuals (no clinical findings, all participants agreed with video recording) and for each individual the load of 15% of his/her body weight was prepared. A model of the upper part of the body was provided with 11 defined anthropometric points (see Fig. 2), the positions of which on the human body were marked by signs.

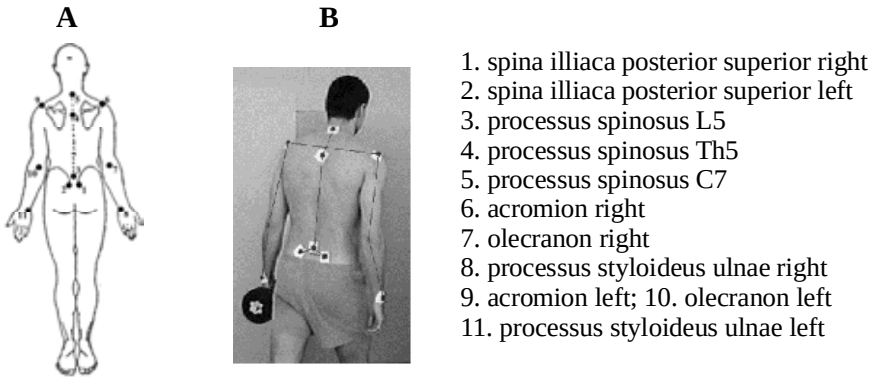

Figure 2. A – a model of the upper part of the body, B – the subject walking with a load recorded by camera number 2

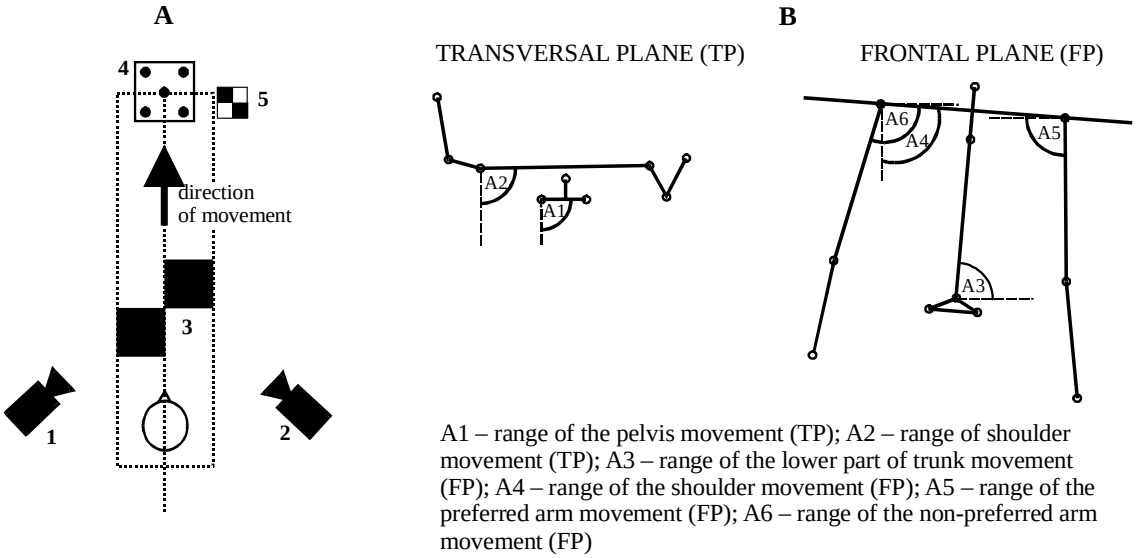

Figure 3. A – the experimental setup (1, 2 – cameras, 3 – two force plates AMTI, 4 – synchronization device, 5 – orientation mark), B – schematic illustration of measured angle variables in transversal and frontal planes

Three variants of walking styles (without a load, with a load on the preferred and non-preferred extremity) were imaged using two cameras (Panasonic NV-M3500, frequency 25 Hz) and, at the same time, the reaction forces of both the left and right legs were registered using two force plates (AMTI OR 6-5, frequency 1000 Hz). The schematic depiction of the organization of the register of movement is presented in Fig. 3. In the given study, we concentrated solely on partial kinematic analysis of the problem. A 3D-analysis was carried out using the APAS system (50 Hz). Movement was analyzed at both frontal and transversal planes and the position of the trunk was characterized by 6 angles. The schematic drawing of the measured angles describing trunk position is provided in Fig. 3. The analysis was done on the one gait cycle on both legs and in three selected phases: heel strike, mid-stance, and toe off.

Results and discussion

Differences among the observed variables were evaluated in three variants of walking (without load, with the load in the preferred hand and in the non-preferred hand) for both steps of the preferred leg (right) and the non-preferred (left) leg. The values of defined variables were measured in three key phases of each step, i.e. at the beginning of the step (heel strike), middle position (mid-stance) and at the end of the step (toe off). Statistical analysis of each angle is derived from 18 values measured for the different variants and the phases of the gait cycle, i.e. for 6 angles in total 180 measured values. The distribution of the experimental data shows normal distribution for all measured variables and, with respect to this fact, we used the parametric method for this one-way analysis of variance (Tukey) and the Pearson correlation coefficient for correlation analysis. As an example we present in Table 2 the statistical analysis of one measured angle – A5. We can see that the differences in the homogeneity of the groups and significance of differences between variants of gait cycles are systematically the same in all situations. The load carried out in the non-preferred arm statistically significantly differs from both walking without load and walking with the load in the preferred arm. More detail and information about the results and the methodology can be found in Vaverka, Abrantes and Drastichova (2004).

Table 2. Analysis of variance of differences in gait without load; with load in preferred and non-preferred arm. Angle A5

Leg	Phase of step	Carrying of Load	Mean	S.D.	F-test	Homogeneity of groups	Significance of differences	
							NOL	PRL
LEFT	HS	NOL	94.71	2.95	F=7.417 p < 0.001	x x		
		PRL	92.80	2.61		x		
		NPL	96.41	4.34		x		*
	MS	NOL	93.13	3.30	F=12.21 p < 0.001	x		
		PRL	91.85	2.43		x		
		NPL	96.20	3.89		x	*	*
	TO	NOL	91.07	3.14	F=11.52 p < 0.001	x		
		PRL	91.00	2.58		x		
		NPL	94.96	4.28		x	*	*
RIGHT	HS	NOL	91.38	3.18	F=9.067 p < 0.001	x		
		PRL	91.54	2.53		x		
		NPL	94.80	3.95		x	*	*
	MS	NOL	94.70	3.20	F=10.88 p < 0.001	x		
		PRL	92.71	2.78		x		
		NPL	97.52	4.89		x	*	*
	TO	NOL	95.02	3.22	F=7.583 p < 0.001	x		
		PRL	94.58	2.81		x		
		NPL	98.15	4.54		x	*	*

HS – heel strike, MS – mid-stance, TO – toe-off
NOL – gait without load, PRL – load in preferred arm, NPL – load in non-preferred arm
* $p < 0.05$

The complex view on measured variables in the graphical form is given in Fig. 4 and 5. In its basic features, the gait model with a unilateral load keeps its kinematic characteristics in the movement of the trunk and arms while walking without a load. Differences occur when carrying the load in the preferred and non-preferred arm, where the movement reactions remarkably differ. The gait model without a load is usually located between models describing the load carried in the preferred and non-preferred arm. A unilateral load slightly reduces the range of movement in the pelvis and shoulders in the transversal plane and, when compared with walking without a load, the load carrying is typical for the slight turn of both pelvis and shoulders towards the loaded side during the entire gait cycle. The range of movement of shoulders is always larger than for the pelvic movement. In the frontal plane, the unilateral load causes trunk inclination in the direction away from the load during the entire gait cycle and, at the same time, a slight reduction in the entire range of movements of the shoulders and lower part of the trunk.

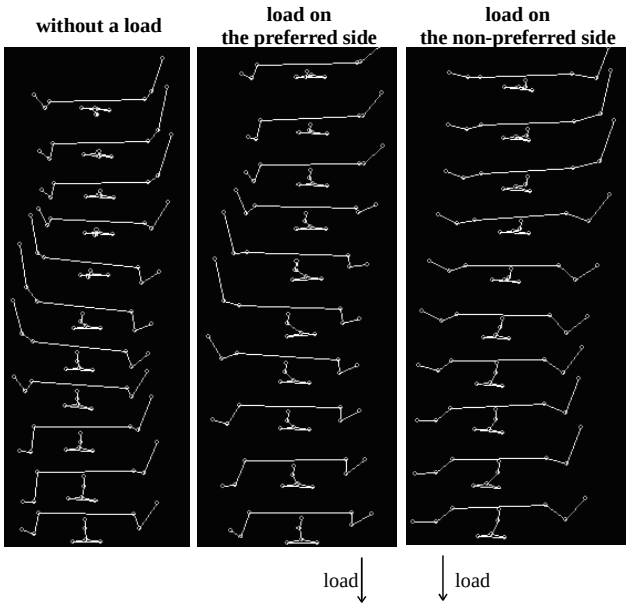

Figure 4. A model of the upper body position while walking in three measured variants of the gait in the transversal plane

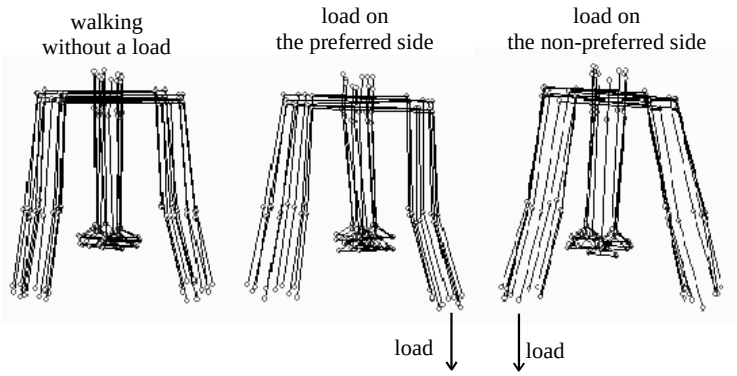

Figure 5. A model of the position of the trunk, shoulders, and arms while walking without a load and walking with a load on the preferred or non-preferred side. Here we can see all of the average positions when stepping on to the right and the left legs and in the three phases of the step: heel strike, mid-stance and toe off.

The basic pattern of the movement of arms while walking without a load is slightly asymmetric and this asymmetry increases while walking with a load. Movement reactions of the preferred and non-preferred arms remarkably differ when loaded. The load carried in the preferred arm decreases the total range of its abduction and, on the contrary, the load carried in the non-preferred arm causes its slight increase. A unilateral load increases abduction in the non-loaded arm in order to maintain the latero-lateral balance.

The results indicate that people with a right-sided lateral preference of the arms are better adapted to load carrying in the preferred arm and the movement gait model with a load does not differ significantly from the gait without the load. Load carrying in the non-preferred arm leads to greater variability in movement reactions and it is obvious that the adaptation to less usual ways of carrying the load is more difficult. It may be assumed that in people with a left-sided preference of the arm, the situation will be mirrored.

From the perspective of daily experience, what seems to be practical is to change regularly the loaded arm and thus minimize one-sided loading of the locomotion system leading towards muscle disbalance and even to health problems.

Conclusions

Lateral preference leads to the preferential usage of one side of the body in movement situations being done asymmetrically. The quality of the movement activity on the preferred side of the body is increasing due to a great number

of training stimuli and the performance of the movement is becoming more effective. The comparison of the effectivity and quality of movement performed by the preferred and non-preferred side of the body, according to the study of human motorics, can be utilized to search for substantial attributes characterizing a higher quality of movement performance. From the methodological point of view, this approach is very profitable. By using a comparison of the same movement activity performed on the preferred and non-preferred side of the body, information can be obtained containing the substantial characteristics of observed movement acts in a relatively small sample of observed persons.

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KINEMATICS OF SHOT PUTTING TECHNIQUE – A REVIEW OF RESEARCH METHODOLOGY USED

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Abstract

The purpose of the paper is to present a review of the methodology used in the most important investigations in long history of kinematics research on shot putting. It will include relevance ratings, issues addressed, methodology of collecting and analyzing of the data and applicability ratings of the obtained results. The ultimate aim of the paper is to predict possible course of prospective kinematics research studies on shot putting technique.

Key words: *biomechanics, track-and-field, throwing events*

Introduction

Opinions about shot putting technique have been changing through more than a hundred years of its history. Throughout performance development, from Garrett's 11.22 m of the first Olympic Games to Barnes's world record of 23.12 m, the dynamic stereotype of putting the shot evolved from throwing from the standing position up to improved rotational movements. The history of shot putting can be observed through the search for a technique which will use athlete's speed and power. The important role in performance development of shot putting can be attributed to the scientists who have been exploring movement patterns of putting the shot more than a half century. From Doherty, who began in 50's of the 20th century, via Fidelus, Zienkowicz, Pearson, Dyson and Tutevich in 60's, and Grigalka, Ariel, Delevan, Simonyi, Koltai, Marhold, Schpenke, Kerssenbrock, Susanka, Lanka, Shalamanov and Zatsiorsky who continued in 1970's and 1980's, until Ihring, Bartonietz, Bosen and Stepanek, who proceeded in 1990's, it has been demonstrated that the development of the technique of shot putting has allowed throwers to use more and more of their own physical capacities.

The purpose of this paper is to review the methodology of the most important investigations in the long history of kinematic research in shot putting. The tendency of this summary is not to present the kinematic parameters obtained in researcher studies on several shot putters who shot the put with various style of the technique. We would like to consider the relevant issues of previous experiments, the methods of collecting data, the analyses used and applicability of the obtain results. Furthermore, the ultimate aim of this paper is to predict the probable course of the future kinematic research studies on shot putting technique.

Objects of the experiments and applicability of the obtain results

All kinematic research studies on shot putting can be divided with reference to the object of experiments. In the first group there are experiments which considered release parameters. The release parameters determine two horizontal distances which make 97% of the result in shot putting (Young, 2003). The first component is the horizontal distance traveled by a shot released at a certain angle to the horizontal, and it depends on three parameters: release velocity, release angle and release height. The second component that contributes to the achieved throwing distance is the release position relative to the point of the measurement. Most frequently, the studies of the first group examined just three release parameters: release velocity, release angle and release height, and only to a lesser degree did they consider the relative influence of the release position in relation to the point of the measurement. The studies confirm that release velocity is the most important factor in shot putting. According to the data of Mullineaux (2001), the answer to the research question should be practically and theoretically valuable. That is why the research issue must not have been answered yet and it should be underpinned by theory. The issues of the mentioned studies do not contribute to the body of knowledge because they discover nothing new. The influence of the abovementioned three release parameters (and particularly the release velocity) to the horizontal distance traveled by a projectile released at a certain angle to the horizontal, when the release variables are independent, has been the well known facts in physics for a long time ago. The difference between the horizontal distance traveled by a projectile released at a certain angle to the horizontal and the measured distance in the shot put is a consequence of two factors: the first one is the horizontal distance that the shot flies over after it has returned to the initial height from which it had been released. (because the release height is not zero), and the second is the fact that the release parameters in the shot put are not independent; they are very much inter, e.g. the release velocity and the release angle are very much interrelated. The benefit of the experiments on the release parameters may be in the accurate determination of optimal release conditions when release velocity depends on the release angle. The farthest

conclusion of such investigations is that all the other parameters of release are somehow subordinated to the initial speed as the most important release parameter.

Unfortunately, the values of the three or four parameters and relation between them do not provide completely helpful information to a coach because they do not display crucial characteristics of throwing technique. The limit of the experiments is that they indicate what should happen, but not what does it take to make it happen. The coach must know how the movements of the thrower's body segments should be coordinated to make the release velocity maximal.

The experiments in the second group consider movement patterns of the athlete's body, especially coordination among the segments of the kinematic chain which provides optimal magnitude of the release parameters. These experiments generate much more pragmatic information to coach. But, there are many flaws in these investigations and are many hypotheses in that field of biomechanics of shot put have not been verified. For example, we "presume" that release velocity of the shot will be reduced if the maximum speed of the extending arm is added to the submaximal speed of the extending lower extremities, we also "suppose" that greater the difference in time between the maximum trunk and lower extremity velocities, the less the total velocity of the shot, but this speed timing pattern has not yet been confirmed experimentally (Zatsiorsky, 1981; Lanka, 2000). We also "presume" that principle of the inverted pendulum has influence on release velocity, but in shot putting it has not yet been confirmed (Lanka, 2000). Therefore, there is a lot of unconfirmed principles and hypotheses in the most important part of kinematics of shot putting - the model of the movement pattern of putting the shot.

Most researchers in the field of biomechanical investigations investigate kinematic parameters of top-level shot putters, often at the most important international competitions, whose shot putting techniques varies in style. That is an adequate way for establishing the technique model of a highly skilled performer. In the investigations researchers are tracing elements of motion patterns, particularly their kinematic parameters, and compare the obtained values to the similar exiting data. The obtained data represent a model of technique to a coach who can compare results of his/her trainees to the established model of a top performer. These investigations do not provide an insight into the causal relations between the inducement and the consequences of the motion performed in the observed throwing pattern. Just a few published investigations analyze and explain these relations with regard to the relation between kinematic parameters and results in shot putting. Scientists and coaches consider these data much more applicable.

Methodology of collecting and analyzing the data

The kinematic analysis of the shot putting technique begins with a description of stances and orientations of a thrower's body in the circle and of joint configuration during the throwing movement pattern performance. Registration and analyses of that group of kinematic values of the shot putting technique started in 1940's and 1950's through the analyses of a picture sequence of typical relevant phases of the throwing pattern.

Registration of speed and acceleration parameters started in 1960's with the analyses of the two-dimensional record. Zatsiorsky analyzed the technique of throwing movements (1964) by measuring magnitude of kinematic features by means of the proportion grid set in the background after the movement has been recorded with one camera. These analyses, which were actual in kinematics until 1970's, contain excessive error, which is commonly reflected in the conclusions. For the example, a drastic decrease of shot speed in the transition stage, obtained by Susanka (Lanka, 2000), is connected with the fact that speed of a shot was measured barely in the vertical plane. The information provided in these articles (analyses of the two-dimensional record) may not always be valid and correct.

Measuring of angles between body segments using the rotational potentiometer, called electrogonimetar, in detection of kinematic magnitudes in shot putting was initialized by Lanka and Shalamanov in 1970's (Zatsiorsky, 1981). The major disadvantage of these devices is that they are not capable to measure translatory movements. The accuracy and precision of these devices is determined by their mechanical design and by the electrical properties of the potentiometer used (Medved, 2000).

Stereophotogrammetric methods, enabling a reconstruction of performance in three spatial dimensions, offer a comprehensive solution for the measurement of kinematic quantities. The beginning of the usage of the 3D stereophotogrammetric methods in shot putting analyses is marked by works of Ariel, Zatsiorsky, Lanka and Shalmanov.

Many analytical methods are used to derive conclusions from the collected data. At most, the choice of a method depends on the aim of the analyses. For a description of the coordination between two intra- or inter-segments of the kinematic chain, researchers use spatial and temporal trend analyses (position-time graphs, position-position graphs). It is a very efficient method for establishing the model of a highly skilled performer or for comparing it to the established model of the valid technique. If researchers have a concept to provide the relation between the inducement and the consequences of the variables which describe the motion, then that concept refers to the idea that one variable has an effect on another and the most often technique used to obtain the relationship between the obtained parameters are correlation analyses and multiple regression analysis. The correlation analysis is a statistical technique used to determine relationships between two or more (dependent) variables and the multiple correlation indicate the relationships between dependent (the criterion) and the independent variables (the weighted sum of the predictors).

Variables

According to Zatsiorsky (1998), kinematic research studies consider two groups of variables: the variables of kinematic geometry of human motion which comprise the variables of position (location or place, orientation or attitude and joint configuration or posture) and the variables of displacement (the difference of coordinate between different positions), as well as variables of differential kinematics of human movement which comprise the variables of speed and acceleration of the movement. If the aim of an experiment concerns economy of the throwing pattern of putting the shot, it is not sufficient to consider just the magnitude of linear or angular speed or acceleration, because those variables mainly depend on strength and power capacities of athletes (particularly the variables of acceleration of proximal segments of the kinematic chain, e.g. knee extension). It is necessary to consider the cause and the consequences of temporal coincidence of body segments' movements upon the set criterion variable.

Therefore, they do not need to consider just the temporal coincidence of linear or angular displacement of certain segments or the temporal coincidence of linear or angular velocity of body segments. Because of the linearity of acceleration and force (by the second Newtonian Law of motion), we can consider acceleration as an outcome of the application of force. The cardinal purpose of throwing technique is to enable economical application of forces. Because of that, researchers need to consider the temporal coincidence of certain linear and, especially, temporal coincidence of angular acceleration of the segments of kinematic chain.

The first criterion variable for verifying influence of some predictor variables would be the measured distance in shot putting. However, if the goal of an experiment is to confirm the hypothesis about economy of the movement pattern (of valid coordination of the body segments before the instant of release) and if the criterion variable (better performance) is a consequence of a more proficient performance of more skilled performer, the researcher could not confirm the hypothesis with assurance. The researchers could try to avoid the influence of the height of the release as an important factor of performance (measured distance) by using the release velocity as the criterion variable. However, if the criterion variable (release velocity) is a consequence of the performer's greater strength, the hypothesis could not be confirmed again. The researchers could try to avoid the ascendancy of these two influences by using the criteria of the difference between the measured distances or release velocities from the standing position and from the completed movement pattern.

Participants

The cardinal precondition for understanding and corroboration of the principle of functional efficiency of the moving pattern is the existence of sensible variations in both sets (in multiple regression) of the observed variables. Researchers seek for different responses from top-quality (highly skilled) participants. Both, inter- and intra-individual variations are possible and these variations influence the reliability and statistical significance testing (Mullineaux, 2001). If there are high differences in the observed variable, it may be because of the no importance of the observed value (if participants are top athletes) or because of different ways to achieving the efficiency. If there are no differences in the observed variables and if the participants are all top-level athletes, it could be because of the powerful influence of the observed variables on the criterion variable. But there is also a possibility when the observed participants are all top-level athletes that there is no variance of the observed values due to their high importance. According to this, an experimenter cannot understand nor confirm the principle of the moving pattern efficiency. If there are no timed variations between the participants, there are no relation between inducements and consequences of the motion. The possible solution to this problem is to use top-level athletes as participants, but they should be both elite and sub-elite ones. They all have automated the throwing movement pattern, but they presumably fluctuate in efficiency of energy exploitations, or in performance quality.

Final considerations

The farthest conclusion of the investigations which analyze the release parameters is that the optimum release conditions other than velocity depend crucially on how the maximum achievable release velocity is functionally related to the other release conditions. The limit of experiments which analyze release parameters is that they indicate what should happen, but not what it takes to make it happen. The investigations which analyze moving patterns often establish the model of a top-level athlete. They are not providing the relation between the inducement and the consequence of the motion in the throwing pattern. There are many unconfirmed hypotheses in pattern of throwing the shot such as influence of the principle of coordination of particular impulses and the inverted pendulum principle. Two-dimensional analyses conducted until 1970's contain an excessive error, which is commonly reflected on conclusions. The most important predictor variables are the variables of temporal coincidence of displacement, velocities and accelerations. The best criteria of efficiency of the pattern are the difference in the achieved release velocity or distance between the putting the shot from the standing position and putting the shot by using the throwing technique pattern. The best sources of the variations of the observed values are top-level athletes, both the elite and sub-elite ones.

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COMPARATIVE KINEMATICAL ANALYSIS OF NOVICE AND ELITE VOLLEYBALL SPIKE TECHNIQUE

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Abstract

The volleyball spike is one of the most important offensive weapons in the competition. When working with novice volleyball players the main attention has to be focused on parameters that influence the height of jump as well as the velocity of the ball. As a contribution to the better understanding of the role of biomechanical analysis in the learning process the goal of this study was to analyze a spike action of young female volleyball player and, by comparing it with top female player, detect eventual technical errors of her performance. The achieved results showed certain errors in young player's spiking technique and, since those errors significantly determine the height and the speed of the spike, suggestions for changes in subject's spiking technique are made.

Introduction

Volleyball game is activity where dominates constant fight between defense and attack. The attack is closely related with victory or defeat. A team with stronger attack has more chance to win. Therefore, the coaches in volleyball schools have to pay more attention on spike as the main element of attack. The basic facts about a spike technique, possible technical errors and learning methods can be found in various books (Selinger 2000., Dearing 2003., Janković and Marelić 2003.). However, in everyday coaches praxis, it is also very important to understand the biomechanical background of the successful spiking action, such as approach velocity, take-off angle, CM trajectory, attack angle, as well as many other parameters that will influence the efficient spiking action. This type of data could be collected by adequate biomechanical analysis. As a result of such analysis it is possible to get precise description of all kinematics parameters of spike technique, detect existing technical errors and following that, give recommendations for correction of exercises that are supposed to be applied during training process (Samson and Roy 1976., Marelić et al. 1995., Coleman et al. 1993.,). As a contribution to the better understanding of the role of biomechanical analysis in the learning process, the goal of this study is to analyze a spike action of young female volleyball player and, by comparing it with top female player, detect eventual technical errors of her performance.

Methods

The subject of this study is young female volleyball player (164 cm, 54 kg, 11 years old), just in the beginning of learning the basic jump spike. Collection of video data was made on regular training by 3 digital video cameras, operating at 60 fps. The model for comparison was top female junior volleyball player (183cm, 70kg, 19 years old), gold medallist from European Youth Volleyball Championship 2003. Among 20 recorded spikes, performed with the right hand from the zone 4 (the approach for a high set), the team of coaches selected one for each of the players, considered to be a typical. Those two spikes are subjected to further analyses. The collected video images were digitized and processed with standardized APAS procedure.

Table1. List of parameters

PARAMETER	MODEL	SUBJECT
1. Height of CM in the beginning of approach (cm)	95,83	89,43
2. Length of first step (cm)	92,13	38,92
3. Length of second step (cm)	245,82	131,24
4. Length of third step (cm)	232,12	175,43
5. Length of approach (cm)	324,32	214,31
6. Max. CM horizontal velocity of approach (m/sec)	2,95	151,38
7. Height of CM at the end of approach (cm)	85,91	87,18
8. Duration of take of (sec)	0,16	0,21
9. Shoulder angle in minimal height of CM* (deg)	- 26,43	14,47
10. Min. knee angle during the take-off (deg)	95,76	115,45
11. Max. arm velocity in take off (m/sec)	14,99	9,89
12. Max. CM vertical velocity in take off (m/sec)	3,13	2,56
13. CM horizontal velocity in take of (m/sec)	1,45	0,79
14. Angle of max. body arch (deg)	133,53	151,17
15. Max. height of CM in flight (cm)	170,29	135,54
16. Height of ball impact (cm)	271,68	223,68
17. Velocity of hand before hit (m/sec)	18,40	10,00
18. Height of CM at the moment of hit (cm)	170,26	125,48
19. Elbow angle at the moment of hit (deg)	134,88	132,34
20. Forearm angle at the moment of hit (deg)	97,52	106,76
21. Trunk angle at the moment of hit (deg)	68,75	72,61
22. Velocity of spiked ball (m/sec)	24,77	13,39
23. Duration of flight (sec)	0,61	0,43
24. Duration of spike (sec)	1,52	1,64
25. Length of spike CM (cm)	377,64	260,41
26. Knee angle in landing (deg)	99,749	116,08

Results

Selected results, collected by kinematics analysis of spike technique, are shown in Table 1. As it can be seen, parameters values obtained on the model (height of the jump, height of the ball impact, velocity of the ball) are similar to those obtained by the other authors researching the kinematics of spike of elite volleyball players.

Discussion

The main differences between the young and the top volleyball player performance will be explained trough five phases of spike action: approach, take-off, flight, ball impact and landing.

Approach

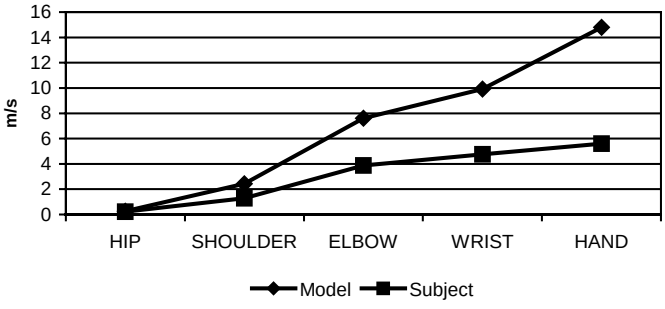
The main purpose of this phase is to increase a horizontal velocity, which later, during the take-off, can partially be transferred to the vertical velocity. Consequently, the jump will be higher and the body will have larger energy that could bee transferred on the ball.

In the case of this study, the steps of the subject are too short (38.9-131.2-175.4), the horizontal velocity is low and there is no enough lowering the CM before the take-off (only for 2 cm from the height of the CM in the beginning of the approach). The consequence of those technical errors is low jump and too early approach to the ball - false "timing".

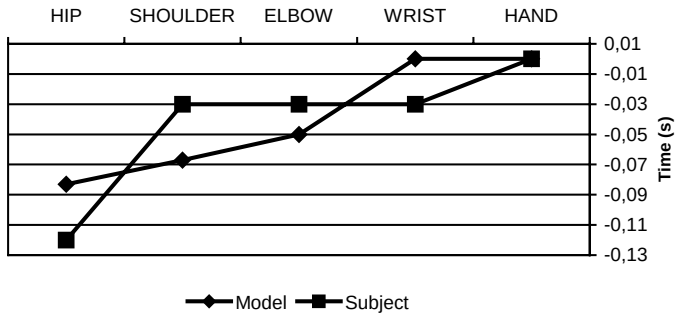
Take of

Generally, during the take-off the horizontal momentum generated through the approach has to be partially transformed in vertical. For that reason take-off has to bee short and powerful, with the coordinated, high-speed arm swing, directed up.

Comparing with the model, the young cadet's take-off is slower (0.16 s versus 0.21 s), the hand swing begins to early and the horizontal velocity is not slowing down enough (poor transfer of the momentum). So, it was not possible to achieve the maximal height of the jump as well as the correct distance from the ball at the time of the hit.



Graph 1 – Peak velocities of the joint centers



Graph 2 – Timing of the peak velocities

Flight

The key point of the flight is the moment of body arch, where the hitting arm and shoulder are moved backward, knees are bended and hips are hyper extended. After that moment the hitting arm swings up and forward. First, the hitting shoulder achieves its peak velocity and then follows the elbow, wrist and hand; consequently the opposite knee is rising up and forward and no-hitting arm is pulling down. The outcome of defined kinematical chain is production of power that will be transferred on the ball in the moment of the hit.

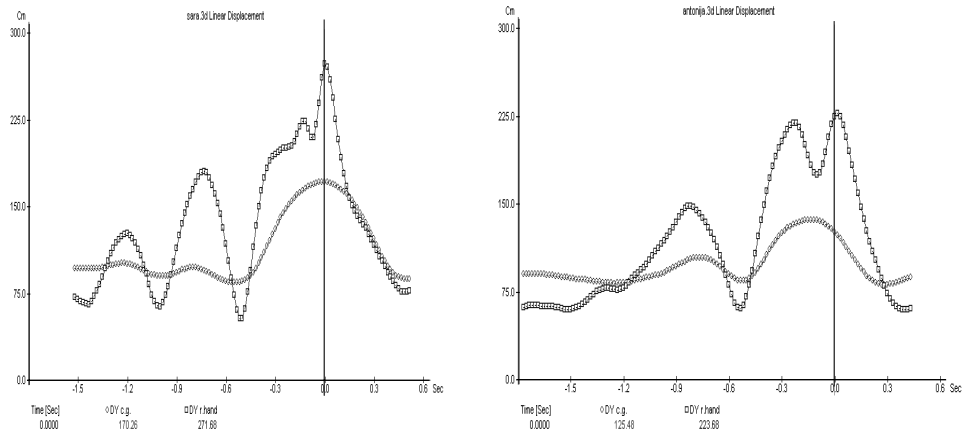
The subject of this study did not have necessary body arch, it was 17.6 deg smaller then the body arch of the model, the knees of subject were not bended and the heels did not go backward. Consequently, prior the swing of the hitting arm, there was no so called "dynamic stability" of the body in the air, and possibility of the achieving the expected hand velocity was limited (Graph 1). Before the ball impact, there was no orderly progression of the peak joint centers velocities, so the peak shoulder velocity was achieved in the same time with elbow and wrist (Graph 2).

Also, the velocity of subject's hand and elbow was rising after contact with the ball, showing that the hand of the subject was purposely slowed down prior the hit, due to previously mentioned "false" take-off timing (too early take-off).

Ball impact

The power of spike action depends of velocity of the hand before hit and the moment of spike, which has to be at the maximal height of CM during the flight. Such a good timing occurred in the case of the spike executed by the model

player. On the contrary, at the moment of the ball impact, the CM of young cadet player has moved down for 10,6 cm from its highest position of the flight trajectory (Graph 3). Furthermore, the forearm was below the ball, and there was no forward bend of the trunk, showing that abdominal muscles did not accomplish their work.



Graph 3 – CM and hand trajectory of the elite and novice volleyball player

As a result of all these technical errors, generated through approach, take-off, flight and ball impact, the spike was not high enough, the ball velocity is smaller and its trajectory is curved.

Landing

The most important is to land softly, with no any trauma on joints. The landing has to be first on toes, following with the rest of the foot, with bending in knees. The knee angle at the end of spike action depends on height of jump and inertia of the body. In the case of this research, the subject did not bend her knees enough, 16,3 deg less then the model, although there was no real necessity for such action since the height of the flight was much lower.

Comparing a complete spike of novice player with the spike executed by highly skilled player it is evident that the first had less powerful spike. Some of the reasons for that lie in different anthropometrical characteristics, subject's status of physical conditioning, as well as in the net height (224 cm). However, there are still many errors in subject's spike execution that can be considered as mainly technical. Since those errors significantly determine the height and the speed of the spike, it is necessary to analytically apply further changes in subject's spiking technique:

- Start approach a bit later
- Accelerate the approach
- Low down the CM before the take-off
- Use maximal arms swing, coordinated with the take-off
- Raise heels backward after take-off to enlarge the body arch
- Use abdominal muscles for more forceful shoulder and arm swing

According to results of this analysis, after the correction of the detected errors, the spike of the subject could be higher for at least 10 cm, and faster for almost 40%, which will significantly improve the efficiency of spike.

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KINEMATIC ANALYSIS OF WOMEN'S HAMMER THROW – A CASE STUDY

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Abstract

Results shown in this paper are based on kinematical analysis of wining throw at Athletic meeting IAAF Grand Prix Zagreb 2003. in women's hammer throw. A three-dimensional photogrammetric technique was used, filming the competition with two digital cameras (operating at 50Hz). APAS analyzing system was used to obtain 3D kinematical parameters.

Distance thrown 73.31m performed by Manuela Mentebrun is characterized with high release velocity 28.28m/s and close to optimum release angle 39.68º. This analyze is a contribution in study of hammer throw technique best female throwers and results can be used for comparison with other similar researches, or can help in development of young hammer throwers.

Key words: *3D analysis, top level female thrower*

Introduction

Women's hammer throw is one of the youngest athletics discipline and had relatively quick increase of best world results from 65.40m in 1993. to 76.07m in 1999. year (current world record achieved by Mihaela Melinte). One of the best women's throwers is Manuela Montebrun (FRA) with personal best 74.50m (48. place in all time lists, only four throwers had better result). She won a bronze in hammer throw At World and Europe Championship in Athletics 2003. and 2002. So, Manuela's Montebrun technique is representing very best women's hammer throwers.

Except the fact that women's hammer is easier (4kg) then men's hammer (7.26kg), there is no significant difference in technique of women's and men's hammer throw. Most advanced women's throwers are also using a four-turn technique. Body position and segmental angles match with men's features of throwing. Generally, some characteristic of hammer throw can be set:

- Preliminary swings where in high point of second swing is an active turn of the upper body towards to the hammer,
- Initial stance in shoulder with or wider, with an decrease of stance during the turn's,
- Shortening the duration of single support phases from turn to turn, with the double support phases being longer then the single support phases,
- During the preliminary swings, turns and release important thing is to keeping the left shoulder lower then the right (right handed throwers) because the left shoulder is a center of rotation at entrance and the axis of rotation for the single support phase of the turns that follow.

In the hammer throw, the distance thrown is determined by the release velocity, the release angle the height of release and air resistance, and is represented in equation (Bartonietz et al., 1997):

$$D=v^2_0/g\ cos\alpha\ (\sqrt{sin^2\ \alpha\ 2gh_0/v^2_0})\pm C(m)$$

D= The distance of thrown (m)

V_o= Hammer velocity at release (m/s)

α= The release angle (degrees)

h= Height of release (cm)

g= The acceleration of the Earth (9.81m/s²)

C= A factor characterizing the influence of air resistance on the distance thrown.

The most important factor for a long throw is the release velocity and it is one of the factors which can be maximize by the athlete's action, the others can have optimal values according to the athlete's technique and morphological (height, mass) and physical capacities (strength, power). Linear relationship between release velocity and distance of thrown is shown in Figure 1 for distance from 40 to 70m.

An optimal release angle is 45º and difference of 5º in the release angle causes a reduction in a distance thrown for about 1m.

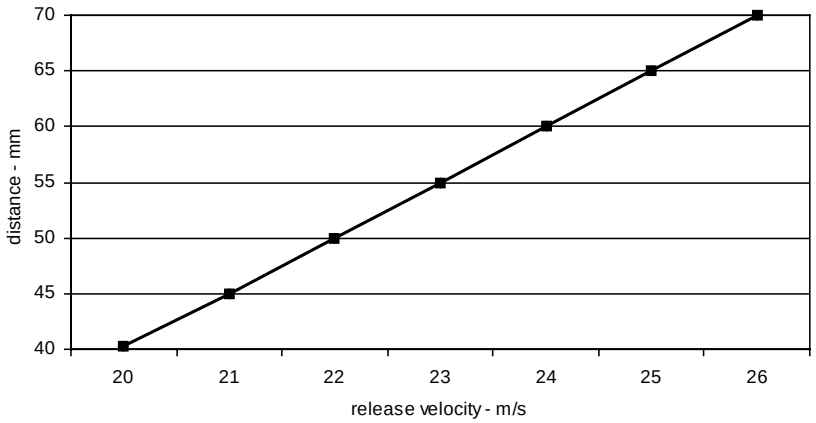

Figure 1. Relationship between release velocity and the distance thrown in the women's hammer throw (height of release 1.5m, release angle 40°)

For a throw distance of 70m with the men's implement, air resistance will reduce the distance thrown by approximately 1.5m (Tutevich, 1967). The women's implement has a smaller surface (75% of the men's implement) and therefore air resistance may reduce the women's throw about 1m.

Probably the most crucial part of the throw is the entrance. If the entry into the throw is good, the majority of the time the throw will be good as long as the thrower turns correctly. However, if the start of a throw is incorrect, the result is almost always a bad throw since the thrower will usually not be able to correct the errors as he turns.

A comparison of the release velocity and release angle (Hunter et al., 2003) of men's and women's throws at the 2002. US Nationals indicated that men and women had very similar release angle (M=36.3°±1.9°; W=36.9°±2.9°), but they significantly different in release velocity (M=26.2±0.8m/s; W=24.9±0.9m/s).

The purpose of this study was to investigate basic kinematics' parameters for achieving women's hammer throw over 70 meters.

Methods

The subject of this study was a top level 24 year old female hammer thrower Manuela Montebrun (FRA), height 175cm weight 90kg (at instant of competition). The filming was done at IAAF Grand Prix Zagreb 2003. Athletic meeting and she's best throw (73.31m) was used for analysis.

The performance has been recorded by two digital video cameras (PAL system, 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 and 2 points for describing the implement, were manually processed for each frame of the movement. Reference scaling frame was placed in the throwing circle before the competition 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 hammer parts were then filtered using Cubic Spline smoothing method. The smoothed coordinates were used to calculate different kinematics' parameters necessary for description of hammer throw technique.

Result

Distance thrown and basic kinematics' parameters at hammer release are shown in Table 1.

Table 1. Distance thrown and velocities, height and angle at release

Variables	Values
The distance thrown (m)	73.31
Resultant hammer velocity at release (m/s)	28.28
Horizontal hammer velocity (m/s)	21.75
Vertical hammer velocity (m/s)	18.06
Height of release (m)	1.78
The release angle (degrees)	39.68

Those are key parameters for calculating the distance thrown: release velocity, release angle and height of release.

Duration of single and double support phases for each turn and total time of throw are shown in Table 2. Total time of throw was calculated from beginning of 1st turn (instant of lifting the right foot) to the end of throw – moment of hammer release. Each turn is divided into single support phase (Ph1) and double support phase (Ph2).

In Table 3 are shown placement of hammer and center of mass (CM). Those parameters are calculated at instance of lowest (double support) point of hammer and highest (single support) point of hammer. At this moment are also calculated velocities of hammer, left knee angles and hip angles. Finally, all those parameters are calculated and for instant of release.

Table 2. Duration of single and double support phases

	Turns				Total time (s)
	1st	2nd	3rd	4th	
Single support phase (s)	0.26	0.26	0.24	0.24	2.02
Double support phase (s)	0.34	0.26	0.20	0.22	

Table 3. Values of hammer height, CM height, hammer velocity, hip angle and knee angle for each turn

	1st turn		2nd turn		3rd turn		4th turn		
	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Release
Time (s)	2.30	2.02	1.66	1.34	1.08	0.82	0.58	0.36	0.00
Hammer height (cm)	182.62	66.06	203.32	10.03	226.09	8.95	236.09	10.62	178.9
Center of mass height cm)	84.11	81.53	81.89	78.28	86.85	83.67	88.83	87.78	95.03
Hammer velocity (m/s)	11.25	17.69	19.28	20.05	22.88	23.40	23.78	25.78	28.28
Hip angle (°)	118.15	101.00	124.04	97.30	131.28	109.47	137.04	128.51	174.84
Left knee angle (°)	153.78	125.76	105.75	96.77	106.14	105.62	116.92	105.44	168.65

Left and right shoulder heights are shown in Table 4 for each turn and moment of release.

Table 4. Left and right shoulder height for each turn

	1st turn		2nd turn		3rd turn		4th turn		
	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Ph 1	Ph 2	Release
Time (s)	2.30	2.02	1.66	1.34	1.08	0.82	0.58	0.36	0.00
Left shoulder height (cm)	114.57	122.83	109.54	121.40	118.33	126.63	125.72	128.87	129.16
Right shoulder height (cm)	115.24	123.84	112.18	120.89	121.50	126.32	127.62	128.47	135.34

Discussion

Distance thrown 73.31m would be enough for bronze medal at OI Athens 2004. in women's hammer throw, so we can say that is an excellent throw. Most important parameters which lead to this distance are release velocity 28.28m/s and release angle 39.68º with height of release at 178cm. Some authors did not found clearly relationship between release angle and distance thrown (Hunter et al., 2003) but in their paper it is clearly noted importance of release velocity on distance thrown. Theoretical angle of release is 45º but more often release angles are from 36-39º (Bartonietz et al., 1997; Bartonietz, 2000; Hunter et al., 2003). It is very difficult to achieve a great angle release with relatively high release velocity. In analyzed throw both of release velocity and angle had a high values.

In duration of certain turn phases shown in Table 2 it is notable slightly shortening in duration of single support phases and also shortening of double support phases from turn to turn. One of the basic demands for achieving sufficient acceleration is longer duration of double support phases in relation with single support phases. In analyzed throw that is partly in accordance with demands of proper technique because there is no enough difference in duration of mentioned turn phases. Because most kinetic energy is producing exactly in double support phases they should be a little bit longer.

Hammer velocity had a regular increase from beginning of throw to the instant of release with a significantly higher increase of hammer speed during the double support phases.

Hip angles and left knee angles shown in Table 3 having higher values during the single support phases with lowering in double support phases. Such result are in accordance with expectation, however those values should be lower then 100º in purpose to obtain more stability and higher output power especially using the leg muscles. Also a lower position give opportunity for increase a radius hammer rotation and contribute to bigger acceleration of a hammer. In analyzed throw that values are not in satisfactory level especially during 3rd and 4th turn.

Left shoulder during the turns and release had lower position then the right shoulder (Table4) and help thrower to keep dynamic balance. Lower position of left shoulder also provides an optimal tension of muscle and adequate interaction between so called "thrower-hammer" system. With that characteristic left shoulder position a thrower can produce maximal force for a good throw.

Conclusion

Based on performance of top level female hammer thrower, results of this study represent a necessary set of kinematics' parameters for achieving similar or longer distances thrown.

Although a good performance, we assumed that some corrections can be made in objective to improve quality of turns. Especially, it could help a lower body position in double support phases that can afford a better power efficiency in function of hammer acceleration. Proper leg work, in the meaning of duration single and double support phases will as well produce an gradually and effective hammer acceleration.

Also results of this study can be used for a comparison with results in similar researches, or for identifying a technique quality for young female hammer throwers.

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COMPARATIVE KINEMATIC ANALYSIS OF TEACHING AND COMPETITIVE PERFORMANCE OF THE *OSOTO-GARI* THROW

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Summary

There are different throwing techniques in judo, but also different ways of performing the same throws. For example, a teaching performance of some judo throw is above all characterized by good technical demonstration, emphasizing the practical demonstration of spatial actions of particular body parts. Contrariwise, the basic objective of the same throw, when performed as a competitive technique, is to surprise the opponent and enable his symbolic destruction. The purpose of this paper was to determine the biomechanical similarities and differences between the teaching and competitive performance of the *osoto-gari* throw. Data gathered by 3D cinematic analysis showed the biggest differences in first phase of this throw, which takes significantly less time in the competitive variant than in the teaching one, in order to prevent the opponent's reaction. In the latter phases, differences have been less marked, since in both techniques it is necessary to produce and realize the sufficient amount of push and swing, necessary to off-balance the opponent.

Introduction

Their basic goal of executing any throwing techniques is to off-balance the opponent in to the direction of the throw. By performing some specific body movements and making adequate body contacts, it is important to prevent the opponent from re-establishing the new supporting surface and regaining the stable posture. The opponent's balance will be unstable more if his center of mass projects further from the support surface center. Since it can be performed in many different ways, the individual style of applying the throwing techniques can be noticed among various judo players.

Osoto-gari is a throwing technique that belongs to the group of leg techniques executed in an upright position. This technique provides an efficient throw with maximum points – ippon. As mentioned, the *Osoto-gari* throw can be executed in different stiles. Among others very common versions are the teaching and the competitive one. The teaching performance is often seen in different schools of combat sports, kinesiology oriented curriculum and extra-curriculum programs, as well as in various promotional programs. Its basic purpose is to demonstrate the technique in a simplest and most popular way. The competitive performance of that throw comprises the same motion structure as the teaching performance, but its basic objective in a direct clash with the opponent is a symbolic destruction and winning. The question is, are there relevant differences between the teaching and competitive performance, particularly from the biomechanical point of view? In an attempt to give some of the answers on this question, the purpose of this paper is to determine the basic kinematical differences between the teaching and competitive performance of the *osoto-gari* throwing technique.

Methods

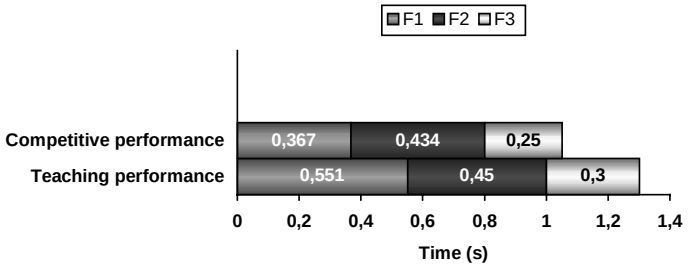
Acquisition of the video material was completed during regular training session, by three digital video cameras, at the speed of 60 fps. Ten executions of the two osoto-gari throwing techniques, performed by the Croatian national judo team member, have been taped, after which the best performances (teaching and competitive ones) have been selected for the purpose of this analysis. The Croatian national team member performed

Data processing (APAS system) has been modified to serve the needs of the combat sports analysis, which is noticeable in the additional modeling of the opponent's anthropomorphic body model. Algorithm DLT has been used for transforming the data into 3D space, whereas for the data filtering, the Cubic Spline Filter has been used.

Results

A total duration, including all three phases[1] of the entire osoto-gari competitive performance lasted 1.05 s, whereas the teaching one lasted 1.30 s (Graph 1.).

[1] *Each throwing techniques consists three phases: off-balancing the opponent (kuzushi), getting the body into proper position for a throw (tsukuri) and the throwing action itself (kake).*



Graph 1. Duration of the throw

Table 1. shows significant differences in horizontal and vertical shifts of *tori*[1], in relation to *uke*[2] in the teaching and competitive performance.

Table 2. shows that foot velocity of the tori's supporting leg is twice as higher in the competitive performance as the one registered in the teaching performance (7.40 m/s in proportion to 3.70 m/s).

Table 1. Amplitudes of the center of gravity during the off-balance phase (cm)

	Tori		Uke	
	CG x	CG z	CG x	CG z
Teaching performance	43,5	27,5	3,7	6,8
Competitive performance	33,1	23,2	4,6	0,1

Table 2. Foot velocity (m/s)

	Teaching performance	Competitive performance
Supporting leg F1	3,70	7,40
Swinging leg F2a	5,82	7,46
Swinging leg F2b	6,39	6,70

(F2a-foreward movement of the swinging leg; F2b-backward movement of the swinging leg)

In Table 3. it is evident that the peak angular velocity of the trunk (forward bent) is significantly lower in the competitive performance in relation to the teaching performance.

Table 3. Peak angular velocity of the trunk (deg/s)

	Teaching performance		Competitive performance	
	Left	Right	Left	Right
Trunk F2a	165,89	108,81	104,95	68,23
Trunk F2b	221,97	314,36	445,04	389,36

Discussion

As expected, the competitive performance of the *osoto-gari* throw has been executed 19.2% faster than the teaching performance (Graph 1). That difference is the most observable during the first phase of the performance, due to the additional jump element that accelerates the lower part of the body. The performance of the *osoto-gari* throwing technique with applied jump element belongs to the throwing techniques with high percentage of effectiveness, speed and timesaving.

It is interesting to analyze the duration of the throw through all three phases. Namely, although the competitive performance was faster for one-third then teaching performance, it happened mostly through the first phase of the throw (off-balancing the opponent), which is an after-effect of the additional jump when entering the attacking space. In the second phase of the throw, this difference is irrelevant (0.017 sec), while in the third and last phase the competitive performance was faster for 17 percent, due to the demand for more active finalization of the throw. It is a necessity that encloses an additional thrusting of the opponent onto the mat and overtaking the control.

Based on the above-mentioned after-effects, it can be concluded that the first phase of the throw has been executed significantly faster than the teaching performance, in order to reduce the counter-attack reaction of the opponent. There are no significant differences between the teaching and competitive performance in the last two phases of the throw, for it is necessary to produce and realize the sufficient amount of push and swing to off-balance the opponent. This is equally important in both performances. Considering the goal of the first phase (off-balancing the opponent), it is interesting to notice the spatial shifts and motion amplitudes of *tori's* (the one who performs the technique) and *uke's* (the one who receives the technique) center of gravity in this phase.

Table 1. shows evidently smaller horizontal shift of *tori* in relation to *uke* in competitive performance, and, which is especially interesting, the absence of lateral movement (side-off-balancing). By doing so, the tori prevent the indication of the throw which obstruct the on time counterattack of uke.

[1] *the one who performs the technique*
[2] *the one who receives the technique*

Foot velocity of the *tori's* supporting leg is twice as higher in the competitive performance (7.40 m/s in proportion to 3.70 m/s) as the one registered in the teaching performance (Table 2.). Partially, this is an after-effect of the basic technique modification, which refers to the jump in the initial phase of the throw. The aforementioned jump brings an additional initial impulse to a complete performance, providing an easier off balancing of the opponent, which is also a goal of the applied technique.

The difference in velocity of the driving leg is somewhat smaller, but still evident. In the first part of the motion (F2a - swing forward), velocity is still noticeably higher than in the teaching performance, whereas in the swing backwards (F2b), this difference becomes almost irrelevant. According to data, the applied jump onto the supporting leg in the competitive performance provides, without a doubt, a faster entering the attacking space. It means a faster support setting for the kinetic chain action, which is transferred from the surface through lower extremities up to the trunk and arms.

The data on the angular velocity of the trunk in the most important part of the throw speak in favor of the above-mentioned statement. Namely, it is evident from table 3 that during the first part of the *tsukuri* phase the angular velocity of the trunk is significantly lower in the competitive performance than in the teaching performance. This is caused by the fast leg movement that makes the trunk fall behind. It is typical in both techniques to see the right side of the trunk moving somewhat slower. Contrariwise, after placing the supporting leg and an effective use of the kinetic chain, the left side of the trunk accelerates up to 4.45 m/s, which is twice as higher in the competitive performance as the one registered in the teaching performance.

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RELATIONS AMONG PERFORMANCE QUALITY (DW), GROUND REACTION FORCES, ACCELERATION AND TURN RADII IN MEN WC SLALOM RACES

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Short abstract

Three independent 3D kinematical measurements have been performed on the SL WC cup races in Kranjska Gora. All together 45 runs have been included in the investigation of relations among the performance quality – differential specific mechanical energy, turn radii, accelerations and ground reaction forces. It has turned out that the last three parameters strongly depend on the course setup, configuration of the terrain, snow basis and skier's kinetic energy. Their usage to determine the general skier's performance is limited only to special cases. Several contradictions to the common experts' knowledge have been proven.

Key words: *world cup slalom races, 3D kinematical measurements, differential specific mechanical energy, radius, force, acceleration.*

Introduction

Several relevant questions still remain open in top level ski racing concerning fundamental understanding of defining a well-performed ski turn. Ski experts, especially coaches, often use turn radius, acceleration or ground reaction forces to evaluate the skier's performance. Some of these parameters can be measured "real time" and the analysis of results can be given immediately after the ski run, directly on the slope. However, it is questionable which parameters are relevant to the quality of ski racing. Recently, two scientific approaches of estimating the quality of performance have been introduced. One implying the generalized friction parameter (Ducret et al., 2004) and the other one an integral parameter of differential specific mechanical energy dw (Supej et al., 2004). Both approaches produce the estimation of quality of skiing performance in each point of observation and have a much profounder biomechanical meaning. This paper deals with relations among the performance quality – differential specific mechanical energy and acceleration, turn radii as well as forces based on the 3D kinematical measurements in men's World Cup slalom races.

Methods

Standard 25 Hz 3D kinematical measurements based on the reduced 12 point human model consisted of three subspaces recorded by six synchronized Sony DV camcorders were taken during slalom WC races in Kranjska Gora (Vitranc Cup) 2002 & 2003. Forty-five runs of top–level WC racers were measured and investigated on both courses in 2003 and on the 2nd course in 2002. The 1st run was measured on the average slope inclination of 24° and the 2nd run in both cases on the average slope inclination of 20°. The 1st course consisted of two "normal" gates and a hair pin, the 2nd one in 2003 consisted of two "normal" gates and one undergate while the 2nd course in 2002 consisted of three "normal" gates. Each measurement lasted approximately 3 seconds. Digitalisation was performed by APAS Ariel. We used our own specially designed software package KinSki 3.1 (Supej et al., 2004 - II) for the analysis of raw data as they emerged from the APAS software. The differential specific mechanical energy – dw as introduced by Supej and associates (Supej et al., 2004) was calculated in each point of observation as the main performance quality parameter. Physically dw represents a derivation of the specific mechanical energy by the altitude difference (the differential specific mechanical energy). The specific mechanical energy, i.e. the mechanical energy composed of kinetic and potential energy divided by the mass of a skier, was calculated from the three dimensional CG's trajectory.

Furthermore, CG's turn radii, accelerations as well as forces have been calculated in each point of observation. Turn radii R were received by fitting an arc segment on each set of three neighbouring points on the CG's trajectory. The 2nd Newton's law was used to estimate ground reaction forces F. They were calculated as a sum of the acceleration vector multiplied by the mass of the skier and the static component of the gravity force. The final ground reaction force is presented by a specific value, where it is divided by the mass of the skier and the gravity constant. The last parameter, the skier's acceleration a is calculated from the filtered (Butterworth 7 Hz, 3rd order) CG's absolute velocity.

All the data from three SL courses were treated in 5 groups. In the 1st group all data for each parameter were collected. The second group of data consisted of ten best performing racers achieving times between 2.88 s and 3 s during the inspected interval on the 1st course, similarly the remaining 9 racers achieving times between 3.04 s and 3.20 s were

gathered in the 3rd group. The 4th and the 5th group consisted of all 15 racers on the 2nd course 2003 and 11 racers on the 2nd course 2002 respectively. The data were collected in several diagrams. In order to prove some chosen hypotheses linear regression, a 95 % confidence interval and residuals have been applied to the data and drawn on the diagrams.

Results

Ten points in the beginning and in the end of each skier's measurement have been truncated in order to avoid any boundary calculation error. Nevertheless, over 2600 points have been investigated. The whole group consists of all points and the other groups are formed according to the number of skiers and time of measurement, which is very close to 3 seconds in all cases.

Figure 1 (top) shows the relation between acceleration and differential specific mechanical energy. Linear regression with a 95 % confidence interval for the data interval up to 5 J/(kg*m) is shown as well. Regression parameters are marked on the diagram. The bottom diagram shows residuals for the linear regression and the norm of residuals. Similarly, Figure 2 shows the acceleration versus differential specific mechanical energy for all four inspected groups. In this case the "all data group" diagram is drawn beneath each group to help guiding the eyes.

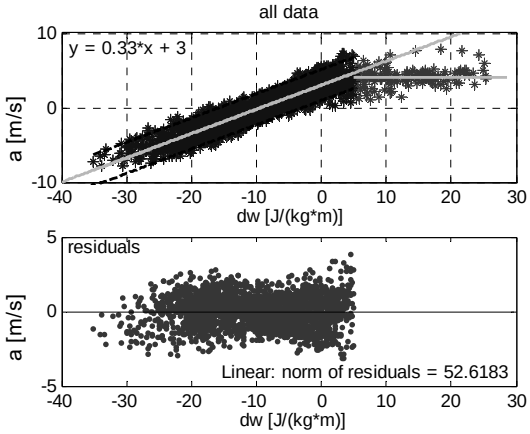

Fig. 1: Relation between acceleration and differential specific mechanical energy for the 1st group – all data.

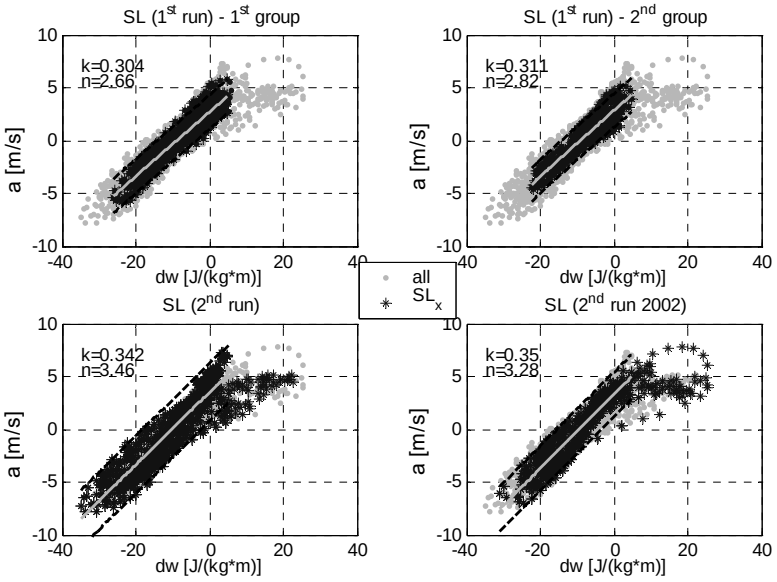

Fig. 2: Acceleration in relation to differential specific mechanical energy for four groups: top left: SL 1st course, 1st group; top right: SL 1st course, 2nd group; bottom left: SL 2nd course, 2003 and bottom right: SL 2nd course, 2002.

The relation between CG's turn radii and the differential specific mechanical energy is presented in Fig. 3 for all four individual groups "drawn over all data group". Similarly, ground reaction forces in relation to the differential specific mechanical energy are shown in Fig. 4. Relations between the acceleration and the ground reaction forces have been taken into consideration as well, but they are not shown on the diagrams. Linear and quadratic regressions with residuals have been applied to data in Fig. 3 but they are not shown on the diagrams.

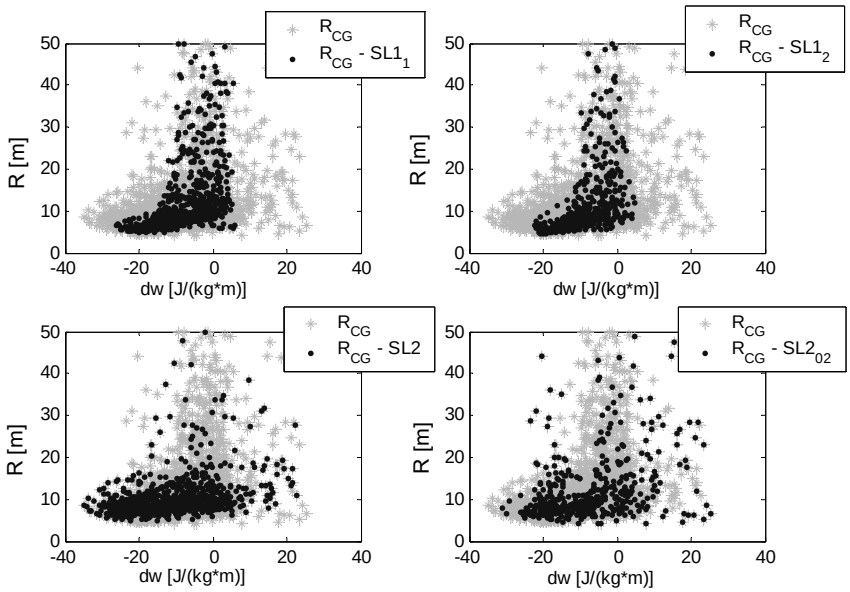

Fig. 3: CG's turn radii in relation to differential specific mechanical energy for four groups: top left: SL 1st course, 1st group; top right: SL 1st course, 2nd group; bottom left: SL 2nd course, 2003 and bottom right: SL 2nd course, 2002.

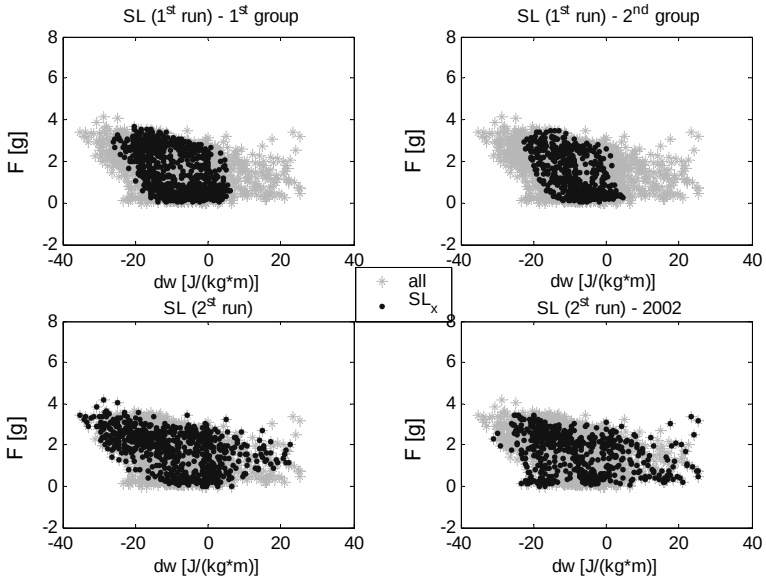

Fig. 4: Ground reaction forces in relation to differential specific mechanical energy for four groups: top left: SL 1st course, 1st group; top right: SL 1st course, 2nd group; bottom left: SL 2nd course, 2003 and bottom right: SL 2nd course, 2002.

Discussion

The analyses in Fig. 1 and 2 show that there is a good linear relationship between the acceleration and differential specific mechanical energy at the interval up to 5 J/(kg*m). The linear relationship is not surprising. Differential specific mechanical energy could be written in the unit of gravity, because J/(kg*g) equals m/s^2. Nevertheless, it has to be borne in mind that the *dw* parameter is much more complex than pure acceleration and it reflects the energy dissipation during skiing. The linear relation is proven by the homogeneously distributed residuals. On the other hand, high dispersion of data reaching approximately ±2 m/s^2 in the 95% confidence interval can be observed. This also means that the acceleration is not a very good quality parameter, because even when acceleration is positive, very high energy dissipation could be present and vice versa. Furthermore, the configuration of the terrain and the course setup influence the relation between energy losses or the parameter *dw* and the acceleration (see Fig. 2). Two different courses on the same terrain in Kranjska Gora (2nd course in both races in 2002 & 2003) had an almost identical linear relation parameter k~0.3 (Fig. 2, bottom)

and of course, a remarkably different one from the 1st course where k~0.35. Similarly, the constant parameter n in linear regression is again attached to the terrain properties with the values close to 2.6-2.8 m/s^2 and 3.3-3.5 m/s^2 for the steeper and flatter slope respectively. The width of a 95% confidence interval is also different when two slopes are compared and even among the courses on the same slope, most probably as a consequence of a different gate setup and snow-base conditions.

Relations between the turn radii and the *dw* parameter were performed both on the CG's trajectory and the ski's trajectory. Because there was no considerable difference we decided to show only the CG's turn radii. Generally, huge dispersion and weak linear relation between the turn radii and *dw* was found out (Fig. 3). As it was expected, shorter turn radii result in higher energy losses (Fig. 3). Again, differences related to the slope are observable. The dispersion of the turn radii around the same energy dissipation was much lower on the steeper slope than it was on the flatter one, especially in the region bellow $dw < -10$ J(kg*m). Different turns and different racers result in very different energy behaviour, e.g. measurements show that performance around 8 to 9 m turn radii resulted in a variety of differential specific mechanical energy values ranging from -30 to +10 J/(kg*m). On the other hand, it was slightly surprising that even at long turn radii over 10 m the dispersion of the *dw* parameter was very high. These long turn radii mostly belonged to the area of weight transfer. This area seems to be one of the most important parts of the turn not only technically, but also tactically.

An interesting result is that the second group on the 1st course, i.e. the slower group, (Fig. 3, top right) had higher density of shorter radii than the 1st group. Besides that the 1st group had much higher density of the radii around 7 to 10 m with *dw* around 0 J/(kg*m). This leads to the conclusion that the shortest way is not the fastest in contradiction to the belief of most coaches.

It has already been proven that the ground reaction forces calculated from the kinematical measurements are disturbed by an error due to skier's ability of absorbing force peaks and due to double differentiation where the measuring error is emphasized (Luthi et al., 2004). Nevertheless, the main behaviour of forces is good enough to find out the basic relations. One would expect a strong force-*dw* relation, but our measurements show a different picture (Fig. 4). Huge differences can be observed in the quality parameter *dw* of the same ground reaction force. Only the upper boundary of the diagram area shows a nice linear relation in all cases. In other words, excellent energy behaviour cannot be achieved when high forces are present. Furthermore, in all four groups energetically the worst performance (the lowest *dw*) happened at the highest forces. This proves the statement that it is preferable to avoid or to reduce the presence of the highest forces in most cases. The relation between the acceleration and the ground reaction forces is much different than expected. In all four groups inverse linear proportion can be observed, but again high dispersion of the acceleration can be observed with the same amount of forces acting. Another two boundary incidents are important: in case of low ground reaction forces acceleration is usually present and on the other hand, when very high forces are active (over 3g), skiers decelerate. It should be pointed out that neither of the results could be generalized.

To conclude the paper, it turns out that the turn radii, forces and accelerations are indeed very important parameters in skiing, but they strongly depend on different / various cases. Knowing only one of the parameters mentioned cannot lead to any general or final conclusion of the skier performance. At least one of the complex quality parameters should be measured and calculated as well. The main contribution of this work is the disproval of several common experts' opinions especially those concerning acceleration and turn radii.

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VELOCITY OF MOVEMENT OF INTERNATIONAL AND NATIONAL SQUASH PLAYERS

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Abstract

In the game of squash, the players velocity of movement mostly depend on the playing tactics, which is based on player's movement from the basic position (T-position) towards the ball and back to T-position after striking the ball. The aim of this research was to establish whether the velocity of movement of international players was higher than that of national players. The sample consisted of 16 world top players and of 14 Slovene top squash players. In both competitions 11 matches were videotaped with a SVHS video-camera. The video-recordings were digitised and than processed by the Sagit/Squash tracking system. The differences between both groups of players was established using the one-way analysis of variance. The results show that the average velocity of movement of international players in a rally was statistically significantly higher than that of national players. This could be due to their more attacking playing tactics or more accurate and efficient employment of a similar playing tactics.

Key words: *squash, velocity of movement, international players, national players, differences*

Introduction

Owing to the fact that squash court is a closed and relatively small area, the movements of squash players are characterised by short runs, frequent stops and acceleration as well as changes of direction. The manner and velocity of movement also depend on the playing tactics. The latter is based on player's movement from the basic position (T-position at the centre of the court) towards the ball and back to T-position after striking the ball. The distance covered by players in a given direction is therefore short, preventing them from developing maximal velocity of movement.

On the other hand, the above mentioned playing conditions and tactics result in rapid returns of the ball and hence continuous movement of players. Based on the previously mentioned we believe that the average velocity of movement may be a good indicator of the playing dynamics.

Hughes and Franks (1994) established the average velocity of movement of winners and losers in four groups of squash players of different quality. The average velocity of movement by quality group ranged from 1.47 ms^{-1} (group of worst players) to 1.98 ms^{-1} in the group of best players. They established that in three groups the average velocity of movement of losers was significantly higher than that of winners of individual rallies. The differences between winners and losers in terms of average velocity of movement in a rally of an individual game were also studied by Vučković et al. (2003). The authors established a similar velocity of players' movement, which on average was 1.60 ms^{-1}, nevertheless, the differences between the winners and the losers were not statistically significant.

In none of the mentioned studies the authors dealt with the differences in velocity of movement of players of greater or lesser playing ability (quality level). Therefore, we decided to establish whether the velocity of movement of international players was higher than that of national players.

Methods

The matches in two different competitions, namely the World Team Championship (Vienna, 2003) and the Slovene National Championship (Ljubljana, 2003), were videotaped with a SVHS video-camera. The sample of players playing in the world championship consisted of 16 top squash players of the world and the sample of players playing in the national championship consisted of 14 Slovene top squash players. In both competitions 11 matches were analysed, taking into account the results of both players by game. In international players, the total number of units was 84 (42 games by two players) and in national players 88 (44 games by two players).

The video-recordings were then digitized using the Video DC30+ video digitizer hardware (Miro, Germany) with the resolution of 384x576 at 2 MB/sec data rate, while the processing was carried out at a resolution of 384x288 pixels. Digital images were processed by the Sagit/Squash tracking system (Perš et al., 2001).

The sample of variables comprised the average velocity of movement of both players in a rally of an individual game.

The data collected for each game were processed by the selected descriptive statistics methods. The differences between both groups of players in the area of a selected variable was established using one-way analysis of variance. All data were processed by the statistical programme SPSS 12.0 for Windows.

Results

Tables 1 and 2 show the average velocity of movement of both groups of players in a rally as well as the differences between them.

Table 1. Descriptive statistics of average velocity of movement in both player groups (m/s)

Variable	N	MEAN	SD	MIN	MAX	K-S	SIG
xaV-I (m/s)	84	1.48	0.06	1.29	1.61	0.48	0.98
xaV-N (m/s)	88	1.29	0.10	1.12	1.53	0.62	0.84

(xaV-I) - the average velocity of movement of international players, (xaV-N) - the average velocity of movement of national players, (N) - number of played games, (MEAN) - arithmetic mean, SD - standard deviation, (MIN) - minimal result, (MAX) - maximal result, (K-S) - Kolmogorov in Smirnov test of distribution normality, (SIG) - significance of K-S test

Table 2. Differences between both groups of players

Variable	Players	MEAN	SD	F	p
	International	1.48	0.06		
xaV (m/s)	National	1.29	0.10	102.27	**0.000**

(xaV) - Average velocity of players movement

In international players the average velocity of movement in a rally was 1.48 m/s, and in national players 1.29 m/s. The differences were statistically significant (Table 2).

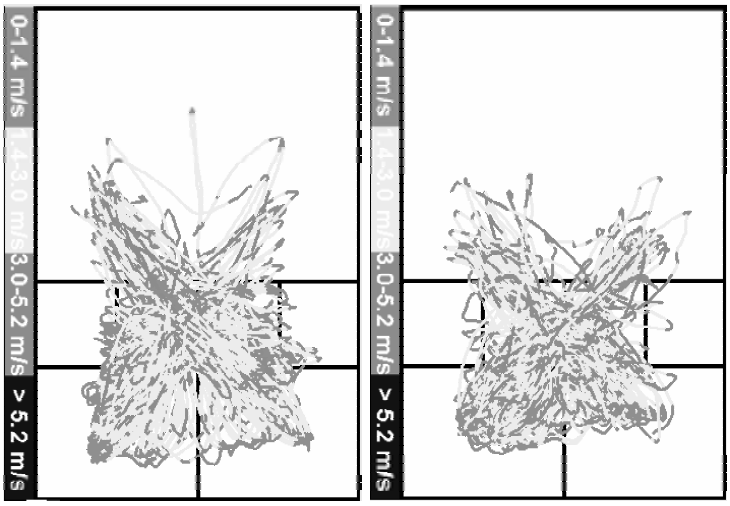

Figure 1 and 2: Movement of an international player (left side) and a national player (right side)

Discussion

The results in Tables 1 and 2 shows that the average velocity of movement of international players in a rally was significantly higher than that of national players. The higher average velocity of movement of international players could be a consequence of their more attacking playing tactics. With their attacking strokes they exerted pressure on the opponents, leaving them little time to respond. Thus, both players had to move faster. The obtained results may as well be a consequence of more efficient employment of a similar playing tactics. When the ball was stricken by an international player, it positioned directly by the side walls i.e. close to the corners of the court, which means that international players played more accurately and efficiently (see figure 1 and figure 2).

Similar findings were also reported by Hong et al. (1996). They established a greater number of efficient and a smaller number of inefficient strokes in international players than in national players. Therefore, we assume that players of higher quality cover greater distances between the strokes, due to which their velocity of movement increases. This is also seen in Figures 1 and 2, showing movement of players in various velocity classes. In both cases a typical movement of squash players is seen, namely, movement in the shape of X. In an international player this shape is much narrower and longer, which confirms the assumption of a longer distance covered. The multicoloured paths of players at the back of the court show that the velocity of movement of international players is higher than that of national players, even at the back. Movement in this part of the court is characterised by basic or straight strokes, which are the most frequent in squash. We infer that international players execute these strokes more aggressively than national players, owing to which they are forced to move faster from the basic position (T-position) towards the ball and back to T-position after striking the ball.

The average velocity of movement of players from both samples was lower than established by Hughes and Franks (1994). The mentioned authors were measuring the velocity of movement only in the last ten seconds of selected rallies. This period coincides with the completion of an individual rally, in which the players find themselves either in superior or inferior position, which undoubtedly contributes to higher velocity of players' movement. Higher average velocity of squash players' movement was also measured in a research by Vučković et al. (2003), where the authors used the same tracking methodology (as in this research) and in which the error of the Sagit/squash tracking system during the measurement of velocity of movement was 0.39 m/s (Vučković, 2002). Slightly lower values of average velocity of players' movement in this research may thus be a consequence of the mentioned measurement error of the tracking system.

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THE APPLICATION OF TAPPING ON KNEE JOINT TO REINFORCING MUSCLE POWER

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Abstract

The current studying is to analyze scientifically the effects to the muscle function when taping is applied to the thigh after endurance exercise.

Two groups of 7 subject, taped and untapped, exercised using the Cybex orthothron device to exercise and strengthen the leg. After the exercise, the difference between the two groups were compared and analyzed. The following conclusion is the result of the analysis.

First, in the 60°/sec flexion exercise taping showed an effective meaning to the maximum muscular strength ($p<.05$), average power ($p<.01$), and total working quantity ($p<.001$).

Second, in the extension exercise, there was an effective of taping to the maximum muscular strength ($p<.05$), but no effects shown in the maximum average power, and total working quantity.

Third, in the 120°/sec flexion exercise, there were no effects shown in the maximum muscular strength, average power, and total working quantity.

Forth, in the extension exercise there were no effects shown in the maximum muscular strength, average power, and total working quantity.

Key words: *Taping, Muscle power, Extension, Flexion*

Introduction

For the improvement of athletic ability, there are several aspects of the sports science such as training, participating in, observing athletes. The main purpose of medical care for sports is to prevent from injuries and recovering with good treatments. One of the medical care measures is so called taping which originated from Japan about 20 years ago. It is taped on the muscles near joints, which makes extension and flexion of muscles easy.

For the most athletes who need muscle power activity, it is used as an important method of preventing from injuries, and as a treatment during athletic games. Especially, taping is understood as one of the sports medical cares to help the athlete's body remain flexible. Since it does not need any special skill for a taping care, it is recognized as a medical treatment to release the pain of muscles and joints area. Recently, the new flexible tapes for the extension and the flexion of joints were invented. Hence the usage of the effects of taping is increased. Nowadays, such a taping is considered as an important method to improve muscle power all over the world. However, there are few experiments to prove taping effects. Hence it is restricted in its usage to improve athlete's ability. In sports science, various analyze and the theoretical background to support the usage of taping is needed. The purpose of the studying is to analyze scientifically the efficient effects to the muscle revelation when taping is applied to the thigh after endurance exercise.

Methods

Sampling

Fourteen experimental subjects were randomly selected among college male students without any kind of body defects. We divided them into two groups; a taping group and a none-taping group. Their physical characteristics are as follows.

Table 1. Physical characteristics of subjects (M±SD)

Group	Age (yr)	Height(cm)	Weight(kg)
A(n=7)	21.6±0.7	178.2±5.1	72.9±8.6
B(n=7)	21.1±0.6	176.7±6.3	70.9±5.9
A: None taping group, B: Taping group			

Experimental method

An elastic tape was attached on near rectus femoris muscle and hamstring muscle. Finally, the auxiliary taping was on patella and patella ligament. In this study, flexible taping is used to analyze thigh functions for extension and flexion. We checked at 60°/sec and 120°/sec using the Cybex Orthothron.

Experimental equipment

Main experimental equipment are shown in Table 2. For checking equivocally, we used Cybex Orthothron.

Table 2. Experimental equipments

Measurement Items	Experimental Apparatus	Manufactory
Muscle Power endurance	Cybex Orthothron	Cybex (U.S.A)
Height Body Weight	GL-150	Cas(Korea)

Data analysis

SPSS 10.1 was used to analyze the data.

1) Standard deviation and mean of each point was computed

2) T-test was used for comparing each measured factor, with the significance level $p<.05$.

Results

1. Comparing the functions of knee joints of flexion and extension at 60°/sec.

Table 3. Highest muscle power of knee joint flexion and extension at 60°/s. (W)

Group			M±SD	T	P
Flexion	A	Pre Ex. Post Ex.	124.78±7.37 111.93±6.89	4.692	.269
	B	Pre Ex. Post Ex.	131.05±7.68 126.63±8.39	1.698	.013
Extension	A	Pre Ex. Post Ex.	229.95±13.94 254.81±19.79	-1.241	.301
	B	Pre Ex. Post Ex.	211.32±8.61 229.33±22.79	-2.675	.037

Table 4. Average power of knee joint flexion and extension at 60°/s. (W)

Group			M±SD	T	P
Flexion	A	Pre Ex. Post Ex.	93.79±11.98 80.01±9.11	4.793	0.45
	B	Pre Ex. Post Ex.	98.72±9.83 88.02±7.93	4.903	0.012
Extension	A	Pre Ex. Post Ex.	129.07±43.91 118.98±28.02	-1.107	.781
	B	Pre Ex. Post Ex.	146.86±19.43 137.83±19.52	-1.425	.891

Table 5. Total work of knee joint of flexion and extension at 60°/s. (Ws)

Group			M±SD	T	P
Flexion	A	Pre Ex. Post Ex.	149.76±17.38 130.72±25.89	3.429	.037
	B	Pre Ex. Post Ex.	169.63±17.32 149.87±18.56	6.913	.018
Extension	A	Pre Ex. Post Ex.	242.37±80.32 250.24±20.37	-.008	.461
	B	Pre Ex. Post Ex.	243.45±22.79 242.82±25.72	.372	.839

Table 3 shows, for the maximum muscle power of knee joint at the flexion and the extension of 60°/sec, there is no significant difference in case of A. On the other hand, there is a significant difference ($p<.05$) in case of B.

Table 4 shows, for the average muscle power of knee joint at the flexion of 60°/sec, in both A and B cases there is a significant difference ($p<.01$) in case of B. However, for the extension case, there is no significant difference. These results come from the fact that taping kept a balance between synergic muscle and antagonistic muscle. Muscles near the joint and tendons keep the stability continuously during the exercise by working together. Hence it is a good combination of agonistic muscle, synergic muscle and antagonistic muscle with taping. These results come from the facts that taping keeps the balance of synergic muscle and antagonistic muscle. Taping effects the agonistic muscle, synergistic muscle and antagonistic muscle efficiently.

Table 5 shows, for the total work of knee joint at the flexion of 60°/sec, in both A and B cases there is a significant difference($p<.01$) in case of B. However, for the extension case, there is no significant difference.

2. Comparing the functions of knee joints of flexion and extension at 120°/sec.

Table 6. Maximum muscle power of knee joint of flexion and extension at 120°/s.(W)

Group			M±SD	T	P
Flexion	A	Pre Ex. Post Ex.	101.49±36.7 118.67±10.4	-1.682	.862
	B	Pre Ex. Post Ex.	104.24±10.6 116.43±9..27	-1.482	.624
Extension	A	Pre Ex. Post Ex.	172.14±14.24 170.24±14.21	.341	.789
	B	Pre Ex. Post Ex.	164.32±11.49 175.32±14.69	-.714	.492

Table 7. Average power of knee joint of flexion and extension at 120°/s. (W)

Group			M±SD	T	P
Flexion	A	Pre Ex. Post Ex.	162.71±19.28 154.18±17.48	.894	.596
	B	Pre Ex. Post Ex.	153.72±3.41 158.71±13.72	-.791	.824
Extension	A	Pre Ex. Post Ex.	187.41±79.82 186.58±27.24	.011	.843
	B	Pre Ex. Post Ex.	186.32±24.19 184.36±24.81	.537	.492

Table 8. Total work of knee joint of flexion and extension at 120°/s. (Ws)

Group			M±SD	T	P
Flexion	A	Pre Ex. Post Ex.	135.14±19.86 136.24±14.92	-.614	.897
	B	Pre Ex. Post Ex.	131.10±19.62 142.62±18.28	-1.413	.892
Extension	A	Pre Ex. Post Ex.	192.18±30.69 186.41±15.46	.382	.493
	B	Pre Ex. Post Ex.	201.48±24.11 203.47±25.46	-.401	.309

Table 6 shows, for the maximum muscle power of knee joint at the flexion and the extension of 120°/sec, there is no significant difference in both A and B cases for the flexion and the extension.

Table 7 shows, for the average muscle power of knee joint at the flexion and the extension of 120°/sec, there is no significant difference in both A and B cases for the flexion and the extension.

Table 8 shows, for the total work of knee joint at the flexion and the extension of 120°/sec, there is no significant difference in both A and B cases for the flexion and the extension.

Conclusion

In this study we investigate the effects of taping how to reduce the fatigue of muscle occurring at the end of the exercise and how to improve the ability of athletes at the end of the exercise. Fourteen athletes were chosen to be tested. They exercised the program four times in ten minutes with taping on knee joint and thigh. We recorded the highest muscle power, average power and total works of flexion and extension at 120 /sec and 60/ sec at before and after the exercise using Cybex 770. We concluded the followings: with

1) After the exercise, taping on thigh and knee joints is meaningful to the highest muscle power, average power and total works of flexion at 60°/sec.
2) After the exercise, taping on thigh and knee joints is meaningful to the highest muscle power, but it is no meaningful to the average power and total works of extension at 60°/sec.
3) After the exercise, taping on thigh and knee joints is no meaningful to the highest muscle power, average power and total works of flexion at 120°/sec.
4) After the exercise, taping on thigh and knee joints is no meaningful to the highest muscle power, average power and total works of extension at 120°/sec.

We now conclude that taping has positive effects on improving the athlete's ability and functioning. Especially, it shows good effects on the flexion at 60°/sec compared to 120°/sec. Hence it is strongly recommended to the athletes who need muscle power at the end of exercise. Since taping shows better effects on flexion compared to extension, taping on rear thigh will improve athlete's ability.

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EQUILIBRIUM REGULATION BY YOUTH ACROBATS DURING SELECTED EXERCISES EXECUTION

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Abstract

The aim of the study was to describe the mechanism of equilibrium control by youth acrobats during three types of exercises. All exercises were performed on the Kistler force platform and recorded by JVC video recorder. Center of pressure and center of mass were selected for two planes: sagital - Y and frontal - X. Base of support, acceleration of COP, external work and time of equilibrium stability were also analyzed. 30 children (7 years old) attended to the research. Individual manner of equilibrium regulation for selected exercises was affirmed. Most of our acrobats controlled their body position by trunk motion in sagital plane (37%) during all exercises. Quality of sway holding was the best for children which got it by micro fluctuations in hip joints. Expert opinions for first exercises were 36,9 % higher for children which got stability by micro fluctuations in hip joints. Similar notes, for this regulation were obtained for second (39%) and third (38,9%) exercises.

Key words: *posture, regulation, acrobats, COP, COM*

Introduction

Performance of many exercises by youth acrobats during training and competition required equilibrium regulation. Some results indicate slight effect of visual condition on the postural sway [3] and describing effect of maintaining body equilibrium during hand stance [2, 6]. The human body is not rigid and its center of gravity and base of support can change with limb movements. Humans can thus control their stability by changing their stance and body position. Arms, legs and head motion are existed usually during stability control of human posture with different area of supporting [4]. Different types of auto regulation exist in children and adult mechanism of equilibrium control [4]. Functional changes of stability can be quantified by COP measurement [1]. Therefore **the aim** of the study was to describe the mechanism of equilibrium control by youth acrobats during selected exercises. Two questions were appeared from the aim:

1. How many manners of regulation exist during equilibrium exercises performed by youth acrobats?
2. Does the mechanism of regulation influence on the external quality of exercise performance?

Material and Methods

30 children ((7 years old) from the MKS „Zak" Biala Podlaska attended the research (body mass – 25 ± 2 kg, body height – 116 ± 5 cm,). Five experts graduated performance of selected exercises (1÷10 points). Three types of exercises were selected to the assessment:

1. Romemberg test [5]: 20 seconds of quiet stance with straighten up body and upper extremities putt parallel to the floor (10 seconds with opened and 10 seconds with closed eyes).
2. 20 seconds one leg stance: 10 seconds on left with flexed right leg (thigh parallel to the floor) then 10 seconds on the right leg.
3. 10 seconds stance with two second back bend of the head (5 – 6 second), upper extremities side raised and parallel to the floor.

All exercises were performed on the Kistler force platform (Type 2812A1-3 under BioWare software analysis system v. 3.23) and recorded by JVC video recorder. Ground reaction forces were collected with 400 Hz and band pass filtered. Center of pressure (COP) and center of mass (COM) were selected for two planes: sagital - Y and frontal - X. Base of support, acceleration of COP, external work and time of equilibrium stability were also analyzed.

Individual regulation of equilibrium was divided to five groups:

1. Trunk motion in sagital plane (forward and backward).
2. Trunk motion in frontal plane (left and right).
3. Arm motion in sagital plane (up and down).
4. Micro fluctuation in hip joints.
5. Other type of regulation.

Results

Individual manner of equilibrium regulation for selected exercises was affirmed (Fig.1). Most of our acrobats controlled their body position by trunk motion in sagital plane (37%) during all exercises. This type of regulation was also characterized by hand shake and knee joint flexing. Example of time histories of force and external work during first exercise are presented on the figure 2 and 3.

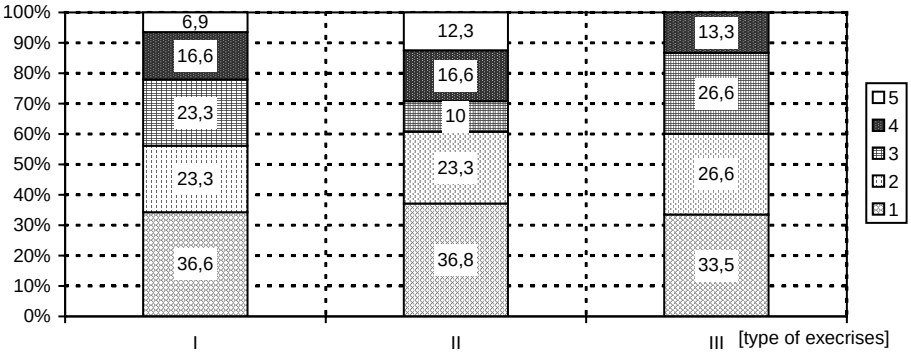

Fig. 1. Percent quantity of children controlled their equilibrium by 1- trunk motion in sagital plane (forward and backward), 2 - trunk motion in frontal plane (left and right), 3 - arm motion in sagital plane (up and down), 4 - micro fluctuation in hip joints, 6 - other type of regulation

16,6% children controlled their equilibrium by micro fluctuation in hip joints during first and second exercises and 13, 3% during third. This kind of regulation is close related to principle of minimizing human relationship with environment [2]. COP forces measured in two directions and connected with it COM dislocation presented on figures 2 and 3 shows differences between individual characteristic of equilibrium regulation between children.

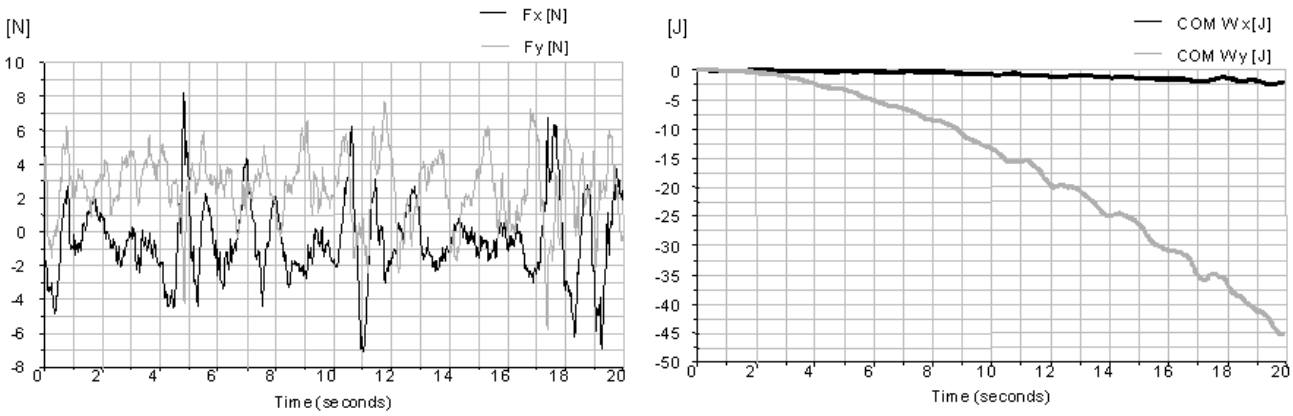

Fig. 2. Examples of force (left) and external work (right) time histories during first exercise performance by first participant; F_x – frontal plane, F_y – sagital plane

Motions of the trunk in frontal plane are not overwhelming manner of the sway regulation during all types of exercises. However it leads children to use quite different energy to get stability (Fig 2 and 3).

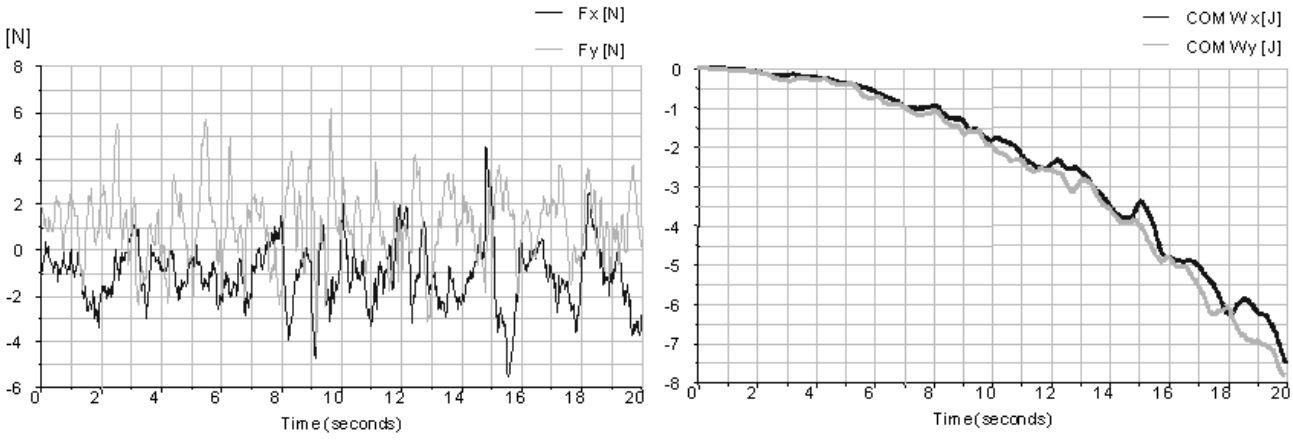

Fig. 3. Examples of force (left) and external work (right) time histories during first exercise performance; F_x – frontal plane, F_y – sagital plane

Force and work time histories presented on the figure 3 are the effect of COM dislocation (Fig.4). This type of regulation was the best way of the sway holding. Micro fluctuations in hip joints to equilibrium regulation were used also by that child.

Most typical dominant way of sway regulations during second exercises is presented on the figure 5.

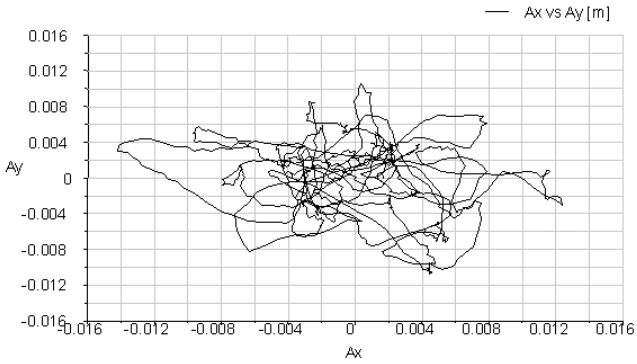

Fig. 4. Example of COM dislocation during performance of first exercise

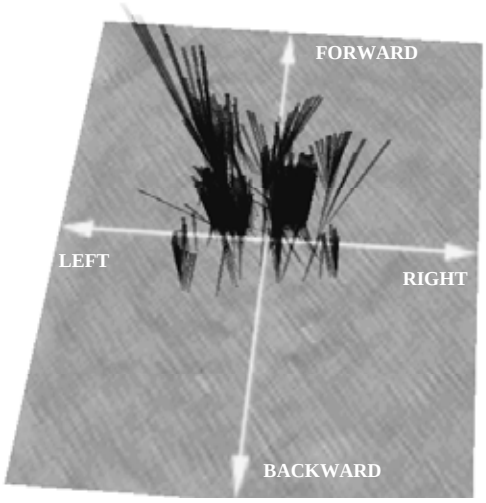

Fig. 5. Example chart of forces resultant for COP during second exercises performance

All time sway holding required different quantity of energy during second exercise. Between 3 to 7 seconds the equilibrium stability was carried by trunk motion in sagital plane (W_y=5,45, W_x=2,25), during legs change (7-12s) the energy requirements were increased by 3 to 5 times and since 16 seconds the stance stability was carried by micro fluctuations in hip joints. Quality of sway holding was the best for children which got it by micro fluctuations in hip joints. Expert opinions for first exercises were 36,9 % higher for children which got stability by micro fluctuations in hip joints. Similar notes for this regulation were obtained for second (39%) and third (38,9%) exercises.

Conclusions

1. The dominant manner of equilibrium stability was trunk motion in sagital plane for all types of chosen exercises.
2. The best performance of exercises was obtained for children who controlled their equilibrium stability by micro fluctuations in hip joints.

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ALLOMETRIC SCALING OF MUSCLE POWER TO BODY SIZE: THE EFFECT OF STRETCH-SHORTENING CYCLE*

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Abstract

The aims of the present study were to investigate the relationship between muscle power recorded in vertical jumps and body size, and to explore possible differences in this relationship between the concentric (CON) and stretch-shortening cycle (SSC) muscle action. Subjects were tested on two CON and two SSC vertical jumps. The relationship between muscle power (P) and body size (S) was assessed by $P=a\,S^b$ where a and b were constant multiplayer and scaling exponent. The results revealed that muscle power scales to body size at a higher rate than predicted by geometric similarity (i.e., b = 0.67), while larger individuals could gain more when switching from CON to SSC muscle action. These findings could be based on a non-geometric scaling of transversal with respect to longitudinal dimensions and/or on different scaling rates of muscles and tendons.

Key words: *vertical jump, allometric, elastic energy, concentric, height*

Introduction

In scientific literature results of human muscle power testing are usually reported either in absolute (watts; W) or in per-body mass ratio standards (W/kg) values. However, similar to other physiological variables (e.g., muscle strength or oxygen uptake; Astrand and Rodahl 1986) human muscle power has a moderate to strong positive relationship to body size when expressed in absolute values (Nevill et al., 1992; Winter et al., 1991). In contrast, muscle power reported per kg of body mass has a low negative relationship to body size, suggesting that the simple ratio standard fails to produce a dimensionless power output variable (Nevill et al., 1992).

Alternatively, a number of authors (Astrand and Rodahl, 1986., Jaric, 2002., Nevill et al., 1992) have demonstrated theoretically and experimentally that an allometric scaling is more appropriate scaling statistic when normalizing muscle power and other size depended human performance variables for body size. Allometric relationship between the performance variable P and a body size variable S is expressed as:

$$P = a \cdot S^b, \qquad \text{(eq. 1)}$$

where a and b are constant multiplayer and scaling exponent, respectively.

In geometrically similar objects all lengths are proportional. As a result, any surface (including the muscle cross-sectional area that mainly determines muscle force and power) is related to any length (such as body height or specific limb circumferences) to the power of two, while any volume or mass related index (such as body mass) is related to any length to the power of three. When applied to human locomotor apparatus, a simple theory of geometric similarity therefore implies that muscle power should be proportional to body mass raised to power 0.67 (i.e., b = 0.67; Astrand and Rodahl, 1986). Several experimental studies provided the data in line to the theory of geometric similarity (i.e., scaling exponent b = 0.67) when analyzing the relationship between muscle power and either body mass (Martin et al., 2004; Nevill et al., 1992) or lean leg volume (Nevill et al., 1991).

Muscle power could be generated during the concentric (CON) and the stretch-shortening cycle (SSC) actions. However, it is unknown whether the relationship between muscle power and body size differs between CON and SSC. The aims of the present study were to investigate the relationship between muscle power obtained from various types of vertical jump and body size, and to explore possible differences in this relationship between the CON and SSC muscle action.

Methods

Physical education students (N = 159; body mass 74.8 ± 7.6 kg; body height 181.0 ± 7.1 cm) were tested on two CON (squat jump with [SJ/WL] and without additional load [SJ]) and two SSC vertical jumps (countermovement jump [CMJ] and hopping [HOP]). Muscle power was assessed both through the mean concentric power calculated from the recorded ground reaction force and through the jumping height. Body mass, fat-free mass and body height were used as indices of body size. Thigh and calf girths were also recorded.

* *Young researcher award*

A regression technique applied on the log-transformed data provided the values of the allometric scaling exponent *b* for each particular test. In short, eq. 1 was taken as the presumed relationship between the recorded performance (either jump height or mean muscle power) and a selected index of body size. The log-log transformation provides a regression model where log *a* and *b* are the intercept and slope, respectively, of the performance-body size relationship:

$$\log P = \log a + b \log S . \quad \text{(eq. 2)}$$

The same method was used to assess the relationship between body mass and thigh and calf girths. A standard procedure was employed to assess the significance of differences between the regression slopes (representing the scaling exponents) observed for different jumps. The level of statistical significance was set to $P = 0.05$.

Results

The following two tables depict the main findings regarding muscle power-body size relationship. With respect to body mass and fat-free mass, the scaling exponents *b* for mean muscle power in CON jumps were mainly above the theoretically predicted $b = 0.67$. A visual inspection suggests that the scaling exponents obtained from the SSC jumps could be higher than the scaling exponents obtained from the non-SSC based jumps. However, the statistical analysis revealed a significant difference only between HOP and SJ for each of the three applied indices of body size.

Table 1. Mean concentric power (mean ± SD) and corresponding body size scaling exponents b (95% confidence interval) for all four vertical jumps.

	Power (W)	$b_{(body\ mass)}$	$b_{(fat\ free\ mass)}$	$b_{(height)}$
SJ/WL	1430 ± 220	0.73 (0.52–0.94)	0.86 (0.63–1.09	0.97 (0.34–1.61)
SJ	1841 ± 243	0.69 (0.52–0.86)	0.82 (0.63–1.00)	0.76 (0.21–1.30)
CMJ	2331 ± 347	0.90 (0.71–1.08)	1.08 (0.89–1.28)	1.23 (0.64–1.82)
HOP	3465 ± 595	0.96[&] (0.74–1.17)	1.15[&] (0.92–1.38)	1.79[&] (1.13–2.44)

[&] - significantly different from SJ; * P < 0.05

Table 2. Jump height (mean ± SD) and corresponding body size scaling exponents b (95% confidence interval) for all four vertical jumps.

	Height (cm)	$b_{(body\ mass)}$	$b_{(fat\ free\ mass)}$	$b_{(height)}$
SJ/WL	27.5 ± 3.2	0.03 (-0.16–0.22)	0.04 (-0.12–0.22)	-0.16 (-0.65–0.34)
SJ	45.1 ± 4.9	0.02 (-0.14–0.18)	0.01 (-0.15–0.17	0.01 (-0.45–0.46)
CMJ	48.9 ± 5.2	0.04 (-0.12–0.20)	0.03 (-0.13–0.17)	0.01 (-0.43–0.46)
HOP	41.9 ± 4.7	0.31[&] (0.15–0.48)	0.28[&] (0.12–0.44)	1.02[&] (0.58–1.47)

[&] - significantly different from SJ/WL and SJ; * P < 0.05

With respect to body height, the scaling exponents are rather close to those obtained from body mass and fat-free body mass rather than being three times higher, as predicted by geometric similarity. When jump height was used as index of muscle power, the same exponents were close to zero in all jumps except a SSC based hopping jump that demonstrated a weak but positive relation to body size. Finally, thigh and calf scaling exponents with respect to body mass revealed $b = 0.42$ (95% CI = 0.36-0.48) and $b = 0.39$ (95% CI = 0.33-0.45), being both significantly higher than predicted by the theory of geometric similarity (i.e., $b = 0.33$).

Discussion

One of the most important findings of the present study is the observed relationship between muscle power and the selected indices of body size. Regarding the calculated mean muscle power, note that the geometric similarity based models predict that the muscle power increases proportionally to either mass $^{0.67}$. Our findings appear to be only partly in line to these predictions. The allometric scaling exponents for body mass and fat-free mass are not only above 0.67, but also some of the corresponding 95% confidence intervals do not cover the theoretically predicted value. The results generally suggest that the calculated mean muscle power is a body size dependent measure that requires normalization for body size. However, it seems that the scaling exponent for mean power with respect to body mass and fat-free mass could be above the most often recommended and used $b = 0.67$.

Regarding the scaling exponents obtained with respect to body height, the results revealed the values well below those expected by geometric scaling. Namely, the exponents are not three times higher than those obtained from body mass or fat-free mass. This finding is in line with previous ones suggesting that body transversal dimensions increase with body size at a higher rate than longitudinal ones (McMahon, 1984). Our findings based on the scaling exponents for the thigh and calf girths with respect to body mass support this concept since their values are significantly above $b = 0.33$, expected by the theory of geometric similarity.

In addition to the calculated mean power, we also recorded the jump height as the most popular index of muscle power and, thereafter, related it to body size. With the exception of HOP, all other tests demonstrated no relationship between the recorded jump height and the selected indices of body size. Since the jump height represents a valid assessment of muscle power (Markovic et al., 2004), this finding suggests that the height of a maximum vertical jump could be a body

size independent index of muscle power *per se*. Most authors seem to implicitly agree with this suggestion since the jump height is usually reported non-normalized for body size (c.f. Markovic and Jaric, 2004).

Another major finding of this study is that muscle power scales with body size differently in CON muscle action as compared with SSC. The scaling exponent appears to be particularly high in HOP, which provides faster SSC than CMJ. Not surprisingly, the jump height recorded in HOP also scales positively with body size, while the heights of all other jumps seem to be body size independent. Taken together, these findings suggest that the larger subjects benefit more from SSC than smaller ones. Therefore, it is likely that the exertion of muscle force during SSC action includes factors differently related to body size than CON muscle action in SJ/WL and SJ. Since the present study does not provide the data describing mechanical actions of individual muscles and their tendons that could reveal the hypothesized factors, we will base further discussion on the available literature.

Several mechanisms have been proposed to account for the performance enhancement in SSC, such as the time available for force development, storage and recoil of elastic energy, potentiation of the contractile machinery, and the contribution of stretch reflexes (see van Ingen Schenau et al., 1997 for review). We will focus the discussion primarily on the storage and recoil of elastic energy. Elastic energy is mainly stored in tendons and partly other connective tissues since they have more pronounced spring-like properties than any other tissues involved (Pollock and Shadwick, 1994). Amount of the energy stored depends not only on the size of tendons, but also on their relative deformation. Some findings obtained from a wide scale of animal body sizes suggest that muscle cross-sectional area (and, consequently, muscle force) is expected to increase at a higher rate with body size than the cross-sectional area of muscle tendons (McMahon, 1984; Pollock and Shadwick, 1994). As a result, larger individuals are exposed to a larger relative deformation of muscle tendons and, as a consequence, a relatively larger amount of elastic energy could be stored for re-use in the next phase of the SSC. The final consequence is that larger individuals could benefit more from SSC than the smaller ones, which is in line with our experimental findings. In particular, Pollock and Shadwick (1994) reported body-mass scaling exponents for elastic energy storage in digital flexor and ankle extensor tendons of mammals between $b = 1.32$ and $b = 1.38$. If we, for example, applied the exponent $b = 1.38$ to the body mass – muscle power relationship based on the geometric similarity (i.e., power ~ $[\text{mass}^{0.67}]^{1.38}$), it would reveal the scaling exponent $b = 0.92$ which is close to the $b = 0.94$, obtained from HOP. Although one could argue that the range of body sizes of our subjects is quite narrow as compared with wide scales of animal body sizes, the obtained scaling exponents (if applicable on any sub-population of a particular species) should not depend on the width of the particular body size range.

In conclusion, our results suggest that muscle power scales to body size at a higher rate than predicted by geometric similarity (i.e., $b = 0.67$), while larger individuals could gain more when switching from CON to SSC muscle action. These findings could be based on a non-geometric scaling of transversal with respect to longitudinal dimensions (McMahon, 1984) and/or on different scaling rates of muscles and tendons (Pollock and Shadwick, 1994).

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TRUNK AND SHOULDER MUSCULATURE ACTIVITY IN NORDIC WALKING USING DIFFERENT POLE LENGTHS

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Abstract

Nordic Walking is an effective way of walking with poles. The length of poles influences the arm swing, and so also the possibility of powerful placing the pole. By making the use of arm movements, and with a proper Nordic Walking technique, almost all muscles of the body are trained (INWA Instructor manual, 2004.). To acquire proper technique, poles of adequate length have to be used. Experts recommend choosing pole length in the same way as in alpine skiing, i.e. according to the formula: body height x 0.68. However, it has not been scientifically proven yet what is the optimal pole length, i.e. in what measure different lengths of the pole influence the intensity of muscular contractions in walkers in command of the basic Nordic Walking technique. This research was aimed at determining to what measure a change in pole length influences the intensity of muscle contractions in some muscles of the trunk and shoulder, as well as to what measure is it possible to simulate hand activity technique by walking without poles. The results have shown that, in general, there are no significant differences in the intensity of muscular contractions when walking without poles and simulating hand activity, as well as with three different pole lengths, in two participants.

Key words: *Nordic Walking, pole lengths, EMG, trunk and shoulder musculature*

Introduction

Nordic Walking a rather new activity, but a number of investigations about its utility for cardio-vascular and motor abilities have been performed (Rodgers et all, 1995, Church et al, 2002, Jordan et al, 2001, Morss et al, 2001.). Anttila at al. (1999.) compared pole walking with regular walking training for 12 weeks in 55 female office workers. The electromyographic (EMG) measurements showed that electrical activity of the muscles of the upper body, neck, shoulder and upper back as significantly higher when walking with poles.

It is very important that Nordic walkers acquire proper arm motion. The arm should become a fixed position (so-called handshake position) "third class" lever with the pivot point (fulcrum) being the shoulder. The effort (force applied) which works to attempt to overcome the resistance created by the pole (resulting force), is applied primarily by the pectoralis major, teres major and latissimus dorsi musculi, which attach at a point on the humerus (upper bone of the arm) very close to the shoulder /pivot point/ fulcrum. To learn proper technique, an adequate pole length must be chosen. Experts recommend choosing pole length in the same way as in alpine skiing, i.e. according to the formula: body height x 0.68. More advanced walkers may use even longer poles. However, it has not been scientifically proven yet what is the optimal pole length, i.e. in what measure different lengths of the pole influence the intensity of muscular contraction in walkers in command of the basic Nordic Walking technique (INWA Instructor manual, 2004).

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This research was aimed at determining in what measure a change in pole length influences the intensity of muscle contraction in some muscles of the trunk and shoulder, as well as in what measure is it possible to simulate hand activity technique by walking without poles. It is a part of our long-term research activity including both laboratory and field measurements of surface EMG in various sportive movement patterns (Medved et al., 2002).

Methods

Subjects

The measurement has been carried out on two (one male, age 45 years old, one female, age 44 years old) well-trained Nordic walkers, of very good overall physical shape.

Procedure

The measurement has been performed in the Biomechanics Laboratory at the Faculty of Kinesiology in Zagreb. The "Elite 2002" biomechanical system was used for data collection and analysis. EMG was recorded to monitor contractions during Nordic Walking without poles (by simulating the technique of arm activity with poles, voluntary contracting arm musculature simultaneously: so called "squeezing"), and with three different pole lengths:

Length 1: -5 cm than the recommended length

Length 2: the recommended length

Length 3: +5 cm than the recommended length

The following muscles of right side of the body were monitored: m. deltoideus anterior, m. deltoideus posterior, m. triceps brachii (cap. longum), m. trapezius medialis, m. latissimus dorsi, m. biceps brachii

The participants were filmed as they completed ten strides in each walking (three times with each pole) tried in laboratory.

They started to walk with the right leg every time.

Data processing and analysis

The data were collected and analyzed both visually and quantitatively. After descriptive statistical analysis of mean values of averaged EMGs (a measure of muscle force: Medved, 2001), a unvariant analysis of differences was calculated, as well as were multiple correlations between the trials, according to muscles monitored, for each participant.

Results

Table 1. Descriptive statistic of averaged EMGs (mV)

Variable	Pole lenght	N	Mean	Std. Dev.	Min	Max	Variable	Pole lenght	N	Mean	Std. devi.	Min	Max
	1	3	21,253	2,115	19,311	23,507		1	3	0,910	0,124	0,766	0,991
	2	3	20,042	5,237	13,996	23,191		2	3	0,761	0,198	0,568	0,965
mdeltant	3	3	21,943	1,660	20,066	23,219	**mdeltantX**	3	3	0,840	0,103	0,747	0,952
	4	3	22,409	2,403	20,013	24,820		4	3	1,024	0,079	0,940	1,098
	Total	12	21,412	2,867	13,996	24,820		Total	12	0,884	0,152	0,568	1,098
	1	3	18,378	5,163	12,936	23,209		1	3	1,669	0,090	1,573	1,753
	2	3	25,556	0,153	25,384	25,681		2	3	3,911	0,254	3,887	3,938
mdeltpos	3	3	24,960	1,345	23,536	26,210	**mdeltposX**	3	3	4,070	0,255	3,776	4,228
	4	3	25,579	1,563	23,883	26,962		4	3	4,783	0,171	4,633	4,970
	Total	12	23,618	3,959	12,936	26,962		Total	12	3,608	1,226	1,573	4,970
	1	3	16,566	3,617	12,738	19,927		1	3	0,895	0,200	0,749	1,123
	2	3	26,077	1,158	25,364	27,414		2	3	4,131	0,173	4,010	4,330
mtriccaplon	3	3	26,081	1,674	24,774	27,968	**mtriccaplonX**	3	3	4,070	0,366	3,666	4,381
	4	3	26,189	2,330	24,713	28,875		4	3	4,855	0,176	4,669	5,021
	Total	12	23,728	4,772	12,738	28,875		Total	12	3,488	1,609	0,749	5,021
	1	3	16,213	4,177	11,817	20,129		1	3	1,058	0,067	0,996	1,130
	2	3	21,040	4,023	16,774	24,766		2	3	1,991	0,266	1,737	2,269
mlatdor	3	3	23,382	0,658	22,632	23,867	**mlatdorX**	3	3	2,085	0,174	1,884	2,200
	4	3	23,823	3,349	20,917	27,486		4	3	2,232	0,239	1,956	2,391
	Total	12	21,115	4,264	11,817	27,486		Total	12	1,841	0,511	0,996	2,391
	1	3	17,869	7,128	13,680	26,099		1	3	0,517	0,098	0,404	0,589
	2	3	21,251	6,450	14,503	27,357		2	3	1,113	0,119	0,977	1,206
mbicbr	3	3	21,892	3,643	18034	25,273	**mbicbrX**	3	3	1,135	0,099	1,021	1,204
	4	3	20,022	3,059	16,894	23,007		4	3	1,290	0,048	1,234	1,322
	Total	12	20,258	4,846	13,680	27,357		Total	12	1,014	0,318	0,404	1,322

Results (Table 2) have shown that, in general, there are not large and significant differences in the intensity of muscular contraction when walking without poles and simulating arm activity and with three different pole lengths in both examinees.

Table 2 Differences between different pole heights (only for significant results)

Variable	Height		Mean difference	Sig	Variable	Height		Mean difference	Sig
mdeltposX	1	2	-1,338	,116	**mtriccaplonX**	1	2	-1,350	**,001**
		3	-1,643	**,045**			3	-1,784	**,000**
		4	-2,460	**,005**			4	-2,090	**,000**
	2	1	1,338	,116		2	1	1,350	**,001**
		3	-0,304	1,000			3	-0,433	,181
		4	-1,121	,152			4	-0,739	**,015**
	3	1	1,643	**,045**		3	1	1,784	**,000**
		2	0,304	1,000			2	0,433	,181
		4	-0,817	,468			4	-0,305	,587
	4	1	2,460	**,005**		4	1	2,090	**,000**
		2	1,121	,152			2	0,739	**,015**
		3	0,817	,468			3	0,305	,587

The mean difference is significant at the .05 level.

Looking individually, significant differences were found in the intensity of muscular contraction of m. deltoideus posterior and m. triceps brachii in the female participant (the most in walking without poles, with the recommended length and with longest poles), while in the male participant there were none significant differences in the intensity of muscular contractions, no matter the pole length.

Discussion

The results may invoke more than one conclusion. One among possible conclusions is that the measurement session with each pole length should last longer, so that strong enough muscular contractions-even muscle fatigue-be developed, and possible differences in particular muscles' activity would become more pronounced.

The second reason might also be in the differences in walking techniques by the two participants. The female examinee, using poles, performed more intensive contractions of monitored musculature with respect to the male one; the reason might have been placing the pole further from the body.

A third, may be the most important, reason might be attributed to the small subject sample, so the repeated research using larger subject sample is recommended.

Acknowledgement: The help of the Ministry of Science, Education and Sports of the Republic Croatia is gratefully acknowledged (Project No: 0034-206: "Creating Centre of Excellence for Locomotion Study").

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COULD EXPLOSIVE CONCENTRIC CONTRACTION INDUCE HIGH-FREQUENCY FATIGUE?

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Abstract

The aim of our study was to find out the relation between the number of repetitions in each set of explosive concentric contraction and high-frequency fatigue appearance. Nine male students performed two different fatiguing protocols: 6 sets of 10 or 20 repetitions in set. Response of relaxed VL to single supra-maximal electrical impulse and high- and low-frequency electrical stimulation were measured after consecutive concentric jumps on the sledge. After both fatiguing protocols the T_{TW} increased in both protocols ($P<0.01$) and the HRT decreased ($P<0.05$). The T20 significantly change only after the last set during the second fatiguing protocol ($P<0.05$). The T100 decreased significant only during the second fatiguing protocol ($P<0.05$). The ratio between torques (100Hz/20Hz) decreased significant during the second fatiguing protocol ($P<0.05$). High-frequency fatigue was induced during the second fatiguing protocol.

Key words: *peripheral fatigue, jumping, knee extension, electrical stimulation*

Introduction

Different studies have shown that high- and low-frequency fatigue appearance was not only task (Tomažin et al., 2002) but also time dependent (Strojnik and Komi, 1996). Eccentric-concentric type of muscle contraction induced high-frequency fatigue (Strojnik and Komi, 1998; Tomažin et al. 2002), on the other hand concentric muscle contraction induced low-frequency fatigue (Tomažin et al. 2002).

Since explosive concentric muscle contractions are often used for strength improvement, it is of interest to study high-frequency fatigue appearance during such type of actions. The basic characteristic of explosive concentric contraction is silent period, which is followed with a high-frequency burst of action potentials. According to that, the firing frequency of alpha motoneurons could reach even 100 Hz or higher in the beginning of such contraction (Enoka and Stuart, 1992). High-frequency fatigue could be expected, if muscle was electrically stimulated with higher frequencies (e.g. 80 or higher) in isometric conditions (Jones, 1996). During prolonged set of contractions initially high-frequency fatigue may change to low-frequency fatigue (Strojnik and Komi, 1996). According to the high-frequency bursts of action potentials in the beginning of explosive concentric contraction, high-frequency fatigue appearance could be expected. Different number of repetitions in such contractions could modify the type of peripheral fatigue appearance. The aim of our study was to find out the relation between the number of repetitions in each set of explosive concentric contraction and type of peripheral fatigue appearance.

Methods

Subjects. Nine male students (21.3±2,6 years, 74.3±5,5 kg, 180,2±7,0 cm) volunteered for the study. They were not involved in any intensive sport activity. Subjects were informed about the experiment and possible risks associated with their participation in the experiment. They gave their informed consent before the experiment. National Commission of Medicine Ethics approved the study.

Experimental design. The experiment was performed in two parts. The rest period between parts was exactly two weeks for all subjects. Subject warmed up with stepping on a 20-cm-high bench for 6 minutes with a frequency of 0.5 Hz, exchanging leg every minute. After the warm up, the initial measurements were performed in the following sequence: response of relaxed m. vastus lateralis (VL) to single supra-maximal electrical impulse and high- and low-frequency electrical stimulation. The same measurements in the same order were performed again after the each set of explosive muscle contraction. The measurements started 30 seconds after the end of each sets and were exactly timed.

Fatigue workout. In the first experiment, subjects performed 6 sets of 10 consecutive concentric jumps on the sledge (leg-press, Črtalič, Dolenske Toplice, Slovenia). After the take-off, the subjects were passively returned to the starting position to avoid landing with eccentric contraction. The starting position was determined with 90º knee and 145º hip angles and stayed the same for all jumps during the first and also during the second experiment. The rest period between sets was 5 minutes. The load was set to 1/3 of 1 RM. In the second experiment, subject performed 6 sets of 20 consecutive explosive concentric jumps on the sledge, the rest period and the load were the same as during the first experiment.

Electrical stimulation: The subjects sat in an isometric knee extension torque-measuring device. The knee angle was 60º. Self-adhering neurostimulation electrodes (5x5 cm; Axelgaard, Fallbrook, CA) were placed over the VL muscle. Three supramaximal stimuli were delivered consequently with 1 s delay to the relaxed VL muscle. The torque signal from the twitch responses was smoothed and averaged. The following parameters were obtained: maximum twitch torque (T_{TW}) and half-relaxation time (HRT). Relaxed VL muscle was stimulated with two consecutive trains of impulses of 20Hz (1 s) and of 100Hz (0.8s). Stimulation amplitude was set to three times that of the motor threshold amplitude and was kept the same for both frequencies during the whole protocol on a single day. The mean torque during the last 100 ms of stimulation for each frequency was obtained (T_{20} and T_{100}). The ratio between T_{100} and T_{20} was calculated.

Statistics. Paired sample t – test was used to test the significant of differences between the initial measurements and measurements after each set.

Results

After both fatiguing protocols T_{TW} increased (P<0.01) and remained at increased level also after the last set (Fig 1). HRT decreased (P<0.05) after first set and remain decreased also after the last set during both fatiguing protocols (Fig 1). There were no significant changes in T_{20} after both fatiguing protocols (Fig 2), except the decrease (P<0.05) after the last set during the second fatiguing protocol (Fig 2).

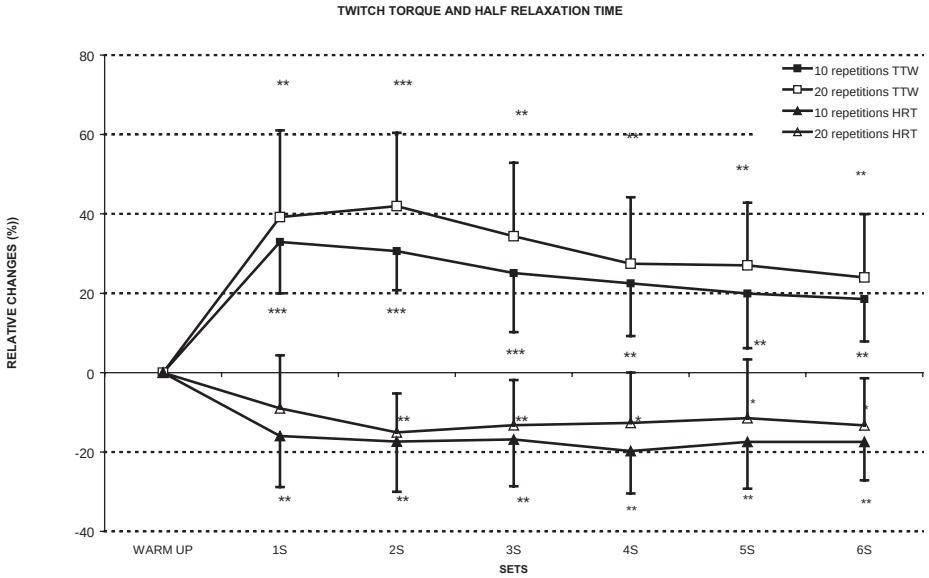

*Figure 1: Relative changes in twitch torque and half relaxation time after set with different repetitions (**P<0.01, ***P<0.001,*P<0.05).*

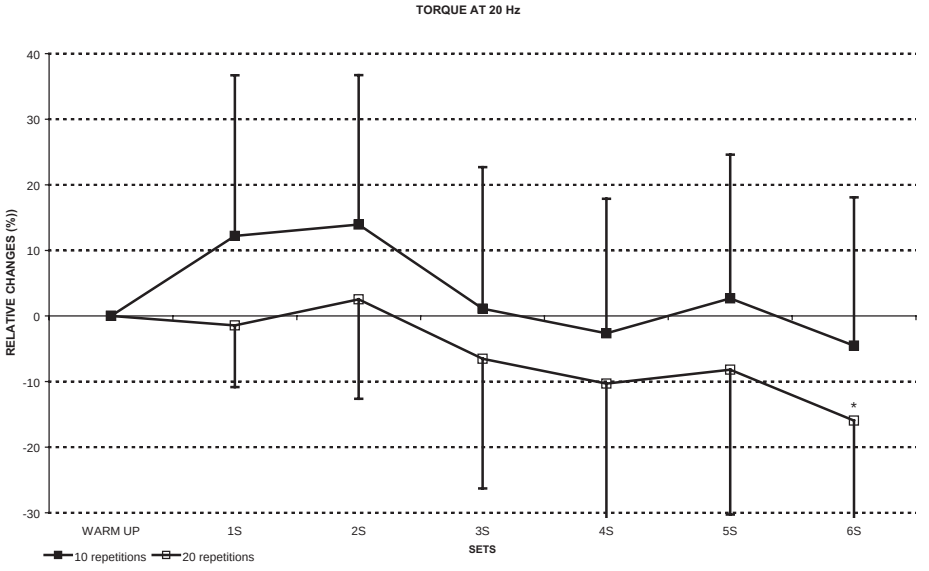

*Figure 2: Relative changes in torque at 20 Hz after sets with different repetitions (*P<0.05).*

On the other hand, the T100 decreased ($P<0.05$) during the second fatiguing protocol (Fig 3). The ratio between T100 and T20 decreased ($P<0.01$, $P<0.05$) during the second fatiguing protocol (Fig 4), on the other hand the first fatiguing protocol didn't cause significant changes (Fig 4) in the torque ratio.

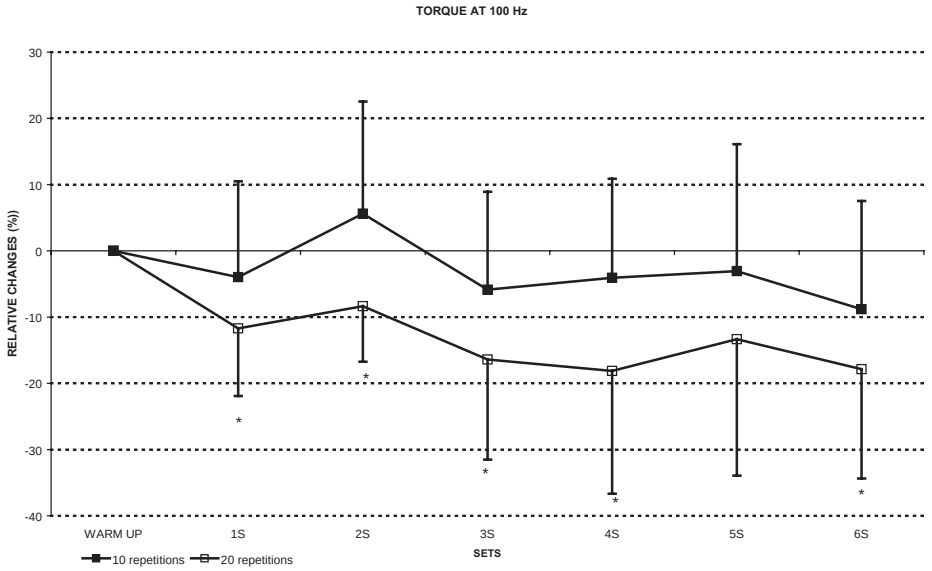

*Figure 3: Relative changes in the torque at 100 Hz after sets with different repetitions (*P<0.05).*

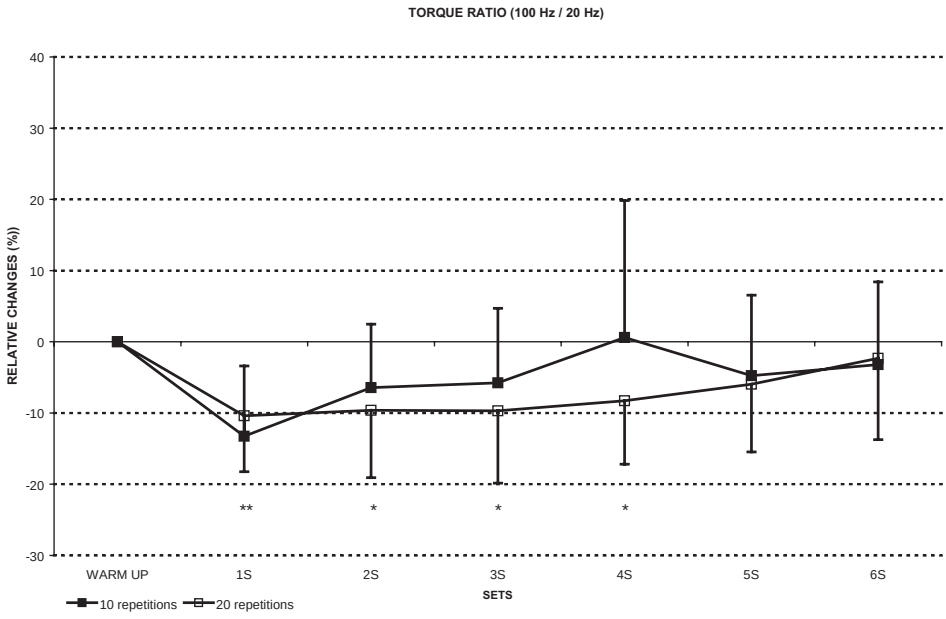

*Figure 4: Relative changes in the torque ratio after sets with different repetitions (*P<0.05, **P<0.01).*

Discussion

The most significant observation after the set of explosive concentric contraction was the occurrence of high-frequency fatigue appearance after the first fourth sets of contractions, but only during the second fatiguing protocol. The first fatiguing protocol showed only the low-frequency potentiation (Fig 1 and 2) after the first and the second sets. Outcome of our data confirmed the relation between the task duration (the number of repetitions in each set) and high-frequency fatigue appearance. Strojnik and Komi (1996) showed that increased duration of eccentric-concentric contraction also induced low-frequency appearance. The similar tendency was also shown by our data (Fig 4), when we prolonged the concentric activity (Fig 4), low-frequency fatigue probably could be induced.

Although the results showed ability of explosive concentric contractions to induce high-frequency fatigue, the conditions to attain it seem far from the practical application in practice. For training purposes, stretch-shortening cycle exercise with maximal intensity seems to be better alternative to induce high-frequency fatigue.

It was concluded that explosive concentric muscle contraction, probably due to high-burst of action potentials in the beginning of concentric contraction, induced high-frequency fatigue, but only when the number of repetition in each set was sufficient. High-frequency burst of action potentials in the beginning of explosive concentric contraction may alter the action potential propagation inside the muscle fibre (Balog and Fits, 1996). On the other hand, greater contraction number and prolonged number of sets may influence activation-contraction coupling inducing low-frequency fatigue (Fig 4).

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Late Submissions

4th INTERNATIONAL SCIENTIFIC CONFERENCE ON KINESIOLOGY

"SCIENCE AND PROFESSION – CHALLENGE FOR THE FUTURE"

SOFTWARE FOR THE BIOMECHANICAL ANALYSIS OF HIGH SKILLED ATHLETE'S MOTOR ACTIONS

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Abstract

This paper presents the "BioVideo" program complex for the biomechanical videocomputer analysis both training, and competitive activity of high skilled athletes.

Key words: *a videocomputer complex, registration of kinematic and dynamic characteristics.*

Introduction

Before Olympic games 2008 in Peking, China, the system of modern sports training, in our opinion, should be directed on realization of more effective methodology of athlete's technical training which is based on objective quantitative biomechanical parameters of sports techniques' elements.

This predetermines and allows proving biomecanically and creating the new automated control systems of training process with influence on the various sides of athlete's preparation.

Now use of the automated control systems in sports training allows creating such conditions of reality sensual reflection for athletes due to which they can to learn objectively and for short time with sufficient completeness the internal laws of movements with complex coordination structure.

Methods

The analysis of the special scientific & methodical literature testifies that now in practice of sports the optical-electronic methods on the basis of biomechanical videocomputer analysis with motion capture are one of the most perspective methods of registration and the analysis of high skilled athlete's motor actions.

As practice shows, the technology of the biomechanical videocomputer analysis includes shooting by videocamera with frequency 25 frames per second (PAL format) and 30 frames per second (NTSC format) or with a frequency from 200 up to 1,000,000 frames per second and processing of the received videograms with the software. Depending on number of used cameras which work is synchronized, the biomechanical analysis can be carried out both in two or three dimensions.

The big variety of the videocomputer analysing systems with motion capture is possible to classify, in our opinion, by several criteria. It is possible to classify the motion capture systems depending on used equipment on those using the specialized equipment with reflexive markers (for example, "Biomech ELITE", Italy; "Qualisys", United Kingdom) and those using standard videocameras (for example, "Simi", Germany; "Dartfish", Switzerland). Under software the videocomputer analysis systems may be the following: those which provide the qualitative, visualized analysis of clips (for example, mix up to nine video clips into one single video clip or create a single image with several superimposed images of a movement) and those systems which provide the quantitative parameters of motor action. As a rule, the systems for the quantitative biomechanical analysis, work with non-standard, but with specialized video equipment.

Results

As the analysis of a special literature has shown, now in the market of motion capture systems there are no those systems which would work with standard videocameras and at the same time provide the quantitative biomechanical characteristics of athlete's motion. The "BioVideo" software for the biomechanical videocomputer analysis which is developed by kinesiology department, National University of Physical Education and Sports of Ukraine, has just those functions.

The "BioVideo" software is designed for measurement of video based kinematic and dynamic characteristics of high skilled athlete's motor actions. The "BioVideo" hardware consists of digital or analog videocamera and a personal computer. It is needed the videograbber if the analog camera is used for motion capture.

The "BioVideo" softare consists of four modules:

1. The construction module.
2. The coordinates of point's module.

3. The calculation of motion characteristics module.
4. The biokinematic scheme of athlete's motor action module.

The construction module is purposed for drawing up of scheme model of researched dynamic object. Model may include the points of athlete's total body or his separate bioparts or biolinks, for example, only the low or upper extremity, etc. Scheme models of researched objects can consist of various numbers of points, depending on the research purpose. In this sense the "BioVideo" construction module is universal. It is possible to create the models including up to 100 points with the "BioVideo" construction module.

The coordinates of points module is purposed to define the coordinates of athlete's body points and/or sport apparatus points (flipper for a scuba diving, a bicycle, pole-vaulter, etc.) during his movement. The identification of point coordinates is carried out according the scheme model which was constructed with the "BioVideo" construction module. In this sense the module of point's coordinates is universal too. The example of working with the module of athlete's body points coordinates is presented by figure 1.

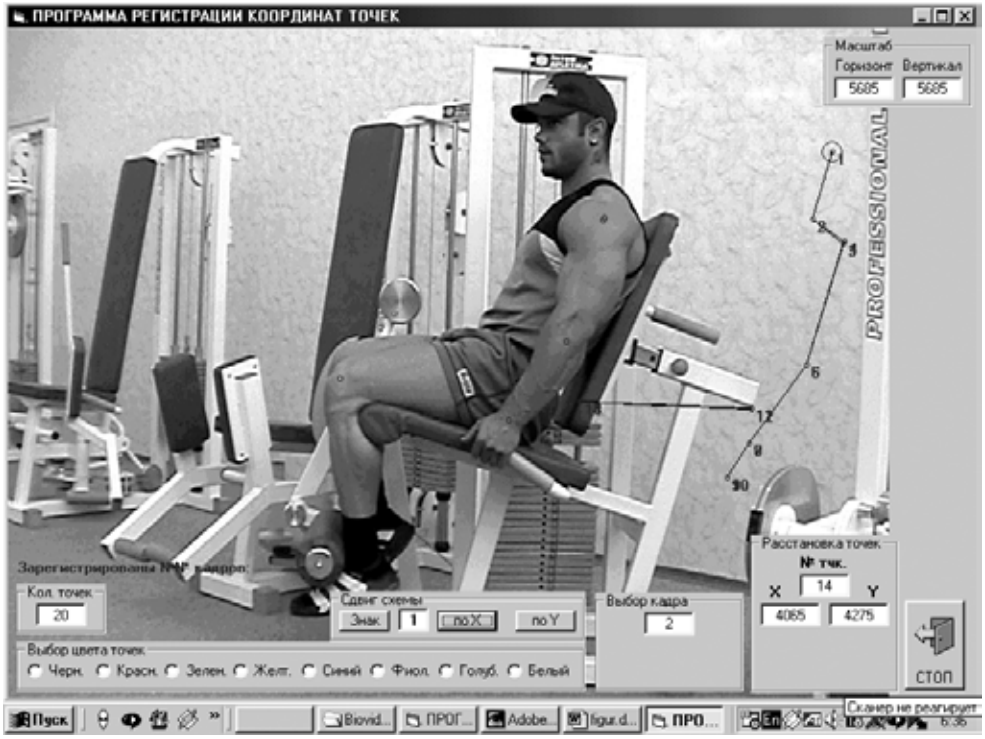

Figure 1. The measurement of coordinates of chosen points with the "BioVideo" module

The "BioVideo" construction module and coordinates of point's module work with athlete's motion image files. It is necessary to keep the biomechanical requirements under video shooting, including placing a scale ruler in length of 1 meter (or scale rulers - vertical and horizontal).

The calculation of athlete's motor actions characteristics module provides quantitative biomechanical characteristics: kinematic and dynamic - with following options: parameters of points; parameters of joints; parameters of bioparts; energy; the phase analysis.

The module of athlete's motion biokinematic scheme gives the opportunity to view the centers of masses (CM) both athlete's total body, and his separate bioparts in every frame of motor action, to construct trajectories of movement on each of the chosen points, of the CM bioparts and of general center of masses.

The "Single" option in the "Scheme View" menu provides the appointed trajectories by frame (fig. 2, a), and "Group" option displays the biokinematic scheme (fig. 2, b).

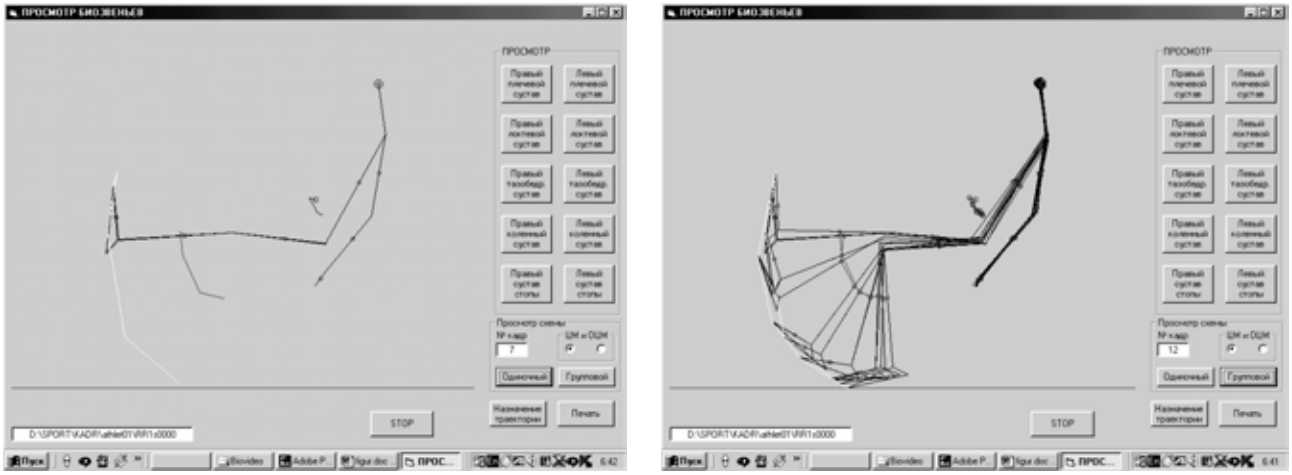

Figure 2. The "BioVideo" module of athlete's motion biokinematic scheme

Discussion

The "BioVideo" software advantage is the opportunity of quantitative biomechanical characteristics measurement (this opportunity is absent, for example in such above mentioned software as SIMI°Motion and Dartfish). "BioVideo" modules determine not only kinematic, but also dynamic characteristics of motor action. While the majority of the biomechanical analysis systems provide the dynamic characteristics based on the data from force plates, the dynamic characteristics with "BioVideo" are also defined as well as kinematic under the motion capture that enables to control the competitive activity of highly skilled athlete. The "BioVideo" program complex provides definition biomechanical characteristics of CM bioparts and general CM of athlete's body, and also the phase analysis of motor action.

As the "BioVideo" program complex was created for work with the equipment available to us, for example with analog or digital videocameras, naturally, coordinates of point should be marked manually, instead of an automatic mode which is provided, for example, with the ELITE Biomech and Qualisys special reflective markers of infra-red light. The "BioVideo" program complex can be used for the analysis of 3-dimension motion capture.

The "BioVideo" software has doubtless value as the analysis tool of athlete's motor action based on a video shooting with any frequency which is set by the user's soft interface.

Thus, the use of optical & electronic methods on which the automated videocomputer systems are based, allows solving the tasks of the biomechanical analysis in sports training and competitions.

The "BioVideo" software can be used in biomechanics of sports for the analysis and modeling of motion actions, and also in forecasting of ways of techniques perfection (on the basis of the control both training, and competitive athlete's activity).

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THE ASSESSMENT OF AEROBIC AND ANAEROBIC CAPACITY OF POLISH JUNIOR HANDBALL TEAM DURING THE PREPARATIONS FOR THE WORLD CHAMPIONSHIP

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Introduction

A high and changeable pace of actions performed characterizes handball. Anaerobic energy processes predominate in an every single repeated case of sudden dash or spurt (jump back, jump forward, jump, throw, counter-attack) after which moments of enlarged oxygen consumption takes place, which means a mobilization of aerobic energy sources. A handball player's effort may be defined as aero-anaerobic where a share of each process in a match or training depends on the way technical and tactical elements are performed. Thus considering modern tendencies to play fast, effectively and attractively anaerobic capacity becomes significant, while aerobic capacity should be a base for training with anaerobic capacity features (Czerwiński, 1988; Harre and Hauptmann, 1988).

The level of effort tolerance in top sport championship players in large measure determines their successes in the international arena. Therefore physical fitness control is an integral part of a preparation system. The aim of the study is the assessment of aerobic and anaerobic capacity of Polish Junior Handball Team preparing for top competitions - the World Championship 2003.

Material and methods

The research was carried out on 13 players of Polish junior handball team, the champions in the former European Championship. Table 1 presents their biometric characteristics.

Physical fitness of handball players was measured by speed and special endurance tests. Training load applied during training camps was also calculated.

Evaluation of a special locomotion speed was based on a 36.4 m-distance run (from the left and right side of the court) in a simulation arrangement as for a counter-attack (without a ball). A rest break during the run lasted 5 min and after a 10 min-rest the subjects performed shuttle runs on a 150 metre-distance 5-10-15-20-25 m with returns.

A general locomotion speed was estimated due to the following runs: 5, 10, 15, and 20 m. Handball players performed a straight run from two different starting positions: standing start (I) and 2 metre-run-up (II)

A set of Globus photocells (Ergo-tester) was applied to measure time on each distance within an accuracy of 0.01s.

General endurance (aerobic) was determined by an effort trial with a progressive load according to a procedure described by Czerwiński and Jastrzębski (2003). A telemetric exhale gas analyzer produced by Italian Cosmed (K4 type of analyzer) was used to measure VO2max and other aerobic capacity indices in the trial.

Statistic values for all indices such as $\bar{x}$ average, ± SD- standard deviation and significance of differences between means according to a statistic package ANOVA (Statistica 6.0 PL) were calculated.

Table 1. Anthropometric characteristics of Polish Junior Handball Team (n = 13).

Measurement	Age (y)	Body height	Body mass (kg)	BMI (kg/m²)
I (21. 07. 02)	19.7 ± 0.60	192.7 ± 6.94	91.0 ± 7.03	24.5 ± 1.24
II (28. 05. 03)	20.5 ± 0.61	192.8 ± 7.30	93.3 ± 7.42	25.1 ± 1.70
III (05. 08. 03)	20.8 ± 0.62	192.5 ± 8.08	96.6 ± 5.66	26.1 ± 1.62

Results

Training loads applied for Polish Junior Handball Team during the following training camps (1-6, 9, 11, 12) present figures 1 and 2. Number (13) on the abscissa refers to the finals of the Junior World Championship. Numbers 7, 8, and 10 characterize periods of work with players according to individual plans.

The highest value of total training load was registered in 11th (35 training units; 2800 min) and 9th training camps (30 training units; 2495 min).

Little training capacity at the beginning period of work with the team (training camps 1-6) was conditioned by league matches, in which national team members participated.

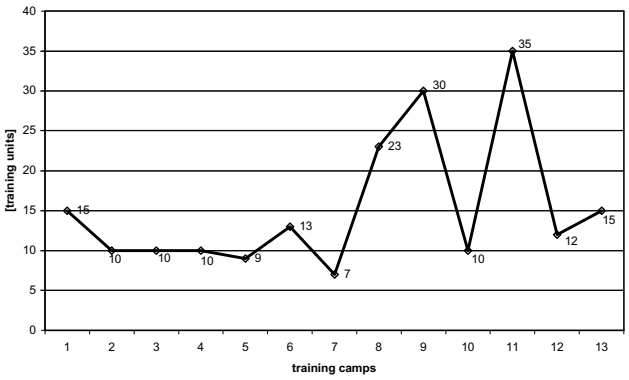

Fig.1. Training units on the sport camps of Polish Junior Handball Team

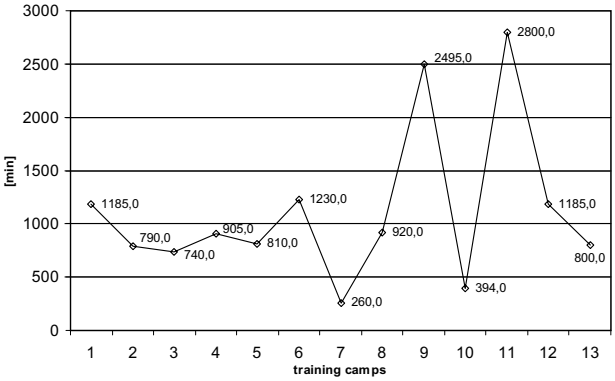

Fig.2. Total work on following sport camps of Polish Junior Handball Tea

Table 2 presents the results of a special endurance test. Significant differences in the level of VO_2 max and VE max indices were observed in handball players between the first and third investigations. Other indices for effort trials (stress tests) measured during three consecutive series of tests were on a similar level.

Table 2. The level of aerobic capacity indices of Polish Junior Handball Team (n = 13)

Measurement terms	VO_2max (ml/ kg x min)	VO_2max/AT (%)	VEmax (l/min)	VE/AT (%)	HRmax (b/ min)	HR/AT (b/min)	HR/AT (%)
I (21. 07. 02)	58.4 ± 4.85 $^{*}_{1\text{-}2,\ 1\text{-}3}$	78.3 ± 4.77	183.0 ± 16.9 $^{*}_{1\text{-}3}$	58.3 ± 4.40	193 ± 10	165 ± 11	85.5 ± 2.97
II (28. 05. 03)	52.6 ± 4.48	79.9 ± 3.42	171.9 ± 9.78	59.6 ± 3.43	193 ± 12	168 ± 12	87.2 ± 3.28
III (05. 08. 03)	50.0 ± 2.73	80.3 ± 2.45	165.2 ± 17.8	58.2 ± 3.53	192 ± 9	163 ± 10	84.7 ± 3.21

Even bigger differences were registered during anaerobic capacity measurement. It chiefly refers to short distance runs.

The players' capability for short and dynamic work was the highest in the first test and the lowest in the third one. However, no changes were registered with reference to a special endurance trial (shuttle run) (Tab.3).

Table 3. The level of anaerobic capacity indices of Polish Junior Handball Team (n = 13)

Measurement terms	VO_2max (ml/ kg x min)	VO_2max/AT (%)	VEmax (l/min)	VE/AT (%)	HRmax (b/ min)	HR/AT (b/min)	HR/AT (%)
I (21. 07. 02)	58.4 ± 4.85 $^{*}_{1\text{-}2,\ 1\text{-}3}$	78.3 ± 4.77	183.0 ± 16.9 $^{*}_{1\text{-}3}$	58.3 ± 4.40	193 ± 10	165 ± 11	85.5 ± 2.97
II (28. 05. 03)	52.6 ± 4.48	79.9 ± 3.42	171.9 ± 9.78	59.6 ± 3.43	193 ± 12	168 ± 12	87.2 ± 3.28
III (05. 08. 03)	50.0 ± 2.73	80.3 ± 2.45	165.2 ± 17.8	58.2 ± 3.53	192 ± 9	163 ± 10	84.7 ± 3.21

Discussion

According to Cardinale (2002) in a 60 min-match handball players cover a distance from 2000 m to 6000 m depending on a position in a game and technical and tactical assumptions during a match. The work of Cuesta (1991) presents the results of a kinetic analysis in a handball match. During a 60 min-effort a left-winger run 3,557 m, right-winger 4,083m, left playmaker 3,464m, right playmaker 2,857 m and middle playmaker 3,531 m. Moreover it was indicated that during the match the players performed, on average, 190 changes of rhythm, 279 changes of run directions, 16 jumps, 285 intensive efforts (8 per min on average). The results decidedly confirm a changeable character of effort performed by handball players and considering a number of actions various in the character it can be stated that the anaerobic-alactic effort is very significant. With reference to effort metabolism interesting data present the results of investigations carried out on Italian team during a friendly match. Lupo (1996) claimed that average frequency of heart rate. HR in Italian handball players equals 145/min (max. 190/min) and lactate in blood – 4 mmol/l. Other results referring to investigations conducted on handball players according to Colli at al. (1997) confirm that an average value of HR during a match is highly variable - from 140/min to 200/min. and lactate concentration in blood comes even up to 9-10 mmol/l. Analyzing the foregoing it may be assumed stated that the main energy source in a handball player's effort is an aerobic metabolic process interrupted by anaerobic processes during short actions on offence and defense. The works of Czerwiński (1988),

Bellotti at al. (1982) and Jastrzębski (1992) confirm the above state. They believe that aerobic processes play an important role in the performance; however the most significant are anaerobic-alactic and anaerobic-lactic efforts.

Considering works of the other authors it must be stated that a high level of aerobic preparations in the performance occurred in the first series of tests but in the third series it was low. For a comparison, characterizing a hypothetical "model of a handball champion" Czerwiński (1990) indicated the VO_2 max value on the level of 54.7 ml/kg x min. Other European handball players presented lower results of the aerobic upper limit than our subjects. For example in a group of 15 top class handball players from Greece the value of VO2max ranged from 43.8 to 51.1 ml/kg x min (Kouidi at al. 2000) and in the studies of Loftin at al. (1996) a value of 48.0 ml/kg x min was registered. Thus it may be considered that in handball (men) an optimal aerobic upper limit determining effort tolerance characterized by aerobic metabolism during a special preparation period should oscillate between 52-55 ml/kg x min, and for top handball players between 55-60 ml/kg x min.

From the point of view of preparations for the World Championship the investigated handball players were in bad condition both with reference to aerobic and anaerobic capacity as their effort tolerance significantly dropped (third series of tests). The sport results they achieved during the World Championship confirmed the above fact. The team finished on the seventh place. It must be treated as a defeat as they began from the position of Champions and were chosen favorites.

Due to the presented investigation results it can be said that effort tolerance of handball players is important in the system of preparations and in large measure decides about a final sport success.

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PSYCHOPHYSIOLOGICAL DIAGNOSTICS OF FOOTBALL PLAYERS*

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Abstract

The peculiarities of individual and typological features of the highest neural activity sensomotor functions and the condition of the athletes' main psychological functions: perception, attention, thinking, memory were studied. The participants were 55 football players (28 males, 27 females) who ranged from 17 to 23 years of age. The received psychophysiological tests results gave the opportunity to evaluate the individual state of neurodynamic functions of each athlete In view of sexual distinctions. The individual and typological features of the athletes' highest nervous activity males are picked up. It is estimated that the males athletes has more speed and quality of the treatment of visual information.

Key words: *psychophysiological state, psychic functions, sensomotor functions, operational thinking coefficient, psychophysiological conditions.*

Introduction

Modern sport and sports activity — components of culture of any nation. All over the world sports for women became social force, means of emancipation, the well-being, defining position in a society. Growth of participation of women in Olympic movement causes high interest of world community to development of female sports, achievement of leading positions of women in sports at national and world levels (Platonov, 1997). Sports perfection of women in football probably only provided that the trainer will consider features which belong to a female organism (Uilmor, & Kostill, 1997; Ueynberg, & Gould, 1998). But it is necessary to consider at planning sports preparation of females physiological features which structures of a body, specificities of separate organs and systems, physiological process which occur in connection with activity sexual and others ferrics internal secretions (Shahlina, & Futorniy, 2003).

The aim of this study was to analyze the results of psychophysiological testing of neurodynamic functions, sensomotor reactions and the psychological functions: perception, attention, thinking, memory at male athletes and female athletes.

Methods

The participants were 55 football players (28 males, 27 females) who ranged from 17 to 23 years of age (M=18.29, SD=1.18). Participant reported that they had been involved in regular sport or exercise for an average of 8.45(SD=4.32) years.

They were examined: the psychophysiological functions – functional mobility of nervous processes, strength of nervous processes and neurodynamic functions were registered by the computer system with the device, on which 2 buttons are located (Makarenko, Boreiko, & Lizogub, 1997). The reseaches of sensomotor reactions begen with the defining of latent period of the simple sensormotor reaction. The sportsman had to press quickly a right button for right – handed persons and a left one for left – handed persons, seeing any figure on the monitor. The latent period of complex sensomotor reaction differed from the previous by that, athlete had to press quickly a right button by right hand seeing on monitor a computer figure "square". In the case of appearing a figure "circle" he had to press a left button by left hand and doesn't press any buttons seeing other figures. The functional mobility of the nervous processes measure was the value of the minimum exposure of visual signals in which the number of erroneous reactions did not exceed 5 % in a series of some sensor motor choice reactions. The strength of nervous processes parameter was difined by the sum of mistakes wich were made by the athletes during test exercise. It was considered that the less mistakes the athlete made the higher is the level of the strength of nervous processes.

The visual perception and information processing were studied by a special computer test with two algorithm changes (Korobeynikov G., 2002).

First algorithm. Four digits (from 0 to 9) are presented on the computer's monitor randomly. The subjects were requested to perform a combination digit test, the task was to calculate (in mind) the number of digits transposed on the display. The aim of each presented digits road was to transpose in the increasing order.

* *Young researcher award*

For example: **2 5 3 4** – initial order
2 3 5 4 – first transposition
2 3 4 5 – second transposition, the result

Thus, the result of this task consists of "2" transpositions which need four digits on the display in the increasing order. To answer, a person must press the computer's key "2".

Second algorithm. Four digits (from 0 to 9) are presented on the computer's monitor randomly. The subjects were requested to perform a combination digit test, the task was to calculate (in mind) the number of digits transposed on the display. The aim of each presented digits road was to transpose in the decreasing order.

For example: **8 0 4 7** – initial order
8 0 7 4 – first transposition
8 7 0 4 – second transposition
8 7 4 0 – final transposition, the result.

Thus, the result of this task consists of "3" transpositions which need four digits on the display in order to calculate (in mind) the number of digits transposed on the display in the decreasing order. To answer, a person must press the computer's key "3".

The time and the accuracy of performing each assignment were registered for each person. The duration of a whole informational process was 4 minutes (2 minutes for each test). The used model of visual perception and informational processing was submitted as part of the computer's system of psychophysiological capacity diagnosis (Korobeinikov, 2002).

Based on the testing results, the following psychophysiological parameters were determined: attention volume (AV) and operational thinking coefficient (OT):

$$AV = (Nr / N) \times 100\% \quad (1)$$

where
Nr – the number of tasks performed successfully,
N – the number of all tasks performed.

$$OT = (Nr / T) \times 100 \quad (2)$$

where
T – average time of solving a test problem (ms).
100 - coefficient.

By results of experimental models pay off psychophysiological parameters of intellectual work capacity of the person.

The coefficient of variation of average time ofsolving a test problem pays off behind the formula:

$$V = (\sigma / T) \times 100\ \%, \quad (3)$$

where V – coefficient of a variation of average time the decision of the test (%);
σ – Standard deviation of average time of solving a test problem;
T – average time of solving a test problem (ms).

For the evaluation of time perception, we used a modified "individual minute" test proposed by Halberg, 1978 (time perception error, ΔT).

Efficiency of attention was estimated by quantity of mistakes.

The memory function was determined by using a method for measuring short-term memory volume (MV), which consists in estimating the correctly memorised digits among twelve two-digit figures presented for a subject on a display within 30 s.

Statistics work was done with the help of the «Statistica» programer of the «Stat Soft» firm, version 6,0. The difinition of certain differences of the indices was worked out with the usage of Kolmogorov- Smirnov λ- criterium.

Results

Results of the basic parameters neurodynamic functions of bone marrow, of male athletes and female athletes are shown on the Table1.

Table1. Psychophysiological parameters in different sex groups of football players

Parameters	Males, n=28		Females, n=27	
	M	SD	M	SD
Latent period simple of sensormotor reaction (ms)	234.85	21.57	251.51	28.91**
Latent period of the complex sensormotor reaction (ms)	411.58	44.64	443.15	56.55*
Functional mobility of the nervous processes, (%)	89.29	15.38	87.78	13.40
Functional strength of the nervous processes, (%)	4.77	1.79	9.52	4.19**

Legend: Here and on the Tab. 4 and 5: M-mean value; SD- dtandard deviation; *- p<0.05, **- p<0.001.

Measurement of the latent period simple sensormotor reactions is widely applied in researches of typological features and a functional condition of the person. It is one of the most simple and authentic quantitative parameters which are measured at psychophysiological researches.

Females *(M =251.51, SD =28.91)* reported significantly higher Latent period simple of sensormotor reaction then males *(M =234.85, SD =21.57)*, p <0.01.

As is known, definition of the latent period of reaction of a choice in sports is of great importance. Duration of this parameter of the basic nervous processes causes high-speed qualities of the sportsman which it is very important in football. Between values of latent periods complex sensormotor reaction also was the established statistics difference of male athletes (*M* =411.58, *SD* =44.64) and female athletes (*M* =443.15, *SD* =56.55),p <0.05.

Kolmogorov – Smirnov's test for the difference in functional strength of the nervous processes showed that males (*M* =4.77, *SD* =1.79) were significantly great (p <0.01) when they in the groupe females (*M* =9.52, *SD* =4.19). There were no significant differences in the functional mobility of the nervous processes (p> 0.05).

The significant differences have been established between result mental activity of male athletes and female athletes are shown on the Table 2.

The males sportsmen spend for the decision of a test problem less time – statistics differences of the result (p <0.05), average time of solving a test problem of the test for rearrangement of figures in ascending order which specifies high speed of processing of the information. And also for the allocated limit time – 2 minutes, solve a lot of problems (p <0.05). The parameter the operational thinking coefficient in the group males also has higher results (p <0.05) in comparison with females sportsmen.

Table 2. Parameters of psychological functions in different sex groups of football players in the test for rearrangement of figures in the increasing order

Parameters	Males, n=28		Females, n=27	
	M	SD	M	SD
Time perception error (c)	4.89	4.26	6.44	4.96
Short-term memory volume (%)	54.46	15.66	53.66	14.33
Attention volume (%)	87.36	10.99	82.46	14.76
Average time of solving a test problem (ms).	681.26	273.29	945.69	373.73*
Coefficient of a variation of the average time of solving a test problem (%)	48.78	11.79	53.26	15.32
Efficiency of attention, quantity of mistakes	2.57	2.20	2.59	1.87
Productivity, total of the solved problems	21.93	5.24	17.22	5.57*
Operational thinking coefficient (s.u.)	3.29	1.51	2.01	1.45*

Time perception error & short – term memory volume as parameters which make mental activity, have no statistical distinction between results of males and females (p> 0.05).

The males sportsmen had the best results such parameters of intellectual functions: average time of solving a test problem (p <0.01), productivity (p <0.05), operational thinking coefficient (p <0.01) at work of the test for rearrangement of figures in the decreasing order, also just as in the previous test (Table 3).

Summing up to the comparative analysis of parameters psychological functions of sportsmen – of male athletes and of female athletes can be ascertained there are certain divergences in parameters of the bone marrow neurodynamic and psychological functions which are shown that higher resaulte of intellectual work and operational thinking characteristic of male athletes.

Table 3. Parameters of psychological functions in different sex groups of football players in the test for rearrangement of figures in the decreasing order

Parameters	Males, n=28		Females, n=27	
	M	SD	M	SD
Attention volume (%)	87.57	13.58	80.64	19.86
Average time of solving a test problem (ms).	607.74	208.97	868.24	386.53**
Coefficient of a variation of the average time of solving a test problem (%)	55.12	17.32	54.30	17.27
Efficiency of attention, quantity of mistakes	2.50	1.62	2.67	2.18
Productivity, total of the solved problems	21.86	6.28	16.52	5.39*
Operational thinking coefficient (s.u.)	3.75	2.13	2.04	1.41**

Discussion and conclusions

The given complex of psychophysiological diagnostics is informative and reliable for estimating the functional state of athletes (Korobeynikov, Bitko, Sakal, & Kulinich, 2003). The male athletes have significant differences in the nervous system' characteristic, and in some displays sensomotor reaction and intellectual work than the female athletes. Results of research allow to perfect control system of the football players' functional state by psycho- physiological methods. Biological features of an organism of women demand reorganization of training process of female athletes. At planning training loadings are necessary, on the one hand, realization of an individual approach to training process females, with another – new methods which allow to improve a functional condition of an organism of female athletes and promote increase of sports results.

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EFFECT OF TWO REGIMES OF VITAMIN C ON DELAYED ONSET OF MUSCLE SORENESS

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Abstract

The aim of the present study was to investigate the physiological effects of two regimes of vitamin C on the delayed onset muscle soreness (DOMS). Thirty seven non-athletic female volunteers (age, 22.02 ± 1.54 yrs) were randomly allocated into 4 groups; Group 1: consumed 100 mg vitamin C (n=9); Group 2: consumed 200 mg vitamin C (n=10); Group 3: consumed placebo (n=9); Group 4: control (n=9). The treatment groups received vitamin C 1 hr before eccentric actions up to 47 hr after actions. The placebo group consumed identical capsules that contained 100 mg lactose. 70 eccentric contractions of the triceps muscle of the non-dominant side on a modified arm curl machine were performed to induce muscle soreness. The time interval every action was 3 s with a 10 s rest between them and there was 1 min rest between every 10 actions. Perceived muscle soreness (PMS), maximal eccentric contraction (MEC), creatine-kinase (CK) enzyme values and elbow range of motion (EROM) were assessed, 1 hr before, and 1 hr, 24 hr, and 48 hr after the eccentric actions. Data were analyzed by two-way analysis of variance (ANOVA) with repeated measures for the time component of the experiment and the following results were concluded:

Peak muscle soreness in all groups in the study occurred 48 hr after the contraction except in the group 1 and there was not a significant difference between the 4 groups in muscle soreness. CK activity increased in all groups after eccentric contraction and there was not a significant difference in CK levels between the 4 studied groups. A non-significant reduction of elbow joint ROM was also indicated in all groups of study. There was not significant reduction in MEC in any groups. Therefore consumption 100 or 200 mg vitamin C dose not affect on (DOMS).

Key words: *Muscle soreness, Anti oxidant, Vitamin C, Free radical*

Introduction

Delayed onset muscle soreness (DOMS) results from high-intensity work involving eccentric exercise contraction (2,7,8,13). It is associated with loss of strength, muscle shortening, elevation of serum CK and muscle disruption (1,4,11).

Muscle soreness may have a number of different causes, including the adverse effects of free radicals (14,15,16). Production of reactive oxygen species during exhaustive exercise well established and the subsequent removal depends on the capacity of the scavenger and antioxidant system (10). If the rise in the level of free radicals exceeds the antioxidant defense capacity of the cells lipid peroxidation will occur (14). A great number of human studies have shown supplementation with antioxidant vitamins has favorable effects on the process of lipid peroxidation (3,5,14).

Vitamin C is a powerful antioxidant scavenging free radicals and ingestion of large amount of vitamin C offers some protection against exercise-induced muscle soreness and lipid peroxidation (16).

Several studies have reported positive effects of vitamin C supplementation on muscle soreness and muscle damage before and after exercise. For example Kaminski and Boal (6) reported a reduction in muscle soreness after consumption 3000 mg vitamin C for 3 days. McBride and coworkers (9) reported a reduction in past – exercise plasma CK activity following a resistance exercise when subjects consumed 1,200 IU of vitamin E for 2 weeks before exercise. Shafat et al. (15) suggested that 37 days of supplementation with vitamin C and vitamin E reduced the deficit in muscle function normally experienced during and after bouts of eccentric muscle contraction.

In contrast Peterson et al. (12) found daily consumption of 500 mg vitamin C and 400 mg vitamin E for 14 days prior to a down hill run did not reduce muscle damage when compared with a control group. Also acute supplementation (1000 mg) 2 hr prior to exercise or consumption a single dose of 200 mg no effect in reducing muscle soreness or indices of damage (16, 18). Therefore the effectiveness of vitamin supplementation on reducing exercise-induced muscle damage has not been consistently demonstrated (3, 15).

Recent studies have shown that excessive doses of vitamin C can lead to toxicity. Furthermore, high vitamin C intakes appear to be occasionally associated with diarrhea and intestinal discomfort possibly due to bacterial fermentation of unabsorbed vitamin C (17). On the other hand vitamin C is water-soluble and availability may be increased after a single

dose and there may be no need for prolonged supplementation (16). Therefore the aim of the present study was to identify consumption 100 or 200 mg vitamin C before and after eccentric contraction would affect on DOMS.

Methods

Subjects

37 apparently healthy females with no history of vitamin C use participated in this study voluntarily. All subjects in this investigation participated in a familiarization session. During the familiarization session, subjects were informed as to the experimental procedures, completed a personal/medical history form, and signed informed consent statement in adherence with the human subject's guidelines of Guilan university. Subject's descriptive characteristicswere(mean ±SD) 21±3yrs, 56±5kg, and 158±4cm.

Procedure

Using a single blind manner, the subjects were randomly assigned to the following groups:

- Group 1 (100 mg vitamin C supplementation, n=9)
- Group 2 (200 mg vitamin C supplementation, n=10)
- Group 3 (Placebo, n=9)
- Group 4 (Control group without supplementation, n=9)

Subjects were instructed to maintain their regular eating habits during the investigation period and ingest the supplements just before exercise, 24 hr and 48 hr after exercise. The supplementation consisted of capsules containing 100 mg and 200 mg of vitamin C, whereas the placebo consisted of similar capsules containing 100mg lactose. To induce DOMS, subjects performed 7 sets of 10 repetitions using 80% of their eccentric one repetition maximum and only the non-dominant arm (as used previously by Rahmani- Nia et al., 2004). Duration of contraction was 3 seconds. Subjects were given 10 seconds rest periods between sets. Dominant arm was determined by dynamometer (Laffayatte, USA). The exercise-testing apparatus consisted of a modified arm curl machine (11). The subject's arm was placed on a designed padded support table that is joined to the arm curl machine. A cuff was placed around the subject's wrist and the cuff was attached to the strain gauge. 1RM using of arm-extension maximal eccentric contraction (MEC) of elbow extensors on the arm curl machine was recorded. Elbow range of motion was measured goniometrically by the researcher. Subjects were seated with shoulder into full extension (11) either to the physiological limitation or to pain tolerance. The measurement of elbow extension on a 180 degree goniometric scale was recorded. This procedure was repeated and the two measures were averaged to produce a mean measurement of elbow extension that was used for data analysis.

Perceived muscle soreness was measured at he same time. Upon reaching full elbow extension, the subject indicated the degree of soreness experienced by a 30 point scale (1=normal and 30=very very sore). Blood was taken from cubital vein of the involved arm. Serum was separated and frozen at –20 ºC for subsequent analysis of CK. Total CK was determined using spectrophotometer at 30 ºC using commercially available kit, 47 UV (Sigma Diagnostic, ST Louis Mo). Creatine-kinase, MEC, range of motion (ROM) of elbow joint and perceived muscle soreness were evaluated in four different times:

- On the first day (1hr before the exercise)
- On the first day (1hr after the exercise)
- On the second day (2hr after supplementation)
- On the third day (2 hr after supplementation)

Statistical analysis

Data were analyzed by two-way analysis of variance (ANOVA) with repeated measures for the time component of the experiment with LSD post-hoc procedures for all daily measurements. Statistical significance was determined as $p<0.05$. Data are presented as means ± SD.

Results

Results of CK, perceived muscle soreness, ROM of elbow and MEC are presented in table 1,2,3 and 4 respectively. No significant differences ($P>0.05$) were found between groups 1,2,3 and 4 in 3 days.

Table 1. Comparison of CK between four groups (X±SD).

Variable	1h before exs.	1h after exs.	Second day	Third day
Group1	94.33 ± 29.97	107.77 ± 29.67	120.77 ± 33.35	101.33 ± 27.50
Group2	105.80 ± 21.80	112.2 ± 26.93	121.50 ± 25.51	97.80 ± 18.73
Group3	108.00 ± 28.46	117.33 ± 37.77	138.66 ± 41.97	96.00 ± 27.73
Group4	89.00 ± 19.29	98.66 ± 26.01	108.66 ± 27.34	82.00 ± 25.31

Table 2. Comparison of perceived muscle soreness between four groups (X±SD).

Variable	1h before exs.	1h after exs.	Second day	Third day
Group1	-	4.66 ± 3.90	13.11± 8.71	6.77 ± 3.90
Group2	-	2.90 ± 2.56	8.50 ± 7.28	9.80 ± 7.03
Group3	-	2.88 ± 2.68	8.55 ± 5.67	9.00 ± 5.67
Group4	-	6.00 ± 5.73	10.22 ± 8.76	10.33 ± 6.54

Table 3. Comparison of ROM of elbow between four groups (X±SD).

Variable	1h before exs.	1h after exs.	Second day	Third day
Group1	145.66 ± 2.22	139.55 ± 4.54	137.55 ± 7.13	142.88 ± 2.88
Group2	143.20 ± 4.31	137.70 ± 7.50	141.20 ± 6.68	142.50 ± 6.28
Group3	145.22 ± 3.10	139.88 ± 6.15	137.44 ± 3.83	142.33 ± 3.49
Group4	146.22 ± 2.67	140.88 ± 7.81	140.55 ± 5.94	144.66 ± 2.67

Table 4. Comparison of MEC between four groups (X±SD).

Variable	1h before exs.	1h after exs.	Second day	Third day
Group1	10.50 ± 1.92	8.27 ± 1.76	9.30 ± 1.99	10.50 ± 1.92
Group2	10.75 ± 1.48	8.37 ± 1.80	9.30 ± 1.54	10.60 ± 1.62
Group3	9.08 ± 1.08	6.97 ± 1.03	7.86 ± 0.90	9.05 ± 1.09
Group4	10.44 ± 1.75	8.00 ± 1.77	9.05 ± 1.78	10.02 ± 1.89

Discussion

The purpose of this study was to investigate whether vitamin C consumed 1 hr before exercise up to 48 hr after that would influence the extent of muscle soreness following eccentric contraction. The muscle soreness experienced by the subjects coupled with the reduction in MEC, in ROM and increase in CK activity and would suggest that eccentric contractions had induced muscle damage. The results of this study indicate that supplementation for 3 days with vitamin C had no effect on DOMS. Similar results have been reported previously (16,18), although in all of these studies only measured biochemical (creatine-kinase, myoglobin, malondialdehyde) markers of muscle damage. It has been suggested that the best measure of muscle damage is not biochemical marker such as CK (3,18). Other studies thought have shown positive effects of vitamin supplementation on DOMS (3, 9,15). Differences in the type and duration of exercise performed, duration and kind of vitamin consumed and the fitness of the subjects used maybe important factors in explaining these contrasting results. There are several explanations for the lack of effect of vitamin C supplementation in the present study. There have been some reports that mixed antioxidant supplementation, including vitamin C and E offer some benefits in terms of lipid peroxidation and muscle damage after exercise. Vitamin C is hydrophilic, accumulates in the cytosol and extra-cellular fluid, whereas vitamin E is hydrophobic, and accumulates in structures such as membrane (17). These vitamins are able to protect different cellular compartment. Therefore the combination of vitamin C and E together may provide more protection from oxidative damage than a single nutrient supplementation. Moreover, vitamin C can also act to reduce oxidized vitamin E antioxidant function (15,17). It has been suggested that all type of leukocyte, including lymphocytes become saturated at vitamin C intakes of 100-200 mg per day (18,19), although it is unclear whether this is also the case for concentration vitamin C in skeletal muscle (19). Therefore another possible explanation is that increased availability of vitamin C led to further uptake by these cells and maybe the plasma do not become saturated. This is important because extra cellular oxidative stress maybe responsible for the amplification of muscle damage. Another possible explanation is that the antioxidant defenses of our subjects were not adequate, so increased availability of vitamin

C offered no additional benefit. Active individuals appear to exhibit better vitamin C status than less active people (16) and the subject in the present study were less active.

In summary, the results of the present study suggest that daily consumption of 100 or 200 mg vitamin C dose does not affect DOMS.

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