Effects of a five-minute classroom-based physical activity on on-task behavior and physical activity volume

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DOCTORAL THESIS

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ACKNOWLEDGMENT

Immeasurable appreciation and deepest gratitude for the help and support are extended to the following persons who in many different ways have contributed in making this doctoral thesis possible:

Boris Neljak, my primary advisor, whose maddening attention to detail drove me to finally learn to punctuate prose. His recognition of my potential and his extention to me of the opportunity to work at the Faculty, have allowed me to finance my doctoral study and continue my research.

Ming-kai Chin, my secondary advisor, who endlessly supported and encouraged me to keep learning and challenged me to continually give more and strive for my best. It is because of him that I have been able to share my ideas on the global stage and develop my unique voice in the field.

Marjeta Mišigoj-Duraković, **Dubravka Miljković**, **Vatroslav Horvat**, **Gordana Furjan-Mandić**, my Committee members, for their unconditional support over the past two years as I evolved what was just a faint idea into a completed study.

Dario Novak, my mentor and counsel, who set me on an exploratory path and planted the seed for what is now my thesis. He has provided unwavering support and guidance, through uncertainty and doubt.

Tom Root and **Ming-kai Chin** of the **HOPSports, Inc**. for allowing me to use Brain Breaks® Physical Activity Solutions in order to complete the studies on which this thesis is based.

Marjeta Mišigoj-Duraković and **Maroje Sorić** of the Department of Kinesiological Anthropology and Methodology at the Faculty of Kinesiology, University of Zagreb for lending their equipment and tactical execution support.

Đurđica Kamenarić of the Student's Office for Doctoral Study, for all of her assistance in coordinating and driving my thesis process. She has made a potentially challenging process seamless in all administrative and coordination aspects.

Special thanks are extended to the teachers and students of the Ivo Andrić Elementary School in Zagreb who took part in this study and generously shared their time and ideas.

Finally, I wish to thank **Nikolina Brusek**, my fiance, for her dedication, understanding and reassurance during many stressful moments, **Ivan Radman**, **Goran Škorić** and **Filip Matković** for their encouragement and tactical support.

My family has taught me perseverance and helped me remain focused throughout my academic endeavors and for that, and their unconditional love, I will always be grateful.

ABSTRACT

INTRODUCTION: The purpose of this study was to explore the effects of a 5-min classroom-based physical activity. The search focused on its effects on on-task behavior and on the physical activity volume and energy expenditure during school days.

METHODS: A convenience sample of 126 pupils were selected from the elementary school Ivo Andrić in Zagreb to participate in the study. During the intervention period, intervention classes participated in a 5-min physical activity daily in the middle of a 45-min academic lesson by imitating video animations projected on the board (Brain Break by HOPSports®). On-task behavior during academic lessons was assessed by implementing multiple baselines across subjects design for 12 weeks by observing the pupils in a classroom. Physical activity volume and energy expenditure were assessed for 8 weeks using SenseWear Armband body monitor (BodyMedia Inc., Pittsburgh, PA, USA).

RESULTS AND DISCUSSION: When classroom-based physical activity was not implemented, on-task behavior during the second part of the lesson decreased (by 3% and 4% for 6-8- and 8-10-year-old pupils, respectively). When classroom-based physical activity was implemented, initially high on-task behavior during the first part of the lesson (91.42% and 94.8% for 6-8 and 8-10-year-old pupils, respectively) was not significantly changed after the 5-min classroom-based physical activity. Additionally, after the classroom-based physical activity was systematically introduced, on-task behavior systematically improved. The results of implementation of classroom-based physical activity also indicate there is a significant increase or improvement in physical activity volume and energy expenditure during school days.

CONCLUSION: On-task behavior during academic lessons and daily in-school physical activity volume may be improved by implementing a classroom-based physical activity.

Key words: academic achievement, academic behaviour, school-day physical activity, elementary school pupils

SAŽETAK

UVOD: Svrha istraživanja bila je utvrditi učinke pet-minutne tjelovježbene aktivnosti u učionici na usredotočenost na zadatak tijekom nastave i na volumen tjelesne aktivnosti i potrošnju energije tijekom školskog dana.

METODE: Prigodni uzorak od 126 (6-10god) učenika odabran je među učenicima osnovne škole Ivo Andrić u Zagrebu. Tijekom perioda intervencije, u eksperimentalnim razrednim odjelima učenici su tijekom jednog nastavnog sata dnevno provoditi tjelovježbene aktivnosti u trajanju od 5 minuta, točno na polovici školskoga nastavnog sata uz pomoć video animacija (Brain Break by HOPSports®). Usredotočenost učenika na zadatak procjenjivana je tijekom 12 tjedna metodom opažanja s uključivanjem u eksperiment u prirodnim uvjetima, dok su se volumen tjelesne aktivnosti i potrošnja energije procjenjivali tijekom osam tjedana SenseWear Armband instrumentom (BodyMediaInc., Pittsburgh, PA, USA).

REZULTATI I DISKUSIJA: Tijekom kontrolnog perioda kada učenici nisu sudjelovali u tjelovježbenim aktivnostima, usredotočenost na zadatak tijekom nastave snizila se u drugom dijelu sata (za 3% kod učenika dobi 6-8 godina i za 4% kod učenika dobi 8-10 godina). Nakon uvođenja tjelovježbene aktivnosti u periodu intervencije, usredotočenost učenika na zadatak bila je na istoj razini tijekom cijelog sata. Inicijalno visoka razina usredotočenosti na zadatak tijekom prvog dijela sat (91,42% kod učenika dobi 6-8 godina i 94,8% kod učenika dobi 8-10 godina) nije se značajno promjenila u drugom dijelu sata nakon sudjelovanja u pet-minutnoj tjelovježbeoj aktivnosti. Nadalje, nakon sustavnog uvođenja pet-minutne tjelovježbene aktivnosti, usredotočenost na zadatak tijekom nastavnog sata sustavno se povećala. Kod obje dobne skupine uočeno je povećanje usredotočenost na zadatak nakon četvrtog tjedna u razredima koji su započeli sa tjelovježbom nakon četiri tjedna. Također, razredi koji su započeli sa tjelovježbom nakon osam tjedana povećali su usredotočenost na zadatak nakon osmog tjedna uz iznimku učenika dobne skupine 8-10 godina čija se usredotočenost na zadatak nije statistički značajno promjenila. Rezultati uvođenja tjelovježbene aktivnosti u učionici ukazuju na statistički značajno povećanje ili unaprijeđenje volumena tjelesne aktivnosti i potrošnje energije tijekom školskog dana. Povećanje je zamijetnije kod učenika dobne skupine 6-8 godina, dok tjelovježbena aktivnost u učionici povećava volumen tjelesne aktivnosti učenika dobi 8-10 godina u manjoj mjeri.

ZAKLJUČAK: Tjelovježbena aktivnost u učionici može unaprijediti usredotočenost na zadatak tijekom nastave i povećati volumen tjelesne aktivnosti tijekom školskog dana.

Ključne riječi: odgojno – obrazovna postignuća, odgojno – obrazovno ponašanje, tjelesna aktivnost tijekom školskog dana, razredna nastava

CONTENT

1. INTRODUCTION

Reasons for the decrease in physical activities of children are ascribed to the effects of environmental factors, increasingly demanding school curriculum, program objectives to be mastered and huge amounts of homework, excessive use of social networks and communication programs on the Internet, etc. With the increase in the amount of time children spend learning, watching television and sitting in front of the computer, the theoretical possibility for spending time in physical activities, in general, is decreased.

The school environment is ideal for introducing programs that will change the trend of physical inactivity among the children and the young. Although physical education is an obligatory subject in the majority of the world's and Europe's countries, it is often shortened and irregular and many participants don't participate actively in it (Dobbins et al., 2009; McKenzie et al., 1995; Simons-Morton et al., 1994). Schools often decide to decrease the number of classes and other physical activities of the children in order to increase the number of academic classes to improve test scores (Rasberry et al., 2011). In the Republic of Croatia physical education is obligatory from elementary to high school but students spend only 46.14% of class time effectively exercising (Findak, 1992), while in first grade that time is 21.58 ± 3.32% (Prskalo, 2001). At the same time, the prevalence of physical inactivity in first grade (7 yrs) is 71.7% among girls and 54% among boys (Jureša et al., 2010), among 11 year olds 81% for girls and 69% for boys, among 13 year old 85% for girls and 69% for boys, and among 15 year olds 92% and 78% for girls and boys, respectively (Currie et al., 2012).

Data suggests the importance of finding new ways of promotion and encouragement of regular physical activity and its integration during the school day. Classroom-based physical activity is a promising way of encouraging in-school physical activity of pupils (Rasberry et al., 2011). During an experiment by Mahar et al. (2006), the pupils who participated in Energizers classroom-based physical activity performed significantly more steps during a school day (5587 ± 1633) with a moderate effect size of 0.49. Stewart et al. (2004) found that during implementation of the TAKE10! Program, the pupils exercised physically in the classroom with moderate intensity and made 644–931 (first grade) 659–1376 (third grade), and 1002–1041 (fifth grade) steps.

Based on current studies, the physical activity volume and energy expenditure during classroom-based physical activity and during the school day is not known. Also, it has not been established yet whether the pupils are more active during the rest of the school day

(during recess or physical education classes) or whether they decrease their physical activity if they participate in classroom-based physical activity.

To promote implementation of classroom-based physical activities, empirical data is needed to document the positive relationship of physical activities and indicators of academic performance, i.e. cognitive skills and attitudes, academic behaviors and academic achievement (Mahar et al., 2006; Rasberry et al., 2011). Physical activity is, undoubtedly, an important factor in achieving an optimal health and decreasing the risk of many diseases. However, studies on the effects of school-based physical activity (e.g. during recess, in classroom, during PE classes or extracurricular programs) on indicators of academic performance show a relatively even split between finding a positive relationships and no significant relationship (Rasberry et al., 2011). Maeda and Randall (2003) report significant improvement of concentration and better ability to solve math problems among second grade pupils after participating in 5-minute physical activities. Mahar et al. (2006) have found a systematic improvement of on-task behavior of elementary school pupils after systematic introduction of Energizers classroom-based program. On-task behavior was significantly improved for 8% after introduction of the intervention, while an improvement of 20% is found with pupils that were least on-task before the intervention. Results of Norlander et al.'s (2005) study, which investigated the influence of a short but regular classroom-based relaxation program on decrease in noise, perception of stress and increase in ability to concentrate, point to a significant decrease in classroom noise after the relaxation treatment is completed. The relaxation program did not lower pupils' stress perception but did increase ability to concentrate. Fredericks et al. (2006) report an improvement in spatial intelligence, reading skills and math skills in first-grade pupils that were participating in daily classroom-based physical activities. However, a significant connection with abstract reasoning, perception, judgment, memorization and speech understanding has not been found. Uhrich and Swalm (2007) have studied the effects of a 6-week program of bimanual coordination on reading skills of fifth-grade pupils. The program significantly improved understanding of the read text regardless of the pupils' gender. Ahamed et al. (2007) did not find a significant association between an additional 15 minutes of classroom-based physical activities and standardized tests. Some of the present studies report a positive association between classroom-based physical activity and academic performance (Maeda & Randall, 2003; Mahar et al., 2006; Norlander et al., 2005; Rasberry et al., 2011), while others report a positive but not significant association (Fredericks et al., 2006; Lowden et al., 2001; Uhrich & Swalm, 2007).

Physical inactivity of the younger generation is increasing and opportunities to be physically active in school are reduced. Simultaneously, more time is allocated for improving pupils' academic achievements, e.g. test scores. Classroom-based physical activity is a promising way to improve academic performance while at the same time providing an increase in in-school physical activity. Therefore, the aim of this study is to investigate the effects of a 5-minute classroom-based physical activity on one indicator of academic performance, on-task behavior and physical activity volume and energy expenditure during the school day.

2. OVERVIEW OF PREVIOUS RESEARCH

There is a growing body of research focused on the association between school-based physical activity and academic performance among school-aged youth. Different school-based physical activity modalities are examined against a wide range of academic performance indicators. Table 1 shows these modalities and indicators as described by Rasberry et al. (2011).

Table 1. Physical activity modalities and academic performance indicators

<table>
<tr><th rowspan="2">SCHOOL-BASED PHYSICAL ACTIVITY MODALITIES</th><th colspan="3">ACADEMIC PERFORMANCE INDICATORS</th></tr>
<tr><td>Cognitive Skills and Attitudes</td><td>Academic Behaviors</td><td>Academic Achievement</td></tr>
<tr><td>School-based physical education studies</td><td rowspan="5">Basic cognitive abilities: executive functioning, attention, memory, creativity, verbal comprehension, information processing

Attitudes and beliefs: motivation, self-concept, satisfaction, school connectedness</td><td rowspan="5">On-task behavior, organization, planning, homework completion, class attendance, scheduling, impulse control</td><td rowspan="5">Standardized test scores in subjects areas such as reading, math and language arts, GPAs, classroom test scores and other formal assessments</td></tr>
<tr><td>Recess studies</td></tr>
<tr><td>Interscholastic school sports studies</td></tr>
<tr><td>Other school-related extracurricular physical activity studies</td></tr>
<tr><td>Classroom physical activity studies</td></tr>
</table>

The current section will include a short overview of conclusions from a range of studies that examined the effects of different school-based physical activity modalities on the academic performance of pupils. In accordance with the objectives of the present study, more in-depth analysis will be presented only for classroom physical activity studies.

2.1 School-based physical education studies

Studies examined how differences in physical education affected academic performance. They examined whether increasing the amount of physical education or level of physical activity intensity in physical education classes affected students' academic performance (Bluechardt et al., 1995; Dwyer et al., 1996; Ericsson, 2008; McNaughten & Gabbard, 1993). They also examined strategies for improving the quality of physical education (Milosis & Papaioannou, 2007; Sallis et al., 1999) and the relationship between increasing the emphasis on different types of activities (i.e., aerobic exercise, coordinative exercise) and indicators of academic performance (Budde et al., 2008), including cognitive skills (e.g., concentration and creativity), attitudes (e.g., self-esteem and motivation), academic behaviors (e.g., conduct), and/or academic achievement (e.g., standardized test scores and GPA).

The study results suggest that school-based physical education either leads to a positive result or is associated with no change in academic performance. The studies also suggest that increased time spent in physical education is not likely to detract from academic performance even when there is less time devoted to subjects other than physical education (Rasberry et al., 2011). Studies clearly demonstrate that physical activity does not need to be sacrificed for academic excellence (Trost, 2007).

2.2 Recess studies

Studies have examined the relationship between recess or increased physical activity during recess and cognitive skills (attention or concentration) and academic behavior (on-task behavior) (Caterino and Polak, 1999; Jarrett et al., 1998; Pellegrini and Davis, 1993; Pellegrini et al., 1995). Most studies used trained observers to collect data on classroom and recess behaviors, with multiple observation points. Results indicate positive associations or no association (Rasberry et al., 2011). Non-intervention recess studies explored the impact of the frequency of recess on teacher reports of classroom behavior (Barros et al., 2009) and the impact of recess on observations of individual students' cognitive and emotional adjustment to school (Pellegrini et al., 2002). A variety of strategies were used within the design and implementation of each of the interventions, including: added equipment/materials, markings, zones, teacher involvement, active video games, activity of the week, and activity cards (Ickes et al., 2013).

Study results suggest that recess is associated with improvements in attention, concentration, and/or on-task classroom behavior and indicate that recess does not appear to detract from students' focus in the classroom (Rasberry et al., 2011). Most studies demonstrated positive outcomes as a result of the recess intervention (Ickes et al., 2013).

2.3 Interscholastic school sports studies

Studies examined the relationship between involvements in interscholastic sports and academic performance. Studies examined how students' participation on sports teams was related to test scores, grades, teacher ratings of academic achievement or dropout rates (Crosnoe, 2002; Fredricks and Eccles, 2008; Fredricks and Eccles, 2006; Hawkins and Mulkey, 2005; McNeal, 1995; Spence and Poon, 1997; Stephens and Schaben, 2002; Yin and Moore, 2004). These studies varied in measurement of academic performance and participation in sports. Some used school records (test scores, GPAs, or dropout rates) and some used a teacher rating of student academic ability for students who participated in interscholastic sports. Others examined the relationship between student report of participation on sports teams and students' self-reported grades.

Rasberry et al. (2011) concluded that more than half of the associations examined in these studies were positive and almost none were negative. The available literature suggests that sport is more likely to benefit academic achievement if offered in school rather than in other sport contexts, given the proximity of educational resources and environment (Trudeau & Shephard, 2008).

2.4 Other school-related extracurricular physical activity studies

These studies focused on assessing the relationship between other extracurricular physical activities organized through the school, but conducted outside the regular school day (e.g., after-school physical activity or exercise programs) and academic performance (grades, math scores, homework completion and attendance).

Collingwood et al. (2000) assessed the impact of a life skills program with a focus on improving physical fitness on students' self-reported grades, school attendance, and self-concept. As part of the program, students completed an individual exercise program as well as instruction on self-assessment, goal setting, fitness, and exercise planning. Results showed positive associations between program participation and academic performance (grades and attendance) or no significant relationships.

Few nonintervention studies examined associations between participation in after-school physical activities and academic performance. Darling (2005) and Darling et al. (2005) found consistently positive associations between extracurricular activity participation and self-reported grades as well as positive academic attitudes and higher academic aspirations. Harrison and Narayan (2003) showed that physical activity participation was positively related to homework completion and class attendance.

2.5 Classroom physical activity studies

Studies examined the effects of introducing classroom-based physical activity as an intervention on physical activity (e.g., average step counts per minute), health (e.g., the frequency of neck pain per week), and learning (e.g., reading scores) (Erwin et al., 2012).

Studies examined how the introduction of brief physical activities in a classroom setting affected cognitive skills (e.g., aptitude, attention, memory); attitudes (e.g., mood); academic behaviors (e.g., on-task behavior, concentration); and academic achievement (e.g., standardized test scores, reading literacy and/or math fluency scores) (Rasberry et al., 2011). The interventions involved the introduction of physical activities by trained teachers into the classroom setting, with activities lasting between 5 and 20 min. per session.

McNaughten and Gabbard (1993) investigated the potential influence of varying durations of physical exertion at different times of the day on immediate mathematical performance by 120 sixth-grade boys and girls. Subjects were assigned to two control and two treatment groups (Solomon Four-group Design), with treated subjects administered physical exertion (paced walking at controlled moderate intensity) for durations of 20, 30, and 40 min at three different times of the school day (8:30 a.m., 11:50 a.m. (before lunch), 2:20 p.m) over 3 weeks. After each exertion session, subjects were immediately administered a 90-sec mathematical computation test. Analysis indicated no significant differences in mathematical performance at any duration in the morning, but scores were significantly higher at 11:50 a.m. and 2:20 p.m. at 30- and 40-min durations in comparison to the 20-min duration. They found no differences by gender of subject.

Lowden et al. (2001) used a sample of 192 student participants (years P–7), 6 detailed study schools (3 Scottish, 3 Welsh) and 24 teacher participants. Teachers delivered 10–15-min physical activity sessions for 3 months. The authors performed class observations during the intervention, semi-structured interviews with head teachers and teachers at each school, and semi-structured group interviews with students from each class. They used teacher-

completed diaries/logs, telephone interviews with parents, feedback sessions with teachers and questionnaires about The Class Moves! intervention. Teachers reported a positive impact on students' concentration and attention as a result of the intervention. They also noted that it helped calm a class, as well as improve student balance and movement. Students noted that it positively impacted their concentration.

Cardon et al. (2004) evaluated differences in sitting habits in the classroom between the project "Moving school" and a traditional school in 8-year-old children. Twenty-two children who had been involved in the project for 1.5 years were compared to 25 children in a traditional school. Making use of the Portable Ergonomic Observation (PEO) method, it was observed that children from a traditional school spend an average of 97% of lesson time sitting statically, of which one-third sit with the trunk bent over 45°. In the "Moving school" this posture was replaced by dynamic sitting (53%), standing (31%) and walking around (10%), while trunk flexion over 45° was nearly not observed. Children from the "Moving school" also showed significantly less neck and trunk rotation. Additionally, accelerometric data showed significantly more physical activity in lessons of the "Moving school." Rates of self-reported back or neck pain did not differ significantly between both study groups. Results show that sitting habits are more favorable in a "Moving school." Authors state that further research is needed to study the impact of implementing "Moving school" concepts in traditional schools on sitting habits.

Norlander et al. (2005) examined whether a short but regularly used program of relaxation, applied to primary and secondary school children, could (a) reduce noise levels (in decibels), (b) reduce pupils' experienced stress levels, and (c) increase the pupils' ability to concentrate, as measured by teachers' estimates. Noise levels in 5 classrooms (84 participants) were measured using sound monitors, before and after a 4-week long relaxation program, as well as when no relaxation training was provided. The results indicated that levels of noise were reduced significantly after the relaxation treatment. The results indicated no significant reduction of stress levels in the classes, but ability to concentrate increased among the pupils.

Mahar et al. (2006) evaluated the effects of a classroom-based physical activity program on children`s in-school physical activity levels and on-task behavior during academic instruction. Physical activity of 243 students was assessed during school hours. Intervention group students (N = 135) received a classroom-based program (i.e., Energizers). The control group (N = 108) did not receive Energizers. On-task behavior during academic instruction time was observed for 62 third-grade (N = 37) and fourth-grade students (N = 25)

before and after Energizers activities. An independent groups t-test compared in-school physical activity levels between intervention and control classes. A multiple-baseline across-classrooms design was used to evaluate the effectiveness of the Energizers on on-task behavior. Additionally, a two-way (time [pre- vs post-observation] x period [baseline vs intervention]) repeated-measures analysis of variance compared on-task behavior between observation periods. Magnitudes of mean differences were evaluated with Cohen's delta (ES). Students in the intervention group took significantly ($P < 0.05$) more in-school steps (5587 ± 1633) than control-group students (4805 ± 1543), and the size of this difference was moderate (ES = 0.49). The intervention was effective in improving on-task behavior; after the Energizers were systematically implemented, on-task behavior systematically improved. The improvement in on-task behavior of 8% between the pre-Energizers and post-Energizers observations was statistically significant ($P < 0.017$), and the difference was moderate (ES = 0.60). Likewise, the least on-task students improved on-task behavior by 20% after Energizers activities. This improvement was statistically significant ($P < 0.001$) and meaningful (ES = 2.20). A classroom-based physical activity program was effective for increasing daily in-school physical activity and improving on-task behavior during academic instruction.

Oliver et al. (2006) investigated a relatively new concept, "integrating" physical activity throughout the school curriculum, thereby teaching children about lifestyle physical activity in a variety of contexts. One method by which this may be achieved is by utilizing pedometers as a motivational and educational tool for measuring accumulated physical activity. No research is available that shows in-depth integration of physical activity into the curriculum or that investigates the efficacy of pedometer use for this purpose. The purposes of this study were to (a) design and implement a 4-week elementary school curriculum unit, based around pedometer walking, and (b) quantify, using pedometry, the physical activity levels of children ($N = 78$) prior to, and during, the unit implementation. Results showed that more than one half of the participants were achieving > 15,000 steps daily, and children were significantly more active on weekdays than weekends ($p = 0.0001$). Boys were more active than girls at baseline ($p = 0.01$) and during intervention weekdays ($p = 0.03$). Differences between baseline and intervention weekdays were non-significant for the complete sample; however, significant increases in step counts were observed when the children with low activity levels, especially females, were examined separately. The authors concluded that overall, the integration of physical activity using pedometer-based activities is feasible. However, increases in activity may be restricted to children who are least active.

Fredricks et al. (2006) report on a developmental movement program that was established to determine whether movement would enhance the academic skills of Grade 1 learners. Four groups of learners were used in this research project. Learners were randomly selected for one of the following groups: experimental, control, free-play, educational toys. The results of the pre-testing and post-testing indicate that the learners of the experimental group showed a significant improvement in spatial development as well as in reading and mathematical skills, compared to the learners in the control group, free-play group and educational toys group.

Uhrich and Swalm (2007) examined the influence of participation in a 6-week bimanual coordination program on Grade 5 students' reading achievement. Twenty Grade 5 students participated in a bimanual activity (sport stacking) and were tested to assess whether reading achievement scores were significantly different from the scores for 21 control students. The experimental group consisted of 20 students (11 boys, 9 girls) from one intact classroom cohort; the control group consisted of 21 students (12 boys, 9 girls) from one intact classroom cohort. Students in both groups ranged in age from 10 to 11 years. The intact classroom cohorts were randomly assigned to experimental and control groups. Reading achievement was measured by differences in pre- and post-test scores from the GMRT-4 Decoding and Comprehension skill subtests. Group by sex analyses of covariance, using pre-test scores as covariates, indicated that there were no significant differences by group or sex for decoding skills. A significant increase was found for the experimental group on Comprehension skills. Therefore, the authors concluded that participation in a bimanual coordination program, using sport stacking as the activity, may improve Grade 5 students' reading comprehension skills, regardless of sex.

Ahamed et al. (2007) evaluated the effectiveness of a school-based physical activity intervention, Action Schools! BC (AS! BC) for maintaining academic performance in a multiethnic group of elementary children, to determine whether boys' and girls' academic performance changed similarly after participation in AS! BC. They implemented a 16-month cluster-randomized controlled trial. Ten schools were randomized to intervention (INT) or usual practice (UP). Eight schools (six INT, two UP) were included in the final analysis. Children (143 boys, 144 girls) in grades 4 and 5 were recruited for the study. They used the Canadian Achievement Test (CAT-3) to evaluate academic performance (TotScore). Weekly teacher activity logs determined amounts of physical activity delivered by teachers to students. Physical activity was determined with the Physical Activity Questionnaire for Children (PAQ-C). Independent t-tests compared descriptive variables between groups and

between boys and girls. They used a mixed linear model to evaluate differences in TotScore at follow-up between groups and between girls and boys. Physical activity delivered by teachers to children in INT schools was increased by 47 min/wk (139 +/- 62 vs 92 +/- 45, P < 0.001). Participants attending UP schools had significantly higher baseline TotScores than those attending INT schools. Despite this, there was no significant difference in TotScore between groups at follow-up and between boys and girls at baseline and follow-up. Authors concluded that the AS! BC model is an attractive and feasible intervention to increase physical activity for students while maintaining levels of academic performance.

Macdonald et al. (2007) conducted a 16-month randomized, controlled, school-based study to compare change in tibial bone strength between 281 boys and girls participating in a daily program of physical activity (Action Schools! BC) and 129 same-sex controls. The aim was to determine whether a daily program of physical activity would improve tibial bone strength in boys and girls who were pre- (Tanner stage 1) or early pubertal (Tanner stage 2 or 3) at baseline. Ten schools were randomized to intervention (INT, 7 schools) or control (CON, 3 schools). The bone-loading component of AS! BC included a daily jumping program (Bounce at the Bell) plus 15 min/day of classroom physical activity in addition to regular physical education. The authors used pQCT to compare 16-month change in bone strength index (BSI, mg2/mm4) at the distal tibia (8% site) and polar strength strain index (SSIp, mm3) at the tibial midshaft (50% site), and used a linear mixed effects model to analyze data. Children were 10.2 ± 0.6 years at baseline. Intervention boys tended to have a greater increase in BSI (+774.6 mg2/mm4; 95% CI: 672.7, 876.4) than CON boys (+650.9 mg2/mm4; 95% CI: 496.4, 805.4), but the difference was only significant in prepubertal boys (p = 0.03 for group × maturity interaction). Intervention boys also tended to have a greater increase in SSIp (+198.6 mm3; 95% CI: 182.9, 214.3) than CON boys (+177.1 mm3; 95% CI: 153.5, 200.7). Change in BSI and SSIp was similar between CON and INT girls. The authors concluded that findings suggest that a simple, pragmatic program of daily activity enhances bone strength at the distal tibia in prepubertal boys.

Gibson et al. (2008) implemented Physical Activity across the Curriculum (PAAC), a 3-year elementary school-based intervention, to determine if increased amounts of moderate intensity physical activity performed in the classroom will diminish gains in body mass index (BMI). They performed a cluster-randomized, controlled trial, involving 4,905 children (2,505 intervention, 2,400 control). The authors collected both qualitative and quantitative process evaluation data from 24 schools (14 intervention and 10 control), which included tracking teacher training issues, challenges and barriers to effective implementation of PAAC

lessons, initial and continual use of program specified activities, and potential competing factors that might contaminate or lessen program effects. Overall teacher attendance at training sessions showed exceptional reach. Teachers incorporated active lessons on most days, resulting in significantly greater student physical activity levels compared to controls ($p < 0.0001$). Enjoyment ratings for classroom-based lessons were also higher for intervention students. Competing factors, which might influence program results, were not carried out at intervention or control schools or were judged to be minimal. In the first year of the PAAC intervention, process evaluation results were instrumental in identifying successes and challenges faced by teachers when trying to modify existing academic lessons to incorporate physical activity.

Macdonald et al. (2008) investigated the effects of a novel school-based physical activity program on femoral neck (FN) bone strength and mass in children aged 9–11 yrs. They used hip structure analysis to compare 16-month changes in FN bone strength, geometry and bone mineral content (BMC) between 293 children who participated in Action Schools! BC (AS! BC) and 117 controls. The authors assessed proximal femur (PF), lumbar spine (LS) and total body (TB) BMC using DXA. They compared changes in bone outcomes between groups using linear regression accounting for the random school effect and select covariates. Changes in FN strength (section modulus, Z), cross-sectional area (CSA), subperiosteal width and BMC was similar between control and intervention boys, but intervention boys had greater gains in BMC at the LS (+2.7%, $p = 0.05$) and TB (+1.7%, $p = 0.03$) than controls. For girls, changes in FN-Z tended to be greater (+3.5%, $p = 0.1$) for intervention girls than controls. The difference in change increased to 5.4% ($p = 0.05$) in a per-protocol analysis that included girls whose teachers reported 80% compliance. Authors concluded AS! BC benefits bone strength and mass in school-aged children; however, findings highlight the importance of accounting for teacher compliance in classroom-based physical activity interventions.

Erwin et al. (2011) conducted the pilot study to examine the effects of integrating physical activity with mathematics content on math class and school day physical activity levels of elementary students. Participants included four teachers and 75 students. Five math classes were taught without physical activity integration (i.e., baseline) followed by 13 math classes that integrated physical activity. Students wore pedometers and accelerometers to track physical activity during math class and throughout the school day. Students performed significantly more physical activity on school days and in math classes during the intervention. In addition, students performed higher intensity (steps/min) physical activity during physical activity integration math classes compared with baseline math classes. The

authors concluded that integrating physical activity into the classroom is an effective alternative approach to improving physical activity levels among youth and is an important component of school-based wellness policies.

As a conclusion of overview of previous research section, results from two recent review articles will be presented.

Rasberry et al. (2011) concluded that the results suggest that physical activity is either positively related to academic performance (50.5% of the associations summarized) or that there is not a demonstrated relationship between physical activity and academic performance (48% of the associations summarized). Very few of the findings in the studies reviewed were negative (only 1.5% of the associations examined). This pattern of having positive relationships or no relationships, along with the lack of negative relationships, was consistent throughout the results, despite the heterogeneous nature of the included studies, and is consistent with other published reviews (Shephard, 1997; Trost, 2007), which suggest that adding physical activity to the school day does not detract from academic performance.
Rasberry et al. (2011) also reported that there were relatively few studies of the impact of classroom physical activity on academic achievement. Regarding classroom physical activity studies, limitations reported by authors include small sample sizes, with most studies having fewer than 100 students, and the inability to analyze data by SES, race/ethnicity, or other subgroups. Some authors noted that classroom observers typically were not blinded to study condition. Authors also noted concerns about group comparability at baseline and its potential impact on determining an intervention effect.

Erwin et al. (2012) conducted a quantitative review of the literature and reported that it is likely that physical activity interventions can be incorporated into a child's school day to enhance learning outcomes. They indicate that the length of the physical activity intervention does not significantly influence the effect of the intervention. The interventions reviewed in their article ranged from 13 to 300 days; therefore, implementing physical activity for as few as 13 days may have a positive effect on children's physical activity levels. They conclude that more research on the effect of classroom-based physical activity interventions on physical activity, learning and health outcomes is warranted.

3. OBJECTIVE AND HYPOTHESES OF RESEARCH

The present study has two objectives. The **first** objective is to determine the effects of 5-minute classroom-based physical activity on on-task behavior. The **second** objective is to determine the effects of 5-minute classroom-based physical activity on physical activity volume and energy expenditure during the school day.

The first objective has three partial objectives and appropriate hypotheses:

I. Determine the effects of 5-minute classroom-based physical activity on on-task behavior

a) during second part of academic lesson after participation in physical activity

- **H1**: Pupils performing a 5-minute classroom-based physical activity will achieve greater levels of on-task behavior during second part of lecture

b) during entire 45-minute academic lesson

- **H2**: Pupils performing a 5-minute classroom-based physical activity will achieve greater levels of on-task behavior during entire academic lesson

c) of pupils with lowest on-task behavior

- **H3**: Pupils with lowest on-task behavior during first part of academic lesson will have greater improvement of on-task behavior during second part of academic lesson.

The second objective has one appropriate hypothesis:

II. Determine the effects of 5-minute classroom-based physical activity on physical activity volume and energy expenditure during the school day.

- **H4**: Pupils performing a 5-minute classroom-based physical activity will achieve greater physical activity volume and energy expenditure during the school day.

4. METHODS

4.1 Participants sample

As a representative of the population of primary school pupils (6–10 yrs), a convenience sample of 126 pupils was selected from among the pupils of elementary school Ivo Andrić in Zagreb. A total of eight class departments or two class departments per grade (first–fourth) were chosen to be included in study. All pupils were asked to participate (total 149) and 126 (85%) agreed to participate.

First- to fourth-grade pupils were divided into two class departments when enrolling into the primary school. Within each grade, the experimental and control class departments were selected by random selection. The pupils that had no health aberrations and whose parents signed the informed agreement on participation participated in the study. The study was approved by the Committee for Scientific Research and Ethics on Faculty of Kinesiology, University of Zagreb.

4.2 Experimental plan

4.2.1 Intervention

The 5-minute classroom-based physical activity is multimedia- and technology-based. It allows teachers to engage pupils in physical activity by integrating it into academic lessons. Considering that today's children are technology dependent, it can indeed be an integral part of learning and exercising. HOPSports® (HopSports, 2012) developed an innovative physical activity program for schools. It provides teachers with a tool for encouraging learning and an active participation of the pupils in the class through integration of physical activity and subject content. It enables teachers to physically engage pupils in a simple and fun way during the school day with a dynamic activity and potentially improve pupils' health, motivation, memory, on-task behavior and academic achievement.

During the intervention period, in the experimental classes teachers conducted a five-minute classroom-based physical activity on a daily basis. It was conducted at the middle of a 45-minute academic lesson (20^{th}–25^{th} minute) with the help of video animations[1]. The pupils stood up next to their work place and imitated video animations projected to the board. The

[1] Examples of the animations used can be found at http://www.hopsports.com

remaining time of the academic lesson in the experimental classes, and the entire academic lesson in the control classes, was conducted according to the curriculum of the appropriate subject.

Before the experiment, classroom teachers attended a 60-minute training session. They were informed about physical inactivity epidemics among children, and the organization and conduct of 5-minute classroom-based physical activity. Teachers also had the opportunity to participate in several activities. At the end of the session, the teachers were provided with a username and password for accessing the video animations and were given an instruction sheet with guidelines on when the observers would be in their classroom, the time of day they should lead the 5-minute classroom-based physical activity and the date on which they should begin performing physical activity in their classroom.

4.2.2 Assessment of on-task behavior

Effects of 5-minute classroom-based physical activity on on-task behavior were determined using multiple baselines across subjects design. Design assumes different groups of participants start the intervention at different time points from the start of the observation. In this study, four classes (1a, 2b, 3b, and 4b) started with intervention after 4 weeks and the rest of the classes (1b, 2c, 3a and 4a) after 8 weeks from the start of observation (see Appendix 2). Design is often used in behavior modification studies (Mahar et al., 2006) in order to determine whether systematic introduction of intervention changes the observed behavior in a systematic way. This study determines whether the systematic introduction of 5-minute classroom-based physical activity systematically influences on-task behavior. Data acquisition lasted 12 weeks and began with the start of the second school semester (January–April). In Table 2, a timetable of assessment of the pupil's on-task behavior is shown.

Each 45-minute academic lesson was recorded by a HD video camera (See Appendix 2). By reviewing the video, observers assessed on-task behavior for 16 minutes during the first part and for 16 minutes during the second part of the academic lesson (3^{rd}–19^{th} minute and 26^{th}–42^{th} minute). Teachers use the first and last three minutes of the academic lesson for opening (getting pupils' attention, stating objectives and planed content, etc.) and closing (giving homework and important information for the next lesson). During that time pupils do not have a specific task to complete. The minute before and after the 5-minute classroom-based physical activity is used for starting video animations and preparing children to start activity or ending video animations and allowing pupils to return to their seats. During the

baseline (no intervention) period, the same observation protocol was used and teachers did not stop academic lessons at any time (Mahar et al., 2006).

Table 2. Timetable of assessment of the pupils' on-task behavior

class/ wk	1	2	3	4	5	6	7	8	9	10	11	12
1a												
2b												
3b												
4b												
1b												
2c												
3a												
4a												

Note: Non-shadowed parts represent the baseline period (no intervention) and shadowed parts represent the intervention period.

Two observers were trained for assessment of on-task behavior. Before the experiment, the observers watched video recordings of pupils during academic lessons and practiced observing and recording information. Observers were informed about the definition of on-task behavior. On-task behavior is verbal or motor behavior that is following the class rules and is appropriate to the learning situation. Additionally, on-task behavior pertains to "children's classroom skills including the ability to work independently and to attend to teacher directed activities," and also includes "student behavior such as eye contact with the teacher, working quietly, and appropriately orienting to a task" (Clare, Jenson, & Bray, 2000, p. 517). Off-task behavior is any behavior that is not on-task and can be motor, acoustic and/or passive/other. The training continued until the index of reliability between the observers expressed in Cohen's kappa was at least 0.7.

Mahar et al. (2006) have reported as one of the limitations of the study that in their experiment observers knew which pupils had participated in classroom-based physical activity. In the present study observers were blinded by editing the video recording. Video showed only 16 minutes of first part and 16 minutes of the second part of the academic lesson, so observers did not know whether pupils had participated in classroom-based physical activity or not.

4.2.3 Assessment of physical activity

Limitations of current studies on effects of classroom-based physical activity include either lack of a control group and lack of information on physical activity volume during the school day (Stewart et al., 2004), or physical activity being assessed with pedometers, which give no insight into activity volume and energy consumption (Mahar et al., 2006).

In the present study the effects of 5-minute classroom-based physical activity on physical activity volume and energy expenditure were assessed for 8 weeks (Table 3) using quasi-experimental design with a control group of standard treatment and measurements taken before and after intervention. The initial state of physical activity volume and energy expenditure during the school day was assessed during the first 4 weeks of the second school semester (January to March) in the morning hours. Pupils wore a SenseWear Armband instrument (SWA – BodyMediaInc., Pittsburgh, PA, USA) for 5 days per week. Pupils from the same class wore the instrument during the same week. The week in which each class wore the instrument was randomly selected. Information on gender, age, height, body mass and the dominant hand was used for instrument configuration. Information on physical activity volume and energy expenditure during the school day (8:00–12:15) was used. SenseWear Armband instrument is described in more detail in the chapter Measuring procedures.

Table 3. Timetable for assessment of physical activity volume and energy expenditure

	class/ wk	1	2	3	4	5	6	7	8
Experimental classes	1a	SWA				SWA			
	2b				SWA				SWA
	3b		SWA				SWA		
	4b			SWA				SWA	
Control classes	1b	SWA				SWA			
	2c				SWA				SWA
	3a		SWA				SWA		
	4a			SWA				SWA	

Note: Non-shadowed parts display the period without intervention and shadowed parts display the period of the intervention; SWA - week in which each class wore the SenseWear Armband instrument.

At the beginning of the fifth week the experimental classes started with the intervention, and the effects of 5-minute classroom-based physical activity on physical activity volume and energy expenditure were determined following the same procedure as for the initial state.

During the school day (8:00–12:15) pupils wore the SenseWear Armband instrument for an average of 98.85% of the time (93.33–100). Trost et al. (2002) reported that in children at least 3 days of monitoring are needed to provide reliable activity data. Therefore, pupils failing to provide a minimum of three separate days of valid recording were excluded from the study. On average, students wore SenseWear Armband instrument 4.4 days per week.

Additionally, PAQ-C questionnaire (Crocker et al., 1997) was used to assess the initial state of pupils' physical activity levels. PAQ-C is constructed for assessment of younger children's total physical activity. Good reliability and construct validity of PAQ-C has been determined in many studies on different samples (Chinapaw et al., 2010). In the present study, a Croatian translation of the PAQ-C questionnaire was used (Vidaković Samaržija & Mišigoj-Duraković, 2013). PAQ-C was administered during the first and third weeks of the study and its internal consistency and test-retest reliability was determined separately for first and second (6–8yrs) and third and fourth (8–10yrs) grade pupils.

4.3 Measuring procedures

4.3.1 Assessment of on-task behavior

On-task behavior was assessed by observation (Mahar et al., 2006). For registering the observed behavior, a quantitative method was used. Assessment lists (see Appendix 4) were used to register the presence or absence of on-task behavior. On-task behavior was assessed during 16-minute periods and pupils were observed in the same order during both periods. The pupils that were observed and the order of observation were randomly selected.

Video recordings were edited so that they included guidelines to the observers as to when to observe and when to record. By watching the video the observers observed on-task behavior in intervals of 10 seconds. After every 10 seconds, they had five seconds to register the behavior of the pupil (on-task or off-task) on the assessment list. After one minute of observation, the observer rotated to the next pupil. The rotation from pupil to pupil was repeated four times, or for 16 observation intervals. One session of watching the video allowed for observation of four pupils.

4.3.2 Assessment of physical activity

Height was measured by anthropometer for measuring standing height with a precision of 0.5 cm. The pupils were standing barefooted, feet together and the head was held in Frankfurt horizontal line. Body mass was measured with the precision of within 0.1 kg by portable digital scale (BF500, Omron, Medizintechnik, Mannheim, Germany). Body mass index (BMI) was calculated as a ratio of kilograms and square of body height expressed in meters (BMI = kg/m^2). All the measurements were conducted during a school day.

Physical activity volume and energy expenditure were assessed by SenseWear Armband instrument (BodyMedia Inc., Pittsburgh, PA, USA) which is described elsewhere (Sorić & Mišigoj-Duraković, 2010). Validation studies that compared SenseWear Armband with indirect calorimeter indicated that the instrument is reliable with regards to assessment of energy expenditure during rest or during different exercising protocols both in adults and in children. Additionally, in the conditions of normal living, SenseWear Armband was compared with the method of doubly labeled water for measuring total daily energy expenditure for adults, and high correlations are being registered for both adults (r = 0.86) and children (r = .79).

4.4 Data processing

4.4.1 Assessment of on-task behavior

For a given lesson, a pupil's score for a particular condition (observation during first and second 16-minute periods) was an average percentage and was calculated by summing the number of intervals in which each behavior occurred during the total 4-min observation period and divided by the total number of intervals (i.e., 16) and then multiplied by 100.

Additionally, four average values of on-task behavior were calculated separately for all classes: for first and second 16-minute period during the baseline (no intervention) period and for first and second 16-minute period during the intervention period. Also, average weekly percentage of on-task behavior for the entire academic lesson was calculated, separately for all classes.

In order to determine the effects of 5-minute classroom-based physical activity on on-task behavior among the least on-task pupils, the average on-task percentage of pupils with 70% or less on-task behavior during baseline were registered.

4.4.2 Assessment of physical activity

Data from all the sensors were averaged over 1-min periods, and these data was stored in memory and subsequently downloaded to a computer with the assistance of the Kinantrophometric laboratory at the Faculty of Kinesiology, University of Zagreb. For the analysis of data obtained by SWA device, most recent child-specific exercise algorithms were used (SenseWear Professional software version 6.1; BodyMedia Inc). Outcome variables were total daily energy expenditure (TEE), daily steps count (STEPS) and the duration of physical activity performed at various intensities. The intensity is described as metabolic equivalents (METs). Total daily physical activity duration (PAD) was described as physical activity requiring more than 4 METs, time spent in less than 4 METs is classified as sedentary physical activity (SEDENTARY), time spent in 4–5.9 METs is classified as moderate physical activity (MODERATE), while time spent at ≥ 6 METs is classified as vigorous physical activity (VIGOROUS). The thresholds of 4.0 and 6.0 METs have frequently been used in defining physical activity intensity in children (Janssen & LeBlanc, 2010).

4.5 Statistical analyses

4.5.1 Assessment of on-task behavior

On-task behavior was assessed through observation. A quantitative method was used in order to discern the absence or presence of on-task behavior. Wilcoxon signed-rank was used to measure the statistical difference between two 16-minute periods. On the other hand, a Mann-Whitney U-test was used to measure statistical difference between baseline and intervention periods.

4.5.2 Assessment of physical activity.

A two-way (period [baseline vs intervention] x group [control vs intervention]) analysis of variance (ANOVA) was used to examine differences in physical activity volume and energy expenditure between control and intervention classes. Simple main effects were run after a statistically significant interaction with a Bonferroni correction for multiple post hoc comparisons to determine the difference between periods for each group and vice versa.

5. RESULTS

5.1 Descriptive statistic of anthropometric measures of pupils

Descriptive statistics of anthropometric measures are presented in Table 4. The average age of first grade pupils was 6.88 ± 0.41yrs. In average they were 128.68 ± 5.37 cm tall with body mass of 27.61 ± 5.74 kg. Male pupils were 130.71 ± 5.87 cm tall and had a body mass of 29.75 ± 7.12 kg while female pupils were slightly shorter (126.65 ± 4.03 cm) and lighter (25.46 ± 2.7 kg). These values correspond with referent values for Croatian pupils of that age and gender (Jureša et al., 2012). Control group pupils were taller (130.43 ± 4.11 cm) than intervention group pupils (127.45 ± 5.89 cm) but with similar body weight (control 27.48 ± 3.46 kg vs intervention 27.7 ± 7 kg). Average BMI values of male (17.27 ± 3.02 kg/m^2) and female (15.84 ± 1.06 kg/m^2) indicate a normal weight for first-grade pupils (Cole et al., 2000).

Second grade pupils were 7.77 ± 0.43 yrs old, 135.65 ± 5.14 cm tall with body mass of 32.17 ± 6.9 kg. Male and female pupils' values correspond with referent values for Croatian pupils of that age and gender (Jureša et al., 2012). Male pupils were taller (137.5 ± 4.72 cm) and heavier (33.23 ± 5.63 kg) than female pupils (height 133.67 ± 4.97 cm, weight 31.03 ± 8.09 kg). There were no big differences between control and intervention group in height (control 136.38 ± 4.63 vs intervention 131.33 ± 6.15) and weight (control 31.52 ± 7.08 kg vs intervention 32.64 ± 6.94 kg). Average BMI value of males (17.54 ± 2.59 kg/m^2) and females (17.22 ± 3.4 kg/m^2) indicate a normal weight for second-grade pupils (Cole et al., 2000).

The average age of third grade pupils was 8.96 ± 0.19 yrs. On average they were 140.93 ± 5.39 cm tall with a body mass of 36.13 ± 6.36 kg. Male and female pupils had similar height (male 141.74 ± 5.74 cm vs female 139.22 ± 4.35 cm) and weight (male 36.21 ± 5.41 kg vs female 35.94 ± 8.41 kg). These values correspond with referent values for Croatian pupils of that age and gender (Jureša et al., 2012). Control group pupils were slightly taller (141.81 ± 4.68 cm) and heavier (37.05 ± 7.22 kg) than intervention group pupils (height 139.75 ± 6.22 cm, weight 34.89 ± 5.03 kg). Average BMI value of male (17.98 ± 2.15 kg/m^2) and female (18.44 ± 3.47 kg/m^2) indicate a normal weight for third-grade pupils (Cole et al., 2000).

Fourth-grade pupils were 9.88 ± 0.33 yrs old, 144.21 ± 7.16 cm tall with a body mass of 38.87 ± 9.25 kg. Male and female pupils' values correspond with referent values for Croatian pupils of that age and gender (Jureša et al., 2012). Male pupils were taller (145.21 ±

6.33 cm) and heavier (41.52 ± 10.13) that female pupils (height 143.47 ± 7.8 cm, weight 36.92 ± 8.28). Control group pupils had similar height (144.11 ± 6.31 cm) as intervention group pupils (144.33 ± 8.29 cm) but they had lower body mass values (control 37.69 ± 5.64 kg vs intervention 40.29 ± 12.37 kg). The average BMI value of male (19.66 ± 4.67 kg/m^2) and female (17.77 ± 2.6 kg/m^2) indicate a normal weight for fourth-grade pupils (Cole et al., 2000).

Table 4. Descriptive statistic of anthropometric measures

			height	weight	BMI	age
First grade	control	M (n = 7)	132.86 ± 4.45	28.73 ± 4.56	16.22 ± 1.95	6.86 ± 0.69
		F (n = 7)	128 ± 1.73	26.23 ± 1.22	16.01 ± 0.7	6.90 ± 0.58
		tot (n = 14)	130.43 ± 4.11	27.48 ± 3.46	16.11 ± 1.41	6.93 ± 0.47
	intervention	M (n = 10)	129.2 ± 6.48	30.47 ± 8.66	18 ± 3.5	6.8 ± 0.42
		F (n = 10)	125.7 ± 4.95	24.93 ± 3.37	15.72 ± 1.27	6.9 ± 0.32
		tot (n = 20)	127.45 ± 5.89	27.7 ± 7	16.86 ± 2.82	6.85 ± 0.37
	total	M (n = 17)	130.71 ± 5.87	29.75 ± 7.12	17.27 ± 3.02	6.82 ± 0.53
		F (n = 17)	126.65 ± 4.03	25.46 ± 2.71	15.84 ± 1.06	6.94 ± 0.24
		tot (n = 34)	128.68 ± 5.37	27.61 ± 5.74	16.55 ± 2.34	6.88 ± 0.41
Second grade	control	M (n = 4)	139 ± 6.22	34.9 ± 7.04	17.97 ± 2.79	7.75 ± 0.5
		F (n = 9)	135.22 ± 3.56	30.01 ± 6.95	16.32 ± 3.11	7.56 ± 0.53
		tot (n = 13)	136.38 ± 4.63	31.52 ± 7.08	16.83 ± 3	7.62 ± 0.51
	intervention	M (n = 12)	137 ± 4.33	32.68 ± 5.32	17.39 ± 2.64	7.83 ± 0.39
		F (n = 6)	131.33 ± 6.15	32.57 ± 10.07	18.56 ± 3.65	7.79 ± 0.41
		tot (n = 18)	135.11 ± 5.55	32.64 ± 6.94	17.78 ± 2.96	7.89 ± 0.32
	total	M (n = 16)	137.5 ± 4.72	33.23 ± 5.63	17.54 ± 2.59	7.81 ± 0.4
		F (n = 15)	133.67 ± 4.97	31.03 ± 8.09	17.22 ± 3.4	7.73 ± 0.46
		tot (n = 31)	135.65 ± 5.14	32.17 ± 6.9	17.38 ± 2.96	7.77 ± 0.43
Third grade	control	M (n = 11)	143 ± 3.92	36.43 ± 5.75	17.77 ± 2.35	8.78 ± 0.41
		F (n = 5)	139.2 ± 5.59	38.42 ± 10.46	19.59 ± 3.87	8.8 ± 0.45
		tot (n = 16)	141.81 ± 4.68	37.05 ± 7.22	18.34 ± 2.9	8.94 ± 0.25
	intervention	M (n = 8)	140 ± 7.54	35.91 ± 5.27	18.28 ± 1.97	8.84 ± 0.49
		F (n = 4)	139.25 ± 2.99	32.85 ± 4.45	16.99 ± 2.67	8.76 ± 0.43
		tot (n = 12)	139.75 ± 6.22	34.89 ± 5.03	17.85 ± 2.19	8.91 ± 0.35
	total	M (n = 19)	141.74 ± 5.74	36.21 ± 5.41	17.98 ± 2.15	8.82 ± 0.45
		F (n = 9)	139.22 ± 4.35	35.94 ± 8.41	18.44 ± 3.47	8.89 ± 0.33
		tot (n = 28)	140.93 ± 5.39	36.13 ± 6.36	18.13 ± 2.59	8.96 ± 0.19
Fourth grade	control	M (n = 7)	144.86 ± 4.63	38.89 ± 6.28	18.46 ± 2.19	9.88 ± 0.33
		F (n = 11)	143.64 ± 7.37	36.93 ± 5.37	17.88 ± 1.97	9.78 ± 0.41
		tot (n = 18)	144.11 ± 6.31	37.69 ± 5.64	18.1 ± 2.02	9.83 ± 0.44
	intervention	M (n = 7)	145.57 ± 8.06	44.16 ± 12.92	20.87 ± 6.25	9.86 ± 0.38
		F (n = 8)	143.25 ± 8.88	36.9 ± 11.63	17.61 ± 3.43	9.63 ± 0.52
		tot (n = 15)	144.33 ± 8.29	40.29 ± 12.37	19.13 ± 5.05	9.73 ± 0.46
	total	M (n = 14)	145.21 ± 6.33	41.52 ± 10.13	19.66 ± 4.67	9.93 ± 0.27
		F (n = 19)	143.47 ± 7.8	36.92 ± 8.28	17.77 ± 2.6	9.84 ± 0.37
		tot (n = 33)	144.21 ± 7.16	38.87 ± 9.25	18.57 ± 3.68	9.88 ± 0.33

5.2 Initial state of physical activity levels of pupils as assessed by PAQ-C

5.2.1 Differences in physical activity between grades

A Kruskal-Wallis H test was run to determine whether there were differences in PAQ-C items' scores between four groups of pupils from first (n = 20), second (n = 26), third (n = 26) and fourth (n = 30) grade. Subsequently, pairwise comparisons were performed using Dunn's (1964) procedure with a Bonferroni correction for multiple comparisons. Adjusted p-values are presented. Distributions of all items' scores were similar for all groups, as assessed by visual inspection of a boxplot. Descriptive statistic of PAQ-C and results of Kruskal-Wallis H test are presented in Table 5.

Table 5. Differences in PAQ-C items' scores between first, second, third and fourth grade

	First Grade (n = 20)	Second Grade (n = 26)	Third Grade (n = 26)	Fourth Grade (n = 30)	$\chi^2(3)$	p
	median (mean rank)	median (mean rank)	median (mean rank)	median (mean rank)		
PA in spare time	1.16(43.68)	1.16(40.27)	1.14(48.29)	1.32(69.23)[c,d,e]	16.322	**.001**
PA during physical education (PE) classes	5.00(52.50)	5.00(50.87)	5.00(49.83)	5.00(52.83)	.237	.971
PA during 5-min breaks between classes	3.00(53.88)	3.00(53.63)	2.00(51.79)	2.00(47.82)	.802	.849
PA during 15-min break for lunch	3.00(57.55)	3.00(58.65)	3.00(44.69)	3.00(47.17)	4.884	.180
PA right after school	2.00(49.63)	2.50(48.42)	3.00(60.06)	2.00(48.00)	3.212	.360
PA during evenings	3.00(48.78)	3.00(46.08)	3.00(59.58)	3.00(51.02)	3.227	.358
PA during last weekend	3.00(55.30)	3.00(53.75)	3.00(55.06)	2.00(43.93)	3.193	.363
Self-evaluated PA	2.50(52.90)	2.50(54.00)	3.00(58.15)	2.00(42.63)	4.593	.204
PA for each day last week	3.29(58.00)	2.93(52.23)	2.79(53.56)	2.71(44.75)	2.676	.444
Total PA level	2.72(53.73)	2.69(51.63)	2.85(55.98)	2.62(46.02)	1.740	.628

[a]First Grade vs 2[sd]Grade–p<0.05; [b]2[sd]Grade vs third grade–p<0.05; [c]third grade vs fourth grade–p<0.05; [d]1[sd]Grade vs fourth grade; [e]2[sd]Grade vs fourth grade

Median scores revealed a low **PA in spare time** for all groups and were statistically significantly different between groups, $\chi2(3) = 16.322$, p = .001. Post hoc analysis revealed that fourth-grade pupils have statistically significantly higher median "PA in spare time" scores (1.32) than first grade (1.16) (p = 0.16), second grade (1.16) (p = 0.01) and third grade (1.14) (p = 0.048). There were no statistically significant differences between any other group combinations. All grades had a high **PA during physical education (PE)** classes (first grade–5.00; second grade–5.00; third grade–5.00; fourth grade–5.00) with no significant differences between groups; $\chi2(3) = .237$, p = .971. **PA during 5-min breaks between classes** was

moderate in first grade (3.00) and second grade (3.00) and low in third grade (2.00) and fourth grade but differences were not significant, $\chi2(3) = .802$, $p = .849$. Non-significant differences were also determined for **PA during 15-min break for lunch**, $\chi2(3) = 4.884$, $p = .180$, during which all grades were moderately active (first grade–3.00; second grade–3.00; third grade 3.00; fourth grade–3.00). **PA right after school** was not significantly different between grades $\chi2(3) = 3.212$, $p = .360$; it was low for first grade (2.00), second grade (2.50) and fourth grade (2.00), but moderate for third grade (3.00). Moderate PA was reported **during evenings** for all grades (first grade–3.00; second grade–3.00; third grade–3.00; fourth grade–3.00) with no significant differences between groups; $\chi2(3) = 3.227$, $p = .358$, as well as for **PA during last weekend** ($\chi2(3) = 3.193$, $p = .363$), when first grade (3.00), second grade and third grade reported moderate, and fourth grade (2.00) low PA. **Self-evaluated PA** did not differ significantly between grades ($\chi2(3) = 4.593$, $p = .204$): first grade (2.50), second grade and third grade (3.00) reported moderate PA while third grade (2.00) reported low PA. All grades reported moderate **PA for each day last week** (first grade–3.29; second grade–2.93; third grade–2.79; fourth grade–2.79), with no significant differences between groups ($\chi2(3) = 2.676$, $p = .444$). **Total PA levels** was moderate for all grades (first grade–2.72; second grade–2.69; third grade–2.85; fourth grade–2.62) and did not differ significantly between groups; $\chi2(3) = 1.740$, $p = .628$.

5.2.2 Differences in physical activity between control and intervention classes

A Mann-Whitney U test was run to determine if there were differences in PAQ-C items' scores between control and intervention classes. Distributions of the PAQ-C items' scores for control and intervention classes were similar, as assessed by visual inspection. Adjusted p-values are presented. Descriptive statistic of PAQ-C and results of Mann-Whitney U test are presented in Table 6.

Table 6. Differences in PAQ-C items' scores between control and intervention classes

	CONTROL (n = 51)	INTERVENTION (n = 51)			
	median (mean rank)	median (mean rank)	U	z	p
PA in spare time	1.2 (48.27)	1.24 (54.73)	1.465	1.104	.270
PA during physical education (PE) classes	5.00 (48.05)	5.00 (54.95)	1.476	1.355	.176
PA during 5-min breaks between classes	3.00 (53.33)	3.00 (49.67)	1.207	-.655	.512
PA during 15-min break for lunch	3.00 (48.70)	3.00 (54.30)	1.443	1.011	.312
PA right after school	3.00 (55.55)	2.00 (47.45)	1.094	-1.441	.150
PA during evenings	3.00 (47.92)	3.00 (55.08)	1.483	1.269	.204
PA during last weekend	2.00 (51.13)	3.00 (51.87)	1.319	.135	.892
Self-evaluated PA	2.00 (48.62)	3.00 (54.38)	1.447	1.024	.306
PA for each day last week	2.86 (49.08)	3.00 (53.92)	1.424	.828	.408
Total PA level	2.63 (49.26)	2.73 (53.74)	1.414	.763	.445

Median scores revealed a low **PA in spare time** for both control and intervention classes and were not statistically significantly different between groups, U = 1.465, z = 1.104, p = .270. All classes had a high **PA during physical education (PE)** classes (CONTROL–5.00; INTERVENTION–5.00) with no significant differences between groups (U = 1.476, z = 1.355, p = .176). **PA during 5-min breaks between classes** was moderate in CONTROL (3.00) and INTERVENTION (3.00) classes and differences were not significant, U = 1.207, z = -.655, p = .512. Non-significant differences were also determined for **PA during 15-min break for lunch**, U = 1.443, z = 1.011, p = .312, during which all classes were moderately active (CONTROL–3.00; INTERVENTION–3.00). **PA right after school** was not significantly different between classes (U = 1.094, z = -1.441, p = .150); it was moderate for CONTROL (3.00) but low for INTERVENTION (2.00) classes. Moderate PA was reported **during evenings** for all classes (CONTROL–3.00; INTERVENTION–3.00) with no significant differences between groups (U = 1.483, z = 1.269, p = .204), as well as for **PA**

during last weekend (U = 1.319, z = .135, p = .892), when CONTROL classes (2.00) reported low and INTERVENTION classes (2.00) moderate PA. **Self-evaluated PA** did not differ significantly between classes (U = 1.447, z = 1.024, p = .306); CONTROL classes (3.00) reported moderate PA while INTERVENTION classes (2.00) reported low PA. All grades reported moderate **PA for each day last week** (CONTROL–2.86; INTERVENTION–3.00) with no significant differences between classes U = 1.424, z = .828, p = .408. **Total PA levels** was moderate for all classes (CONTROL–2.63; INTERVENTION–2.73) and did not differ significantly between groups (U = 1.414, z = .763, p = .445).

5.3 Results of internal consistency and test-retest reliability of Croatian version of PAQ-C

All pupils (n = 126) from first–fourth grade (6–10 years old) were invited to participate in this test-retest study in spring of 2014. A Croatian version of PAQ-C was used. The PAQ-C is a self-administered, 7-day recall instrument. It was developed to assess general levels of physical activity throughout the elementary school year for pupils approximately 8 to 14 years of age. The PAQ-C can be administered in a classroom setting and provides a summary physical activity score derived from nine items, each scored on a 5-point scale. A score of 1 indicates low physical activity, whereas a score of 5 indicates high physical activity. The Croatian version was translated by Vidaković Samaržija and Mišigoj-Duraković (2013), who confirmed its test-retest reliability for assessment of younger children's physical activity on a sample of 10-year-old pupils. In the first item of the Croatian version of PAQ-C some culture-appropriate activities were added (Vidaković Samaržija & Mišigoj-Duraković, 2013).

Questionnaires were administered twice to pupils in the classroom, each time in the presence of a trained project worker. The time period between administrations of the two questionnaires was 3 weeks. On both occasions first and second grade pupils took home a questionnaire to be completed by one of their parents. Parents were informed that it was preferable that the same parent responded to the questionnaire on both occasions. Third and fourth grade pupils filled out the questionnaire in the classroom. A total of 81 pupils (participation rate 65%) filled out questionnaire at both time points and reported they had no unusual activity during the previous week (PAQ-C item 10). Test-retest analysis was done separately for first and second grade (6–8 yrs) and third and fourth grade (8–10 yrs).

Descriptive statistics of two groups are presented in Table 7. Average age of first and second grade pupils was 7.31 ± 0.63 yrs. In average they were 131.74 ± 7.05 cm tall with body mass of 29.44 ± 6.44 kg. Male pupils were 133.93 ± 7.22 cm tall and had a body mass of 30.41 ± 5.71 kg while female pupils were slightly shorter (130.1 ± 6.63 cm) and lighter (28.71 ± 6.99 kg). These values correspond with referent values for Croatian pupils of that age and gender (Jureša et al., 2012). Average BMI values of male (16.85 ± 2.16 kg/m^2) and female (16.76 ± 2.43 kg/m^2) indicate a normal weight for first and second grade pupils (Cole et al., 2000).

Third and fourth grade pupils were 9.41 ± 0.54 yrs old, 142.3 ± 6.58 cm tall with body mass of 36.54 ± 7.53 kg. Male and female pupils' values correspond with referent values for

Croatian pupils of that age and gender (Jureša et al., 2012). Male pupils were a similar height (142.17 ± 5.65 cm) and weight (36.29 ± 5.96 kg) as female pupils (height 142.43 ± 7.52 cm, weight 36.79 ± 8.97 kg). Average BMI value of male (17.92 ± 2.54 kg/m^2) and female (17.95 ± 3.04 kg/m^2) indicate a normal weight for third and fourth grade pupils (Cole et al., 2000).

Table 7. Descriptive statistic of anthropometric measures

		AGE	HEIGHT	WEIGHT	BMI
First and second grade (6–8 yrs)	M (n = 15)	7.27 ± 0.7	133.93 ± 7.22	30.41 ± 5.71	16.85 ± 2.16
	F (n = 20)	7.35 ± 0.59	130.1 ± 6.63	28.71 ± 6.99	16.76 ± 2.43
	TOT (n = 35)	7.31 ± 0.63	131.74 ± 7.05	29.44 ± 6.44	16.79 ± 2.28
First and second grade (8–10 yrs)	M (n = 23)	9.35 ± 0.49	142.17 ± 5.65	36.29 ± 5.96	17.92 ± 2.54
	F (n = 23)	9.48 ± 0.59	142.43 ± 7.52	36.79 ± 8.97	17.95 ± 3.04
	TOT (n = 46)	9.41 ± 0.54	142.3 ± 6.58	36.54 ± 7.53	17.93 ± 2.77

The data from PAQ-C were generally skewed, hence nonparametric statistical methods were chosen. Wilcoxon signed-rank test was used to test for differences between the test and the retest estimates. Spearman correlation coefficient was used to estimate the rank order agreement between the test and the retest. Level of internal consistency was determined by a Cronbach's alpha. Results are presented in Table 8.

Total PA levels were moderate for both 6–8-year-old (first measure 2.81; second measure 2.89) and 8–10-year-old pupils (first measure 2.66; second measure 2.72). Lowest levels of PA were reported for PA in spare time for both 6–8-year-old (first measure 1.16; second measure 1.12) and 8–10-year-old pupils (first measure 1.28; second measure 1.24). Highest levels of PA were reported for PA during physical education (PE) classes for both 6–8-year-old (first measure 5.00; second measure 5.00) and 8–10-year-old pupils (first measure 5.00; second measure 5.00).

There was no statistically significant difference in median scores between first and second measure in all PAQ-C items, as assessed by Wilcoxon signed-rank test, except for PA for each day last week in the 6–8 yrs group (second-first =-.29, z = -2.276, p = .023).

Spearman correlation between first and second measure ranged from .156 (PA during 15-min break for lunch) to .619 (PA for each day last week) and from .361 (PA during 15-min break for lunch) to .828 (PA in spare time) for 6–8yrs and 8–10yrs groups, respectively. All correlations were statistically significant ($p < .05$) except for PA during last weekend ($r = .316$, $p = .065$) for 6–8yrs group.

Internal consistency for 6–8yrs group, as assessed by Cronbach's alpha, was 0.71 and 0.69 for first and second measure, respectively. For 8–10yrs group, Cronbach's alpha for first and second measure was 0.77 and 0.75, respectively.

Table 8. Results of internal consistency and test-retest reliability of Croatian version of PAQ-C

		Grade (median)		Difference (median)	Wilcoxon signed-rank test		Spearman correlation	
		1st	2nd	2nd-1st	z	p	R	p
First and second grade (6–8yrs)	PA in spare time	1.16	1.12	,00	-1.329	.184	.570	**.001**
	PA during physical education (PE) classes	5.00	5.00	,00	-.284	.776	.439	**.008**
	PA during 5-min breaks between classes	3.00	3.00	,00	1.676	.094	.349	**.040**
	PA during 15-min break for lunch	3.00	3.00	,00	-.476	.634	.156	**.372**
	PA right after school	3.00	2.00	,00	-.159	.874	.351	**.039**
	PA during evenings	3.00	3.00	,00	-.050	.960	.386	**.022**
	PA during last weekend	3.00	3.00	,00	-1.360	.174	.316	.065
	Self-evaluated PA	3.00	3.00	,00	-.107	.915	.541	**.001**
	PA for each day last week	3.14	3.00	-,29	**-2.276**	**.023**	.619	**.001**
	Total PA level	2.81	2.89	.01	.016	.987	.352	**.038**
	Cronbach's alpha	0.71	0.69					
Third and fourth grade (8–10yrs)	PA in spare time	1.28	1.24	,00	.273	.785	.828	**.001**
	PA during physical education (PE) classes	5.00	5.00	,00	-.483	.629	.550	**.001**
	PA during 5-min breaks between classes	2.00	2.50	,00	.473	.636	.362	**.014**
	PA during 15-min break for lunch	3.00	3.00	,00	.700	.484	.361	**.014**
	PA right after school	3.00	2.00	,00	-.648	.517	.377	**.010**
	PA during evenings	3.00	3.00	,00	.739	.460	.477	**.001**
	PA during last weekend	2.00	3.00	,00	.948	.343	.377	**.010**
	Self-evaluated PA	2.00	2.50	,00	.562	.574	.445	**.002**
	PA for each day last week	2.71	2.50	,00	.312	.755	.664	**.001**
	Total PA level	2.66	2.72	-.05	.705	.481	.527	**.001**
	Cronbach's alpha	0.77	0.75					

5.4 Descriptive statistics of 5-minute classroom-based physical activity and differences between grade levels

A one-way ANOVA and Tukey post hoc test were conducted to determine if values of TEE, STEPS, PAD, SEDENTARY, MODERATE, VIGOROUS and MET scores achieved during 5-minute PA differ between grade levels. Welch ANOVA and Games-Howell post hoc test were used when assumption of homogeneity was violated.

There were outliers in the data, as assessed by inspection of a boxplot for values greater than 1.5 box-lengths from the edge of the box. Outliers were genuinely unusual values and were modified by replacing the outliers' values with one that was less extreme (e.g., next largest or smallest value was used instead). A total of five outliers were determined and modified, as presented in a Table 9. All variables' scores were normally distributed for the first, second, third and fourth grade, as assessed by Shapiro-Wilk's test of normality ($p > .05$).

Table 9. Original and modified outliers' values

	Grade	Original value	Modified value
TEE	first	15.27	13.27
		20.57	13.57
STEPS	second	365	400
SEDENTARY	first	3.4	2.8
		0.0	0.7
MODERATE	second	5.5	5.0
	fourth	5.25	3.5
MET	fourth	9.47	5.47

Results of one-way ANOVA and Tukey post hoc test are presented in Table 10. Data is presented as mean ± standard deviation.

Table 10. Average scores achieved during 5-minute classroom-based physical activity

	1st grade	2nd grade	3rd grade	4th grade	TOTAL	F	p
TEE	10.69 ± 1.71[a,d,f]	15.11 ± 2.71	15.06 ± 2.62	17.69 ± 5.18	14.57 ± 4.08	**15.427[W]**	**.001**
STEPS	433.21 ± 65.04	507.4 ± 60.12[a,b,e]	369.55 ± 40.62[f]	387.75 ± 53.46	429.07 ± 77.1	**15.322**	**.001**
PAD	4.03 ± 0.8	4.69 ± 0.49[b,c]	3.38 ± 0.57	3.42 ± 1.3	3.93 ± 0.98	**12.979[W]**	**.001**
SEDENTARY	1.74 ± 0.68	1.23 ± 0.49[b]	2.47 ± 0.75	2.32 ± 1.34	1.89 ± 0.97	**8.496[W]**	**.001**
MODERATE	3.08 ± 0.65	3.34 ± 0.93[b,e]	2.32 ± 0.59	2.46 ± 0.74	2.84 ± 0.84	**5.298**	**.003**
VIGOROUS	0.95 ± 0.74	1.09 ± 1.07	0.97 ± 0.51	0.66 ± 0.59	0.92 ± 0.77	.688	.564
MET	4.69 ± 0.53	4.84 ± 0.58	4.48 ± 0.46	4.37 ± 0.59	4.61 ± 0.56	1.957	.134.

[a]1st First grade vs 2nd second grade–$p<0.05$; [b]second grade vs third grade–$p<0.05$; [c]third grade vs fourth grade–$p<0.05$; [d]First Grade vs fourth grade–$p<0.05$; [e]second grade vs fourth grade–$p<0.05$, [f]First Grade vs third grade–$p<0.05$; [W] Robust Tests of Equality of Means—Welch

TEE (Figure 1) increased with grade level from first grade (10.69 ± 1.71), to second grade (15.11 ± 2.71), to third grade (15.06 ± 2.62) to fourth grade (17.69 ± 5.18). The assumption of homogeneity of variances was violated, as assessed by Levene's Test of Homogeneity of Variance (p = .001). TEE was statistically significantly different between grade levels (Welch's F(3.23.635) = 15.427, p < .001. Games-Howell post hoc analysis revealed that first grade pupils had lowest TEE compared to second grade (-4.43, 95% CI (-6.83 to -2.02), p < .001), third grade (-4.37, 95% CI (-6.99 to -1.75), p = .001) and fourth grade (-7.01, 95% CI (-11.59 to -2.41),p = .003).

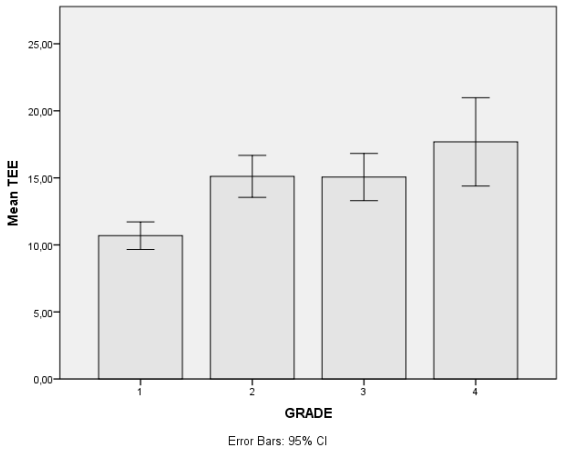

Figure 1. TEE scores during 5-minute classroom-based physical activity by grade level

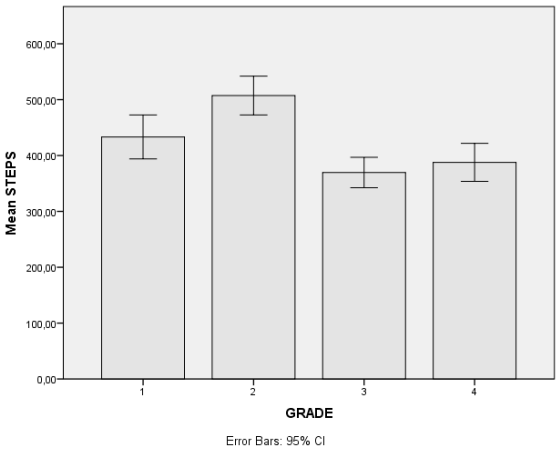

Figure 2. STEPS scores during 5-minute classroom-based physical activity by grade level

The mean STEPS scores (Figure 2) were higher for first grade (433.21 ± 65.04) and second grade (507.4 ± 60.12) than third grade (369.55 ± 40.62) and fourth grade (387.75 ± 53.46). There was homogeneity of variances as assessed by Levene's Test of Homogeneity of Variance (p > .05). STEPS scores were statistically significantly different between grade levels, F(3.46) = 15.322, p < .001. Tukey post hoc analysis revealed that second grade had statistically significantly highest STEPS scores compared to first grade (74.2, 95% CI (16.42 to 131.98), p = .007), third grade (137.86, 95% CI (77.42 to 198.29), p < .001) and fourth grade (119.65, 95% CI (60.64 to 178.67), p < .001). Third grade had statistically significantly lowest STEPS scores compared to first grade (-63.66, 95% CI (-125.12 to -2.21), p = .040 and second grade (-137, 95% CI (-198.29 to -77.42), p < .001).

PAD scores (Figure 3) were higher in first grade (4.03 ± 0.8) and second grade (4.69 ± 0.49) than in third grade (3.38 ± 0.57) and fourth grade (3.42 ± 1.3). The assumption of homogeneity of variances was violated, as assessed by Levene's Test of Homogeneity of Variance (p = .033). PAD was statistically significantly different between grade levels,

Welch's F(3.23.828) = 12.979, p < .001. Games-Howell post hoc analysis revealed that PAD scores were statistically significantly higher in second grade compared to third grade (1.31, 95% CI (0.71 to 1.92), p < .001) and fourth grade (1.27, 95% CI (0.11 to 2.43), p = .030) but no other group differences were statistically significant.

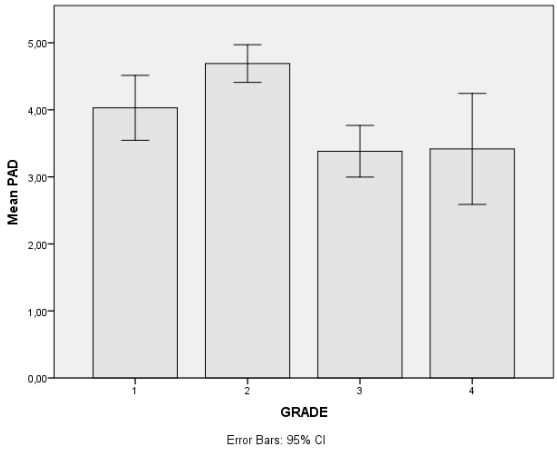

Figure 3. PAD scores during 5-minute classroom-based physical activity by grade level

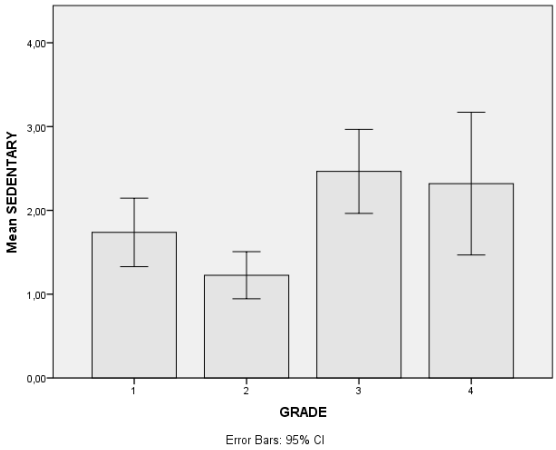

Figure 4. SEDENTARY scores during 5-minute classroom-based physical activity by grade level

SEDENTARY scores (Figure 4) were lower in first grade (1.74 ± 0.68) and second grade (1.23 ± 0.49) compared to third grade (2.47 ± 0.75) and fourth grade (2.32 ± 1.34). The assumption of homogeneity of variances was violated, as assessed by Levene's Test of Homogeneity of Variance (p = .029). SEDENTARY scores were statistically significantly different between grade levels (Welch's F (3.23.399) = 8.496, p = .001). Games-Howell post hoc analysis revealed that SEDENTARY scores were statistically significantly lower in second grade compared to fourth grade (-1.24, 95% CI (-1.98 to -0.49), p = .001) but no other group differences were statistically significant.

MODERATE scores (Figure 5) were higher in first grade (3.08 ± 0.65) and second grade (3.34 ± 0.93) compared to third grade (2.32 ± 0.59) and fourth grade (2.46 ± 0.74). There was homogeneity of variances as assessed by Levene's Test of Homogeneity of Variance (p > .05). MODERATE score was statistically significantly different between grade levels, F(3.46) = 5.298, p = .003. Tukey post hoc analysis revealed that second grade had statistically significantly higher MODERATE scores compared to third grade (1.02, 95% CI (0.21 to 1.82), p = .008) and fourth grade (0.88, 95% CI (0.96 to 1.67), p = .022), but no other group differences were statistically significant.

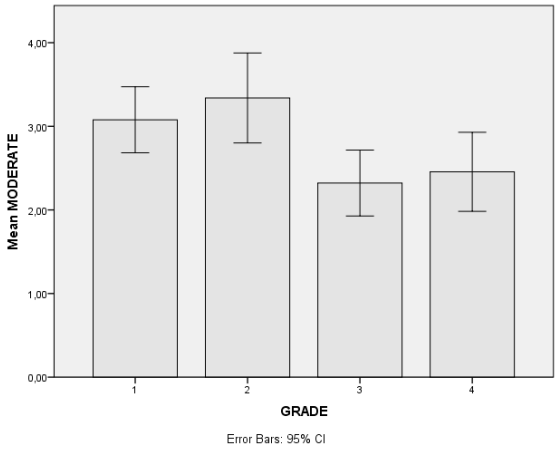

Figure 5. MODERATE scores during 5-minute classroom-based physical activity by grade level

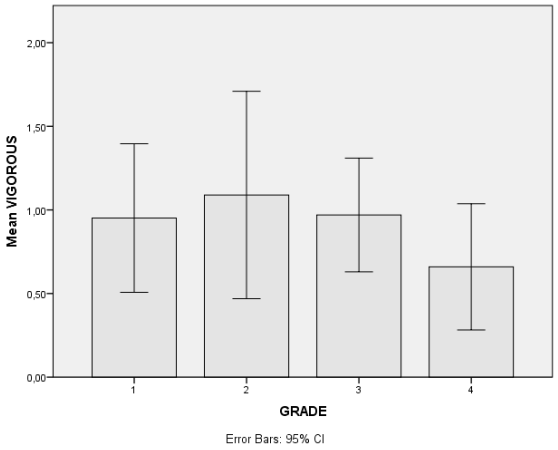

Figure 6. VIGOROUS scores during 5-minute classroom-based physical activity by grade level

VIGOROUS (Figure 6) scores were higher for second grade (1.09 ± 1.07) compared to first grade (0.95 ± 0.74), third grade (0.97 ± 0.51) and fourth grade (0.66 ± 0.59), but observed differences between grades were not statistically significant, F(3.46) = .688, p = .564.

MET scores (Figure 7) were similar for first grade (4.69 ± 0.53), second grade (4.84 ± 0.58), third grade (4.48 ± 0.46) and fourth grade (4.37 ± 0.59), with no statistically significant difference between groups (F(3.46) = 1.957, p = .134).

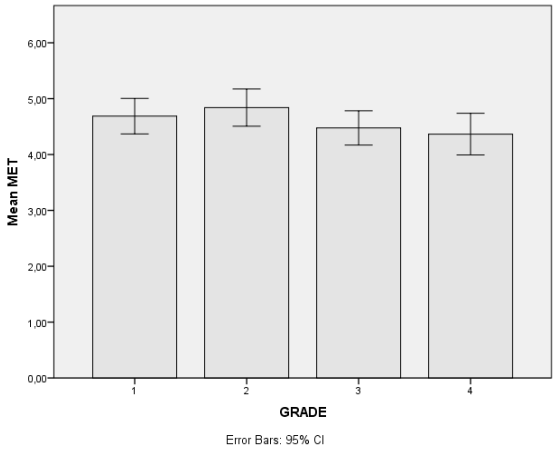

Figure 7. MET scores during 5-minute classroom-based physical activity by grade level

5.5 Measure of agreement between two raters

Cohen's kappa (κ) was run to determine if there was agreement between observers' judgment on whether pupils were exhibiting on-task behavior in classroom (Cohen, 1960). Cohen's kappa (κ) is a statistic that was designed to take into account chance agreement. Instead of measuring the overall proportion of agreement, Cohen's kappa measures the proportion of agreement over and above the agreement expected by chance (i.e., chance agreement). This can be described by the following formula (Wood, 2007):

$$kappa\ (\kappa) = \frac{proportion\ of\ observed\ agreement - proportion\ of\ chance\ agreement}{1 - proportion\ of\ chance\ agreement}$$

Cohen's kappa (κ) can range from -1 to +1. A negative value for kappa (κ) indicates that agreement between the two raters was less than the agreement expected by chance with -1 indicating that there was no observed agreement (i.e., they didn't agree on anything) and 0 (zero) indicating that agreement was no better than chance. Alternately, kappa (κ) values increasingly greater that 0 (zero) represent increasing better-than-chance agreement for the two raters, to a maximum value of +1, which indicates perfect agreement (i.e., they agreed on everything). Different classifications have been suggested for assessing how good the strength of agreement is when based on the value of Cohen's kappa (κ) coefficient. The guidelines in Table 11 are from Altman (1999), and adapted from Landis and Koch (1977):

Table 11. Classification of Cohen's kappa (κ)

Value of κ	Strength of agreement
< 0.20	Poor
0.21–0.40	Fair
0.41–0.60	Moderate
0.61–0.80	Good
0.81–1.00	Very good

Results of Cohen's kappa (κ) are presented in Table 12. The observers agreed on 83.1% of observations of pupils exhibiting on-task behavior and 11.7% of observations of pupils not exhibiting on-task behavior. However, observer 1 rated 3.3% of observations as on-task when observer 2 rated them as not on-task behavior, and observer 1 rated 1.9% of observations as not on-task behavior when observer 2 rated them as on-task behavior. There was good agreement between the two observers' judgments, $\kappa = .790$ (95% CI, .774 to .806), $p < .0005$.

Table 12. Results of Cohen's kappa (κ)

		OBSERVER 2		
		not on-task	on-task	total
OBSERVER 1	not on-task	11.7%	1.9%	13.7%
	on-task	3.3%	83.1%	86.3%
	total	15.0%	85.0%	100.0%

5.6 Effects of a 5-minute classroom-based physical activity on on-task behavior

5.6.1 Effects on on-task behavior during second part of academic lesson after participation in physical activity

Mean on-task behavior was calculated for the first and second 16 minutes during the baseline and intervention period (averaged across all baseline or intervention weeks) separate for first and second grade (6–8yrs) and third and fourth grade (8–10yrs). For group comparison, overall mean on-task behavior of all students was combined over all baseline or intervention weeks.

The data were generally skewed, hence nonparametric statistical methods were chosen. The Wilcoxon signed-rank test was used to determine whether there is a median difference in on-task behavior between first and second 16-min observation periods during baseline and intervention periods. A Mann-Whitney U test was run to determine if there were differences in on-task behavior score between baseline and intervention periods. Distributions of the on-task behavior scores for baseline and intervention periods were similar, as assessed by visual inspection.

5.6.1.1 On-task behavior of 6–8-year-old pupils

During both baseline and intervention period average on-task behavior of 6–8-year-old pupils was high (> 85%). During baseline, median on-task behavior decreased (-2.03%) from first 16-min (88.79%) to second 16-min (85.12%) observation period, but the difference was not statistically significant (z = -.778, p = .437). During intervention, median on-task behavior increased (1.64%) from first 16-min (91.42%) to second 16-min (94.32%) period, but the difference was not statistically significant (z = 1.635, p = .102) (Table 13, Figure 8).

Table 13. Median difference between first and second 16min observation periods for 6–8 yrs

		first 16 min	second 16 min	2nd-1st	z	p
first and second grade (6–8yrs)	Baseline Period	88.79	85.12	-2.03	-,778	.437
	Intervention Period	91.42	94.32	1.64	1.635	.102

Note: Data presented are grouped median scores; first 16 min and second 16 min are observation periods between third–19th minute and 26th–42th minute of a 45-minute lesson, respectively.

Median on-task behavior score during baseline (88.79%) and intervention (91.42%) for first 16-min observation period was not statistically significantly different (U = 10.763, z = .764, p = .445). However, median on-task behavior score for second 16-min observation period was significantly higher (U = 12.489, z = 3.287, p = .001) during intervention (94.32%) compared to baseline (85.12%) period (Table 14, Figure 9).

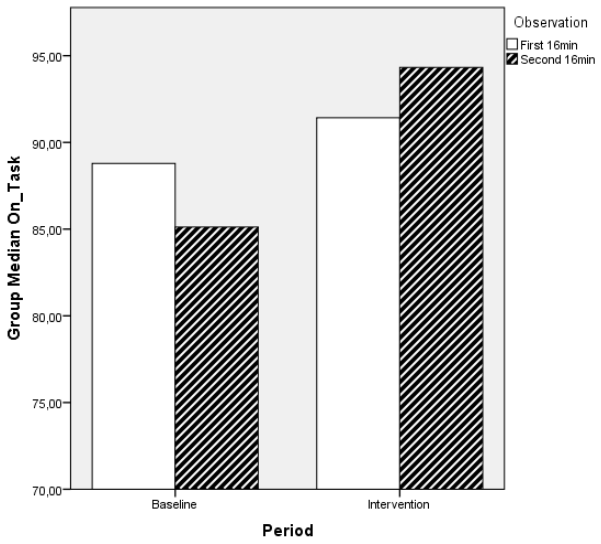

Figure 8. Difference between first and second 16-min observation periods for 6–8yrs

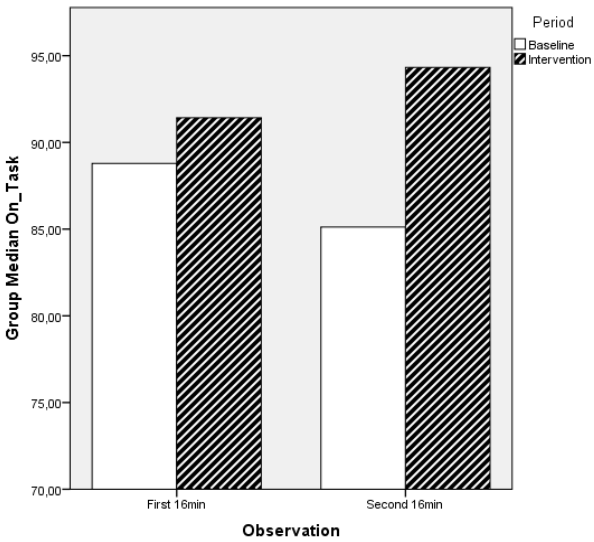

Figure 9. Difference between baseline and intervention periods for 6–8yrs

Table 14. Median difference between baseline and intervention periods for 6–8yrs

		Baseline Period	Intervention Period	U	z	p
first and second grade (6–8yrs)	first 16 min	88.79 (140.41)	91.42 (147.77)	10.763	,764	.445
	second 16 min	85.12 (126.93)	94.32 (158.56)	12.489	**3.287**	**.001**

Note: Data presented are grouped median scores (mean ranks); first 16 min and second 16 min are observation periods between third–19th minute and 26th–42th minute of a 45-minute lesson, respectively.

5.6.1.2 On-task behavior of 8–10-year-old pupils

Average on-task behavior of 8–10-year-old pupils was high during both baseline and intervention period (> 89%). During baseline, median on-task behavior decreased (-2.01%) from the first 16-min (94.14%) to second 16-min (89.83%) observation period, and the difference was statistically significant, z = -3.126, p = .002 (Table 15, Figure 10). During intervention, median on-task behavior did not change significantly (-.87, z = -1.379, p = .162) from first 16 min (94.8%) to second 16 min (92.09%).

Table 15. Median difference between baseline and intervention periods for 8–10yrs

		first 16min	second 16min	2nd-1st	z	p
Third and fourth grade (8–10yrs)	Baseline Period	94.14	89.83	-2.01	**-3.126**	**.002**
	Intervention Period	94.8	92.09	-,87	-1.379	.162

Note: Data presented are grouped median scores; first 16 min and second 16 min are observation periods between third–19th minute and 26th–42th minute of a 45-minute lesson, respectively.

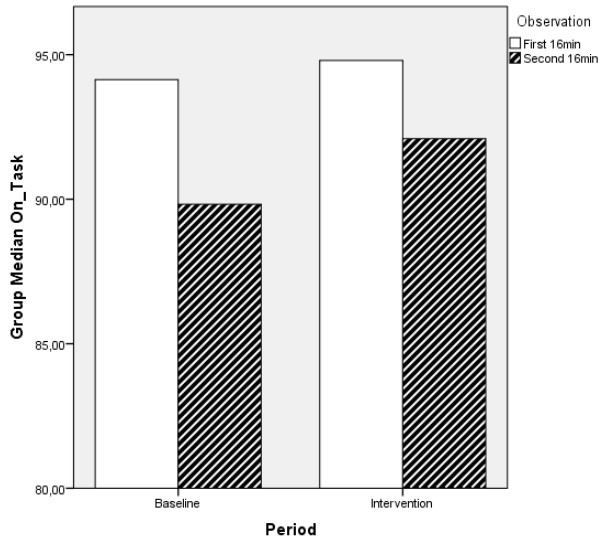

Figure 10. Difference between first and second 16-min observation periods for 8–10 yrs

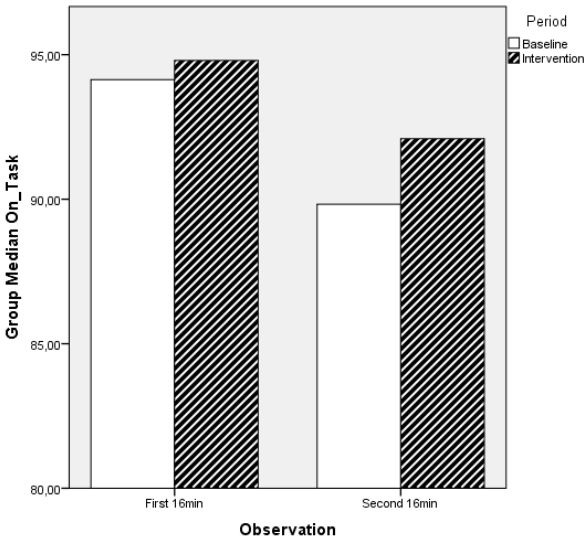

Figure 11. Difference between baseline and intervention periods for 8–10 yrs

Median on-task behavior score during baseline (94.14%) and intervention (94.8%) for first 16-min observation period was not statistically significantly different (U = 18.698, z = .259, p = .796). Median on-task behavior score for second 16-min observation period was higher during intervention (92.09%) compared to baseline (89.83%) period, but the difference was not statistically significant (U = 19.247, z = .778, p = .437) (Table 16, Figure 11).

Table 16. Median difference between baseline and intervention periods for 8–10yrs

		Baseline Period	Intervention Period	U	z	p
Third and fourth grade (8–10yrs)	first 16 min	94.14 (191.11)	94.8 (193.89)	18.698	,259	.796
	second 16 min	89.83 (188.25)	92.09 (196.75)	19.247	,778	.437

Note: Data presented are grouped median scores (mean ranks); first 16 min and second 16 min are observation periods between third–19th minute and 26th–42th minute of a 45-minute lesson, respectively.

5.6.2 Effects on on-task behavior during entire academic lesson

Mean on-task behavior during entire academic lesson was calculated separately for classes that started the intervention after 4 weeks (1a, 2b, 3b, 4b) and for classes that started intervention after 8 weeks (1b, 2c, 3a, 4a). Mean on-task behavior was calculated for 1–4 week, 5–8 week and 9–12 week periods separately for first and second grade (6–8 yrs) and third and fourth grade (8–10 yrs). During weeks 1–4 there was no intervention, during weeks 5–8 only classes 1a, 2b (6–8yrs) and 3b, 4b (8–10yrs) participated in intervention, and during weeks 9–12 all classes participated in intervention.

The data were generally skewed, hence Friedman test was run to determine if there were differences in on-task behavior during a 12-week observational period. Pairwise comparisons were performed (SPSS, 2012) with a Bonferroni correction for multiple comparisons.

5.6.2.1 On-task behavior of 6–8-year-old pupils

On-task behavior of 6–8-year-old pupils was statistically significantly different at the different time points during the 12-week observational period for classes that started intervention after 4 weeks, $\chi2(2) = 18.059$, $p < .001$, and for classes that started intervention after 8 weeks, $\chi2(2) = 13.782$, $p = .001$ (Table 17, Figure 12). Post hoc analysis revealed statistically significant differences in on-task behavior for classes that started intervention after 4 weeks from the 1–4 week (77.5%) to 5–8 week (89.69%) ($p = .027$) and to 9–12 week (88.77%) ($p < .001$), but not 5–8 to 9–12 week ($p = .472$) periods. For classes that started intervention after 8 weeks, post hoc analysis revealed non-statistically significant differences in on-task behavior from 1–4 week (92.19%) to 5–8 week (92.58%) ($p > .99$) but statistically significant differences from 1–4 week (92.19%) ($p = .003$) and 5–8 week (92.58%) ($p < .031$) to 9–12 week (97.32%) periods.

Table 17. Differences in on-task behavior during 12-week observational period (6–8 yrs)

	BEGINNING OF INTERVENTION	WEEKS			X^2	p
		1 - 4	5 - 8	9 - 12		
First and second grade (6–8yrs)	After 4 weeks	77.5[a,b]	89.69	88.77	**18.059**	**.001**
	After 8 weeks	92.19	92.58	97.32[b,c]	**13.782**	**.001**

Note: Data presented are grouped median scores; during weeks 1–4 there was no intervention, during weeks 5–8 only class 1a and 2b (after 4 weeks) participated in intervention, and during weeks 9–12 class 1b and 2a also started with intervention (after 8 weeks); [a]1 - 4 vs 5–8, p<0.05; [b]1 - 4 vs 9–12, p<0.05; [c]5 - 8 vs 9–12, p<0.05

5.6.2.2 On-task behavior of 8–10-year-old pupils

On-task behavior of 8–10-year-old pupils was statistically significantly different at the different time points during the 12-week observational period for classes that started intervention after 4 weeks, $\chi 2(2) = 14.945$, $p = .001$, but not for classes that started intervention after 8 weeks, $\chi 2(2) = 5.041$, $p = .080$ (Table 18, Figure 13). Post hoc analysis revealed statistically significant differences in on-task behavior for classes that started intervention after 4 weeks from the 1–4 week (83.81%) to 5–8 week (92.55%) ($p = .001$) and to 9–12 week (91.52%) ($p < .040$), but not the 5–8 to 9–12 week ($p = .752$) period.

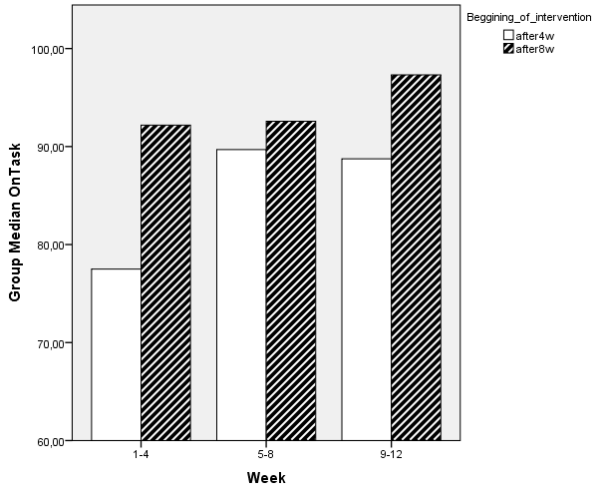

Figure 12. On-task behavior during 12-week observational period for 6–8yrs

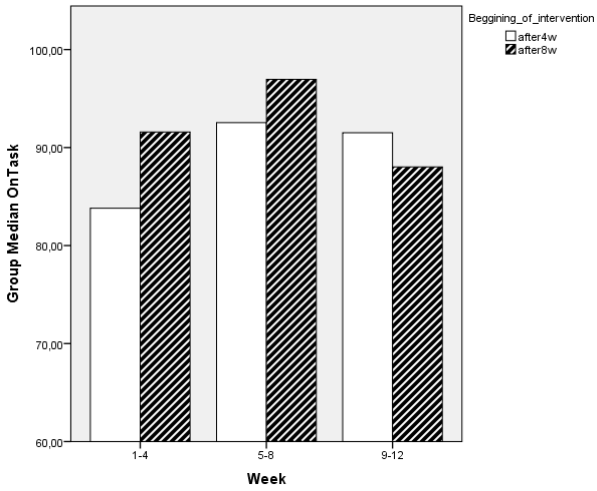

Figure 13. On-task behavior during 12-week observational period for 8–10yrs

Table 18. Differences in on-task behavior during 12-week observational period (8–10yrs)

	BEGINNING OF INTERVENTION	WEEKS			χ^2	p
		1 - 4	5 - 8	9 - 12		
Third and fourth grade (8–10yrs)	After 4 weeks	83.81[a,b]	92.55	91.52	**14.945**	**.001**
	After 8 weeks	91.59	96.96	88.02	5.041	.080

Note: Data presented are grouped median scores; during weeks 1–4 there was no intervention, during weeks 5–8 only class 1a and 2b (after 4 weeks) participated in intervention, and during weeks 9–12 class 1b and 2a also started with intervention (after 8 weeks); [a]1 - 4 vs 5–8, p<0.05; [b]1 - 4 vs 9–12, p<0.05; [c]5 - 8 vs 9–12, p<0.05

5.6.3 Effects on on-task behavior among the least on-task pupils

Mean on-task behavior among the least on-task pupils (< 70%) was calculated for first and second 16 minutes during the baseline and intervention period (averaged across all baseline or intervention weeks) separately for first and second grade (6–8yrs) and third and fourth grade (8–10yrs). For group comparison, overall mean on-task behavior of all students was combined over all baseline or intervention weeks.

The data were generally skewed, hence the Wilcoxon signed-rank test was used to determine whether there is a median difference in on-task behavior between first and second 16min observation periods during baseline and intervention periods.

5.6.3.1 On-task behavior among the least on-task 6–8-year-old pupils

During baseline, median on-task behavior among the least on-task 6–8-year-old pupils increased (12.5%) from first 16-min (50.0%) to second 16-min (59.38%) observation period and the difference was statistically significant, z = 3.341, p = .001. During intervention, median on-task behavior also increased (12.5%) from first 16 min (50.0%) to second 16 min (68.75%) and difference was statistically significant, z = 2.813, p = .005 (Table 19, Figure 14).

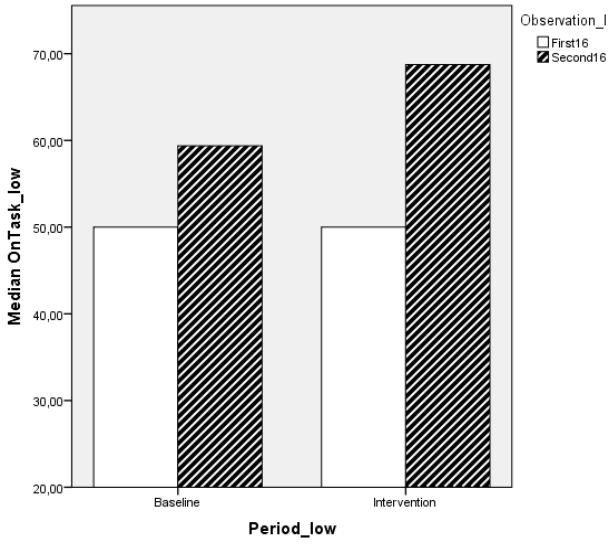

Figure 14. On-task difference between baseline and intervention periods among the least on-task 6–8-year-old pupils

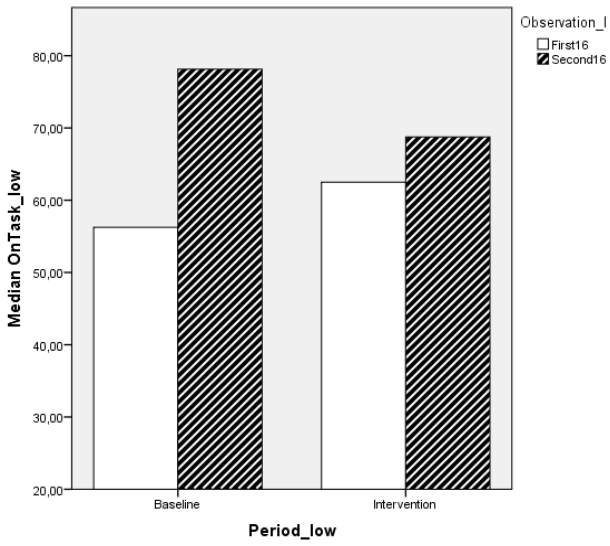

Figure 15. On-task difference between baseline and intervention periods among the least on-task 8–10-year-old pupils

Table 19. Median on-task difference between baseline and intervention periods among the least on-task 6–8-year-old pupils

		first 16 min	second 16 min	2nd-1st	z	p
First and second grade (6–8yrs)	Baseline Period	50.0	59.38	12.5	**3.341**	**.001**
	Intervention Period	50.0	68.75	12.5	**2.813**	**.005**

Note: Data presented are grouped median scores; first 16 min and second 16 min are observation periods between third–19th minute and 26th–42th minute of a 45-minute lesson, respectively.

5.6.3.2 On-task behavior among the least on-task 8–10-year-old pupils.

During baseline, median on-task behavior among the least on-task 6–8-year-old pupils increased (15.63%) from first 16-min (56.25%) to second 16-min (78.13%) observation period and difference was statistically significant, z = 3.812, p = .001. During intervention, median on-task behavior also increased (18.75%) from first 16 min (62.5%) to second 16 min (68.75%) and difference was statistically significant, z = 2.738, p = .006 (Table 20, Figure 15).

Table 20. Median on-task difference between baseline and intervention periods among the least on-task 8–10-year-old pupils

		first 16 min	second 16 min	2nd-1st	z	p
Third and fourth grade (8–10yrs)	Baseline Period	56.25	78.13	15.63	**3.812**	**.001**
	Intervention Period	62.5	68.75	18.75	**2.738**	**.006**

Note: Data presented are grouped median scores (mean ranks); first 16 min and second 16 min are observation periods between third–19th minute and 26th–42th minute of a 45-minute lesson, respectively.

5.7 Effects of a 5-minute classroom-based physical activity on physical activity volume

A two-way (period [baseline vs intervention] x group [control vs intervention]) analysis of variance (ANOVA) was used to examine differences in TEE, STEPS, PAD, SEDENTARY, MODERATE, VIGOROUS and MET scores between control and intervention classes. Simple main effects were run after statistically significant interaction with a Bonferroni correction for multiple post hoc comparisons to determine the difference between periods for each group and vice versa. There were outliers in the data as assessed by inspection of a boxplot for values greater than 1.5 box-lengths from the edge of the box. All outliers were genuinely unusual values and were not extreme data points. All outliers were included in the analysis. Analysis was done separately for first and second grade (6–8 yrs) and third and fourth grade (8–10 yrs). Results of two-way (period*group) ANOVA for age 6–8 and 8–10 are presented in Tables 21 and 22, respectively.

5.7.1 Physical activity volume of 6–8-year-old pupils

Table 21. Results of two-way (period*group) ANOVA for 6–8-year-old pupils

Age 6–8	group	period		two-way (period*group) ANOVA					
				period*group		period		group	
		baseline	intervention	F	p	F	p	F	p
TEE	control	245.98 ± 58.6	227.36 ± 52.29	.754	.388	.395	.531	.434	.512
	intervention	243.37 ± 42.1	246.35 ± 69.07						
STEPS	control	2409.35 ± 565.12	2492.1 ± 509.77	**5.446**	**.022**	8.852	.004	13.680	.000
	intervention	2585.38 ± 587.57	3270.02 ± 808.21[a,b]						
PAD	control	29.69 ± 11.8	19.57 ± 8.68[a,b]	**4.064**	**.047**	2.796	.098	1.706	.195
	intervention	27.74 ± 14.09	28.69 ± 17.16						
SEDENTARY	control	178.04 ± 12.28	187.14 ± 8.89[a,b]	**4.574**	**.035**	1.392	.241	1.575	.213
	intervention	180.46 ± 14.53	177.83 ± 16.46						
MODERATE	control	21.43 ± 11.09	13.87 ± 5.21[a,b]	**7.055**	**.009**	1.956	.165	2.772	.099
	intervention	19.58 ± 8.92	21.93 ± 10.12						
VIGOROUS	control	7.48 ± 5.19	4.76 ± 3.65	.805	.372	.651	.422	1.515	.222
	intervention	8.02 ± 5.87	8.16 ± 4.03						
METs	control	2.35 ± 0.35	2.21 ± 0.26	.517	.474	.699	.406	3.091	.082
	intervention	2.45 ± 0.42	2.44 ± 0.54						

[a]control vs intervention, $p < .05$; [b]baseline vs intervention, $p < .05$

TEE was reduced in control classes from 245.98 ± 58.6 kcal to 227.36 ± 52.29 kcal while in intervention classes TEE remained similar (baseline 243.37 ± 42.1 vs intervention

246.35 ± 69.07). There was no statistically significant interaction between period and group on TEE, F(1.82)= .754, p = .388 (Figure 16).

There was a statistically significant interaction between period and time on STEPS, F(1.97)=5.446, p = .022, partial η2 = .053. Data are mean ± standard error, unless otherwise stated. For the intervention group, pupils performed statistically significantly more steps during intervention period (684.64 ± 174.1) compared to baseline, F(1.97)=15.465, p = .000, partial η2 = .138. There was no statistically significant difference between baseline and intervention period for control group, F(1.97) = .189, p = .665, partial η2 = .002. There was no statistically significant difference between intervention and control group during baseline period, F(1.97) = .937, p = .335, partial η2 = .010. During intervention period, intervention group performed statistically more steps (777.91 ± 182.92) compared to control group, F(1.97)=18.087, p<.001, partial η2 = .157 (Figure 17).

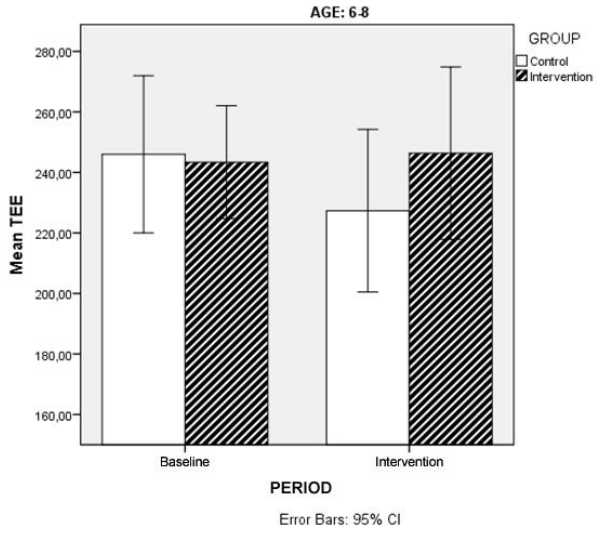

Figure 16. Mean values of TEE with 95% confidence intervals for all groups and periods

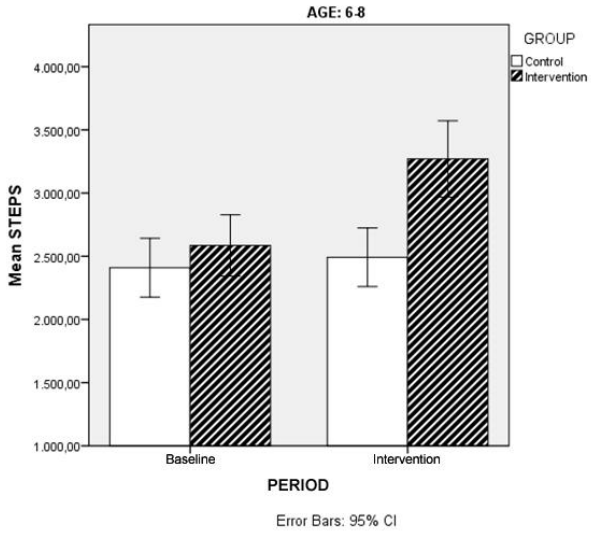

Figure 17. Mean values of STEPS with 95% confidence intervals for all groups and periods

There was a statistically significant interaction between period and time on PAD, F(1.97) = 4.064, p = .047, partial η2 = .040. Data are mean ± standard error. For the control group, pupils had statistically significant lower PAD during intervention period (-10.12 ± 4.05) compared to baseline, F(1.97) = 6.247, p = .014, partial η2 = .061. There was no statistically significant difference in PAD between baseline and intervention period for intervention group, F(1.97) = .065, p = .800, partial η2 = .001. There was no statistically significant difference between control and intervention group during baseline period, F(1.97) = .253, p = .616, partial η2 = .003. During intervention period intervention group had

statistically higher PAD (9.17 ± 3.89) compared to control, F(1.97) = 5.486, p = .021, partial η2 = .054 (Figure 18).

There was a statistically significant interaction between period and time on SEDENTARY time, F(1.97) = 4.574, p = .035, partial η2 = .045. Data are mean ± standard error. For the control group, pupils had statistically significant higher SEDENTARY time during intervention period (9.1 ± 4.05) compared to baseline, F(1.97) = 5.058, p = .027, partial η2 = .050. There was no statistically significant difference in SEDENTARY time between baseline and intervention period for intervention group, F(1.97) = .504, p = .479, partial η2 = .005. There was no statistically significant difference between control and intervention group during baseline period, F(1.97) = .393, p = .532, partial η2 = .004. During intervention period, intervention group had statistically lower SEDENTARY time (-9.31 ± 3.89) compared to control, F(1.97) = 5.724, p = .019, partial η2 = .056 (Figure 19).

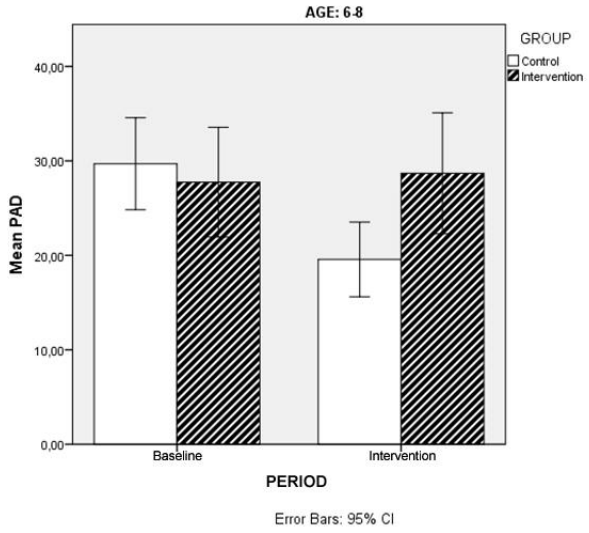

Figure 18. Mean values of PAD with 95% confidence intervals for all groups and periods

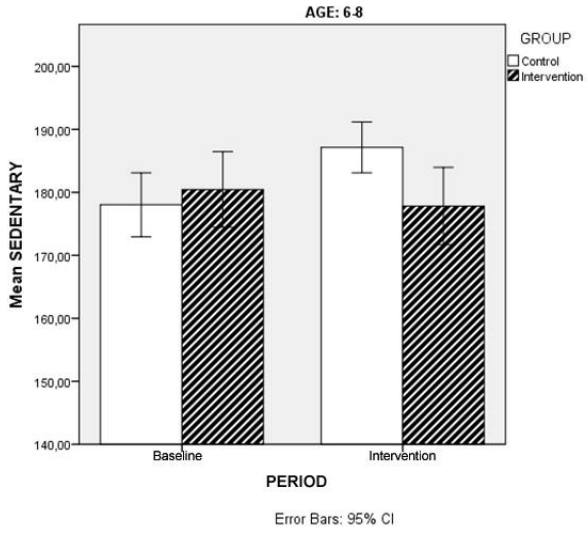

Figure 19. Mean values of SEDENTARY with 95% confidence intervals for all groups and periods

There was a statistically significant interaction between period and time on MODERATE time, F(1.97) = 7.055, p = .009, partial η2 = .068. Data are mean ± standard error. For the control group, pupils had statistically significant lower MODERATE time during intervention period (-7.56 ± 2.75) compared to baseline, F(1.97) = 7.550, p = .001, partial η2 = .072. There was no statistically significant difference in MODERATE time between baseline and intervention period for intervention group, F(1.97) = .868, p = .354, partial η2 = .009. There was no statistically significant difference between control and intervention group during baseline period, F(1.97) = .494, p = .484, partial η2 = .005. During

intervention period intervention group had statistically higher MODERATE time (8.05 ± 2.64) compared to control, F(1.97) = 9.281, p = .003, partial η2 = .087 (Figure 20).

VIGOROUS time was reduced from 7.48 ± 5.19 min to 4.76 ± 3.65 min in control classes while in intervention classes VIGOROUS time remained at a similar level (baseline 8.02 ± 5.87 vs intervention 8.16 ± 4.03). There was no statistically significant interaction between period and group on VIGOROUS time, F(1.82) = 0.805, p = .372 (Figure 21).

There was no statistically significant interaction between period and group on MET scores, F(1.82) = 0.517, p = .474. Mean values are similar for control (baseline 2.35 ± 0.35 vs intervention 2.21 ± 0.26) and intervention (baseline 2.45 ± 0.42 vs intervention 2.44 ± 0.54) classes (Figure 22).

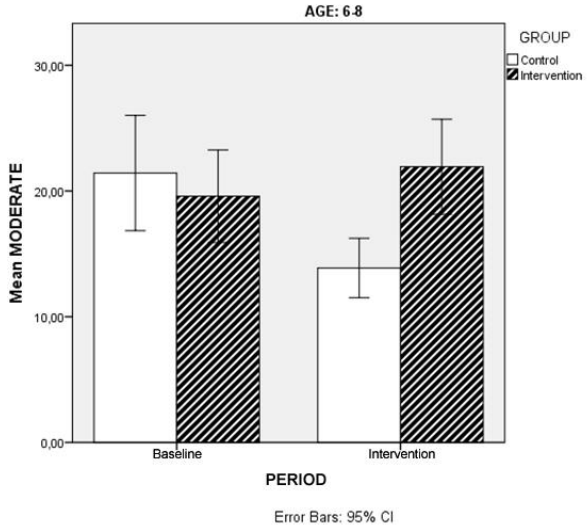

Figure 20. Mean values of MODERATE with 95% confidence intervals for all groups and periods

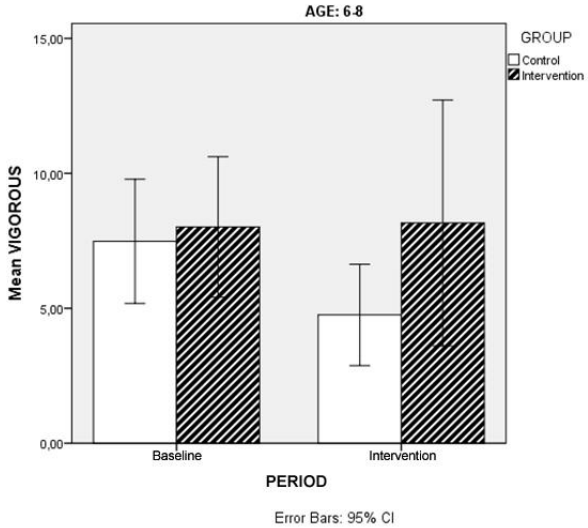

Figure 21. Mean values of VIGOROUS with 95% confidence intervals for all groups and periods

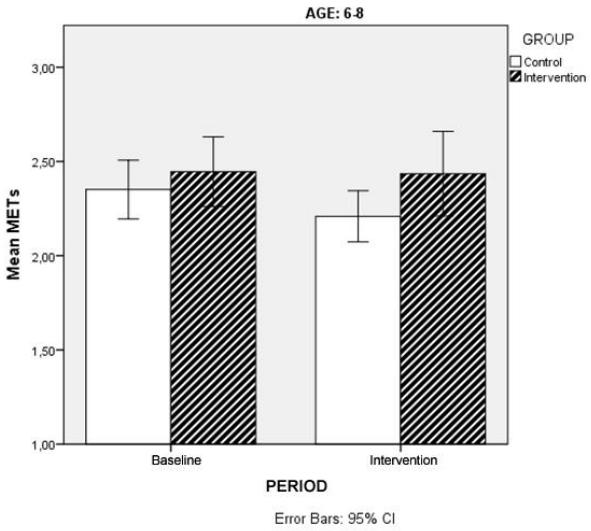

Figure 22. Mean values of METs with 95% confidence intervals for all groups and periods

5.7.2 Physical activity volume of 8–10-year-old pupils

Table 22. Results of two-way (period*group) ANOVA for 8–10-year-old pupils

8–10	group	period		2-way (period*group) ANOVA					
		initial	final	period*group		period		group	
				F	p	F	p	F	p
TEE	control	304.85 ± 60.7	301.55 ± 62.35	.406	.526	.177	.674	.067	.797
	intervention	299.05 ± 86.05	315.23 ± 96.66						
STEPS	control	2784.31 ± 674.33	2941.58 ± 739.47	.414	.522	2.635	.107	.282	.596
	intervention	2595.92 ± 869.38	2959.54 ± 963.53						
PAD	control	26.12 ± 9.28	29.41 ± 13.94	.108	.743	2.647	.107	3.231	.075
	intervention	20.75 ± 9.52	25.69 ± 16.1						
SEDENTARY	control	178.39 ± 14.12	178.42 ± 13.77	.686	.410	.667	.416	**5.588**	**.020**
	intervention	187.54 ± 9.64	182.83 ± 15.85						
MODERATE	control	18.15 ± 5.84	21.28 ± 10.4	.167	.684	4.902	.029	2.262	.136
	intervention	14.82 ± 6.69	19.38 ± 10.56						
VOGOROUS	control	7.98 ± 4.51	8.12 ± 5.94	.008	.927	.038	.845	2.081	.152
	intervention	5.93 ± 4.99	6.31 ± 9.58						
METs	control	2.41 ± 0.4	2.38 ± 0.38	1.087	.299	.513	.476	1.967	.164
	intervention	2.2 ± 0.33	2.35 ± 0.59						

TEE was reduced from 304.85 ± 60.7 kcal to 301.55 ± 62.35 kcal in control classes while in intervention classes TEE increased from 299.05 ± 86.05 kcal to 315.23 ± 96.66 kcal. There was no statistically significant interaction between period and group on TEE, F(1.106) = 0.406, p = .526 (Figure 23).

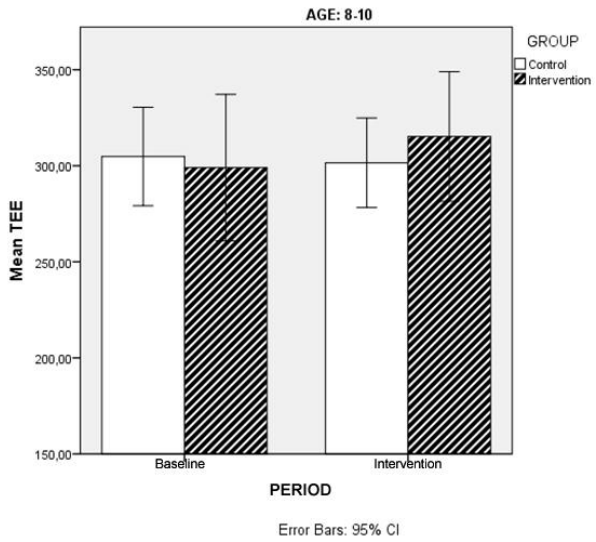

Figure 23. Mean values of TEE with 95% confidence intervals for all groups and periods

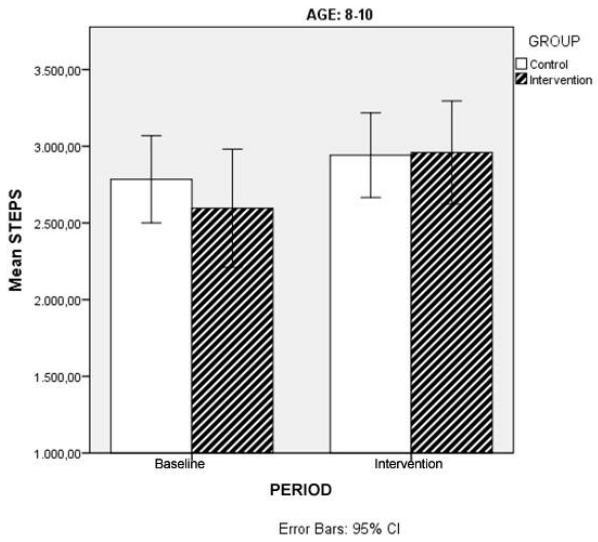

Figure 24. Mean values of STEPS with 95% confidence intervals for all groups and periods

There was no statistically significant interaction between period and group on STEPS scores, F(1.106) = 0.414, p = .522. Mean STEPS scores increased for intervention (baseline 2595.92 ± 869.38 vs intervention 2959.54 ± 963.53) classes more than for control (baseline 2784.31 ± 674.33 vs intervention 2941.58 ± 739.47) classes (Figure 24).

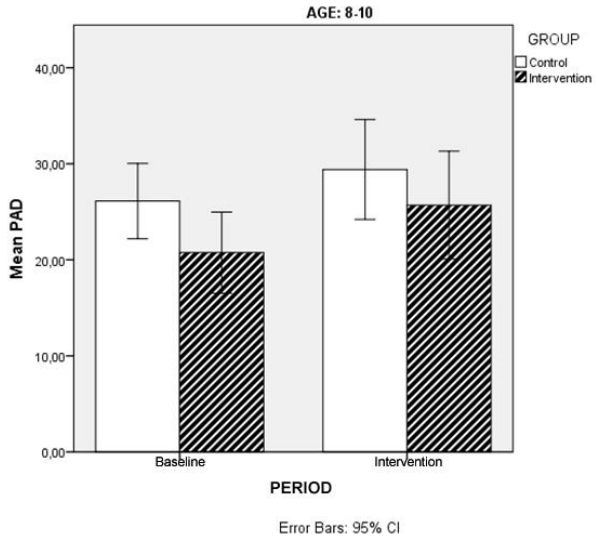

Figure 25. Mean values of PAD with 95% confidence intervals for all groups and periods

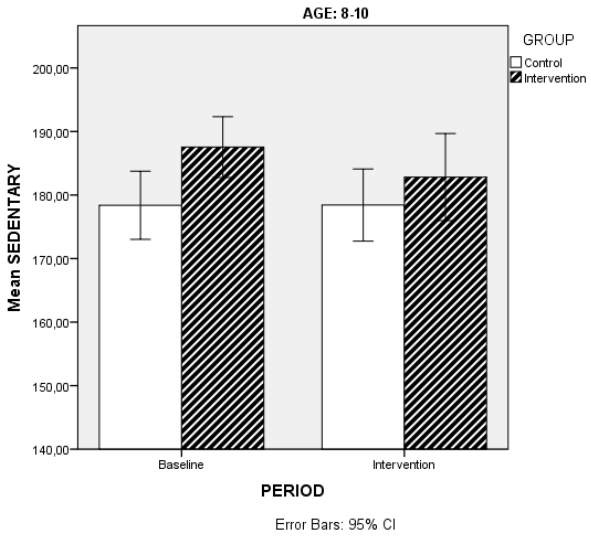

Figure 26. Mean values of SEDENTARY with 95% confidence intervals for all groups and periods

PAD was increased from 26.12 ± 9.28 min to 29.41 ± 13.94 min in control classes while in intervention classes PAD increased from 20.75 ± 9.52 min to 25.69 ± 16.1 min. There was no statistically significant interaction between period and group on TEE, F(1.106) = 0.108, p = .743 (Figure 25).

There was no statistically significant interaction between period and group on SEDENTARY scores, F(1.106) = 0.686, p = .410. There was a statistically significant difference in SEDENTARY scores between control and intervention groups, F(1.106) = 5.588, p = .020, partial η2 = .045. Mean SEDENTARY time remained unchanged in control classes (baseline 178.39 ± 14.12 min vs intervention 178.42 ± 13.77 min) while it was decreased (baseline 187.54 ± 9.64 min vs intervention 182.83 ± 15.85 min) in intervention classes (Figure 26).

There was no statistically significant interaction between period and group on MODERATE scores, F(1.106) = 0.167, p = .684. MODERATE time increased more for intervention (baseline 14.82 ± 6.69 min vs intervention 19.38 ± 10.56 min) than control (baseline 18.15 ± 5.84 min vs intervention 21.28 ± 10.4 min) classes (Figure 27).

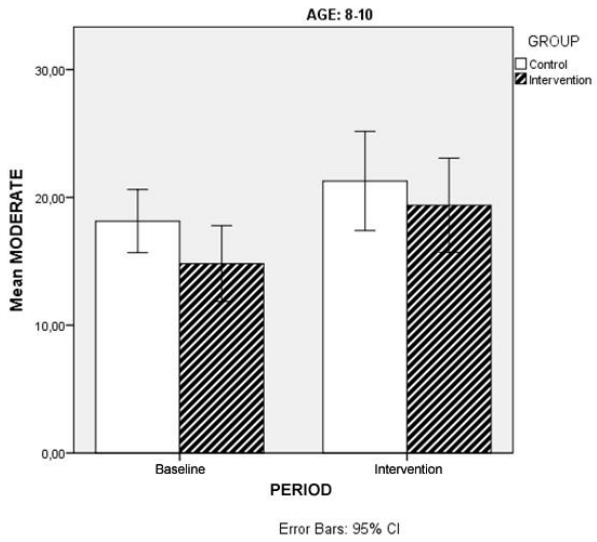

Figure 27. Mean values of MODERATE with 95% confidence intervals for all groups and periods

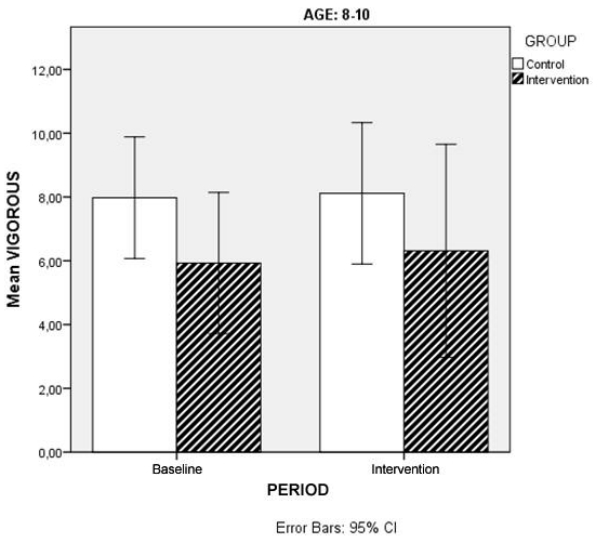

Figure 28. Mean values of VIGOROUS with 95% confidence intervals for all groups and periods

VIGOROUS time remained at a similar level in control classes (baseline 7.98 ± 4.51 min vs intervention 8.12 ± 5.94 min), while in intervention classes it was increased from 5.93 ± 4.99 min to 6.31 ± 9.58 min. There was no statistically significant interaction between period and group on VIGOROUS time, F(1.106) = 0.008, p = .927 (Figure 28).

There was no statistically significant interaction between period and group on MET scores, F(1.06) = 1.087, p = .299. Mean values are similar for control (baseline 2.41 ± 0.4 vs intervention 2.38 ± 0.38) and intervention (baseline 2.2 ± 0.33 vs intervention 2.35 ± 0.59) classes (Figure 29).

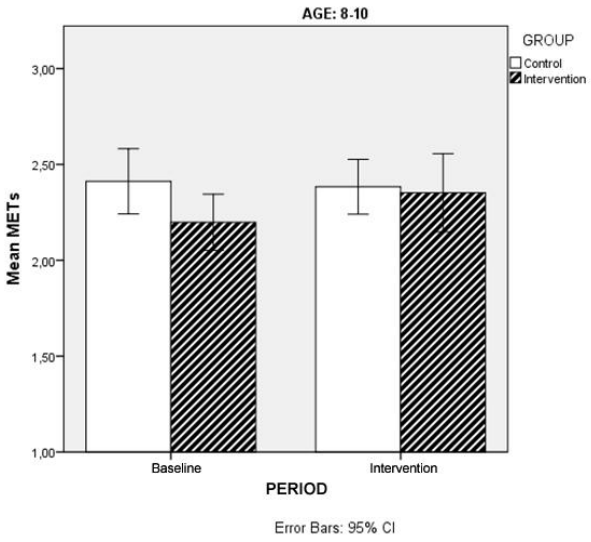

Figure 29. Mean values of METs with 95% confidence intervals for all groups and periods

6. DISCUSSION

Over recent decades, a steadily growing body of literature has indicated the need to examine the positive effects of incorporating classroom-based physical activity among pupils and educators. Based on finding in the literature, healthcare and academic professionals have perceived that physical education/activity strongly impacts the students' behavior inside the classroom, particularly in terms of their effort level, communication skills with their co-pupils and teachers, completion of homework, and determination to work through complex conditions. Findings have revealed that engaging in physical activity does lead to enhancement of cognition and brain functioning, thereby improving the academic performance of students (Singh et al., 2012). However, there is still some skepticism towards regular inclusion of physical activity inside the classroom. It is important to recognize that the positive effects of incorporating classroom-based physical activities is not only an essential concept but also a compliant one that can be affected by academic setting changes.

The purpose of this study was to explore the effects of a 5-minute classroom-based physical activity. The research focused on the effects of such physical activity on on-task behavior during the second part of the academic lesson after participation in physical activity, during the entire 45-minute academic lesson, its effects on pupils with lowest on-task behavior, and its effects on physical activity volume and energy expenditure during the school day.

Due to the nature of the study and its corresponding objectives and goals established, the study was patterned after a quantitative research design. The principal objective of a quantitative research study is to produce a comprehensive report of all features or elements that elicit a significant result on the construct under study. Thus, this kind of research is geared towards and more concerned with the implications of the study or with what a condition, stimulus, response or any occurrence could denote and what significances it could indicate. Quantitative research is, therefore, seen as a best fit for this study as the design is decisive and definite in nature and is not only aimed at the superficial goals of the study but seeks to determine underlying causalities attached to the constructs, variables and factors under investigation. The need to build a systematic method for collecting data from a specified sample was also deemed important for the purpose of constructing a definite description and overview of the attributes of the whole population. For the purposes of gathering and analyzing the context on which the study is set, numerous literary and academic references were also utilized in this study.

6.1 Initial state of physical activity levels of pupils as assessed by PAQ-C

Self-reported physical activity at the start of experiment, as assessed by PAQ-C, was similar for all classes included in the study. Total physical activity of pupils was moderate, which is consistent with similar research on Croatian pupils. Vidaković Samaržija and Mišigoj-Duraković (2013) also reported moderate physical activity among 10-year-old pupils. The highest physical activity was reported for PA during physical education (PE) classes. Despite the fact that physical education (PE) classes are the only organized activity during the school day that allows pupils to be physically active, PE classes are often shortened and sacrificed for other subjects (Dobbins et al., 2009; McKenzie et al., 1995; Simons-Morton et al., 1994). A growing body of research indicating the importance of physical education, not only for physical development but also for academic excellence (Trost, 2007), suggests that an increase in time allocated for physical education is justified. The lowest self-reported physical activity of pupils was in their spare time. This fact highlights the importance of promoting and implementing strategies for increasing physical activity during the school day. Students spend a substantial amount of time in school, and even a small increase in daily in-school physical activity can accumulate to a significant amount during the school year (Mahar et al., 2006).

The strength of the present study is the inclusion of control groups that allowed a comparison of pupils that participated in 5-minute classroom-based physical activity with those who did not. Results from PAQ-C indicate that control and intervention groups did not differ significantly in physical activity levels before the start of experiment.

6.2 Results of internal consistency and test-retest reliability of Croatian version of PAQ-C

The aim of this subchapter is to discuss the test reliability and internal consistency of PAQ-C. PAQ-C was indicated as a promising questionnaire for children (Chinapaw et al., 2010) and its reliability and validity was confirmed in many international (Crocker et al., 2007; Currie et al., 2008; Kowalski et al., 1997; Martinez–Gomez et al., 2011) and Croatian studies (Vidaković Samaržija & Mišigoj-Duraković, 2013). However, in all of these studies subjects were 8 years old or older. One of the unique aspects of this study was that PAQ-C, designed to assess general levels of physical activity for pupils approximately 8–14 years of age, was administered also to 6–8-year-old pupils. Parents were asked to assist in filling out

the questionnaire for 6–8-year-old pupils. Test-retest reliability and internal consistency analysis was conducted. Statistically significant Spearman correlations between two measures ranging from .156 to .619 and from .361 to .828 for 6–8-year-old and 8–10-year-old pupils, respectively, indicate a good reliability of PAQ-C for assessing physical activity of both groups. Internal consistency for 6–8-year-old group, as assessed by Cronbach's alpha of 0.71 and 0.69 for the first and second measure, respectively, and for 8–10-year-old group for first and second measure of 0.77 and 0.75, respectively, also contribute to confidence that PAQ-C can be used for assessing physical activity of both 6–8 and 8–10-year-old pupils.

6.3 Descriptive statistics of 5-minute classroom-based physical activity

Today, physical activity among children is declining; they are spending more time in sedentary activities and yet only a few studies have been conducted to evaluate the physical activity levels of pupils during a school day (Barfield et al., 2004; Dale et al., 2006; Steward et al., 2004; Mahar et al., 2006). This is especially important since children spend the majority of time on week days in school, for five days a week, and stay in school for most of their childhood and teenage years.

In the present study, physical activity levels and energy expenditure of first- to fourth-grade pupils during classroom-based physical activity and also during a school day were measured. Similar studies investigating the effects of classroom-based physical activity used pedometers to assess physical activity. Mahar et al. (2006) implemented a classroom-based physical activity called Energizers for 10 minutes per day from kindergarten through to fourth grade. They reported mean step counts for each grade level during Energizers activities ranging from 438 to 595 steps, with the fourth-grade pupils having the highest step count. Steward et al. (2004) measured physical activity levels of first-, third- and fourth-grade pupils during the Take 10! 10-minute classroom-based physical activity. The researchers found that step counts during the Take 10! activities increased with grade level, with first-, third-, and fifth-grade students averaging 743, 946, and 1022 steps, respectively.

In the present study, during a 5-minute classroom-based physical activity pupils performed a similar number of steps as during an Energizers activity that lasted twice as long. The mean step counts for each grade level ranged from 369 to 507 steps. Different from previous studies (Mahar et al., 2006; Steward et al., 2004), first- and second-grade pupils achieved higher mean step counts during 5-minute classroom-based physical activity than did third- and fourth-grade pupils. Another unique aspect of this study was the use of body

monitors that allowed for physical activity volume and energy expenditure assessment. Results show that pupils engaged in moderate-to-vigorous physical activity. MET levels did not differ between grades and were 4.61 on average across all grades. First- and second-grade pupils spent more time in moderate-to-vigorous physical activity than third- and fourth-grade pupils. They also had a lower sedentary time during the activities. Possibly, the video animations used were more motivating for younger pupils as they include cartoon characters and an environment that is more appealing to younger pupils. Also, it is likely that the classroom teachers play an important role in the overall activity level during the activity by encouraging and motivating pupils to participate. The content of video animations should be taken into consideration and they should be chosen to accommodate pupils' preferences.

Because 5-minute classroom-based physical activity had a different effect on physical activity levels during the activity for 6–8 and 8–10-year-old pupils, it could be assumed that effects on on-task behavior and daily physical activity might also be different. That is why all subsequent analyses of effects of 5-minute classroom-based physical activity were performed separately for 6–8 and 8–10-year-old pupils.

6.4 Measure of agreement between two raters

On-task behavior was assessed during baseline period when no classroom-based physical activity was introduced, as well as during the intervention period after pupils participated in a 5-minute physical activity. In previous studies classroom teachers rated each pupil's behavior in the classroom (Shepard, 1996). Overall, teachers indicated improved classroom behavior when students engaged in more physical activity during the school day. A limitation to these studies may have been teacher bias in rating classroom behavior, if teachers supported increasing physical activity during the school day. In the present study, observers were not classroom teachers but thoroughly trained observers with over ten years' experience in teaching. Mahar et al. (2006) implemented a similar protocol for observing on-task behavior of pupils. They reported, as one of the limitations of the study, that in their experiment observers knew which pupils had participated in classroom-based physical activity. In the present study observers were blinded by editing the video recording. Video showed only 16 minutes of the first part and 16 minutes of the second part of the academic lesson, so observers did not know whether pupils had participated in classroom-based physical activity or not. Mahar et al. (2006) reported an average percentage agreement between observers of 94%, and second observer made observations for 39% of the total

observations. In the present study, Cohen's kappa was run to determine if there was agreement between observers' judgments, which is designed to take into account chance agreement. Both observers conducted all observations and Cohen's kappa of .79 showed a good agreement between the two observers' judgments, as classified by Altman (1999).

6.5 Effects on on-task behavior during second part of academic lesson after participation in physical activity

The research results show the different effects on participants after undergoing the said experiment. This section discusses the effects on on-task behavior during the second part of academic lesson after participation in physical activity based on age group. Further, implication will also be covered. For this part of the study, the samples were divided into two groups: the first group was composed of first- and second-graders, aged 6–8-years-old, while the second group was composed of third and fourth graders, aged 8–10-years-old.

In terms of the effects of the experiment during the second part of the academic lesson, participants generally achieved a higher level of on-task behavior after participation in physical activity. On-task behavior during the first 16 minutes during the baseline and intervention period did not differ for either 6–8 or 8–10-year-old pupils. This is consistent with previous research (Jarrett et al., 1998; Mahar et al., 2006) and indicates that anticipation of physical activity has no effect on on-task behavior. Pupils do not increase or decrease their on-task behavior when they anticipate a physically active break. During the second 16 minutes of intervention period, after pupils participated in a 5-minute classroom-based physical activity, the on-task behavior of 6–8-year-old pupils was 9% higher than during the same observational period during baseline. On-task behavior of 8–10-year-old pupils was also higher during the second 16 min in intervention period compared to baseline, but this 2% difference was not statistically significant.

On-task behavior during baseline period decreased from first to second 16 minute observational periods. For 6–8-year-old pupils, a decrease of 3% was not statistically significant but for 8–10-year-old pupils there was a 4% statistically significant decrease in on-task behavior. This is consistent with previous research that indicated that it is expected that on-task behavior would decrease as the length of work time without a break increases (Mahar et al., 2006) and that children might think and work less efficiently when engaged in long periods of uninterrupted instructional time (Jarrett et al., 1998; Pellegrini and Davis, 1993). During intervention period pupils maintained a similar level of on-task behavior during both

observational periods. The initially high on-task behavior of 91.42% and 94.8% for 6–8 and 8–10-year-old pupils, respectively, was not significantly changed after 5-minute classroom-based physical activity. Possibly, initially high on-task behavior made it difficult to achieve a significant increase of on-task behavior. However, results show an evident trend of slowing the decrease of on-task behavior in the second part of the lesson for 8–10-year-old pupils and even a slight increase of initially high on-task behavior by almost 4% for 6–8-year-old pupils. In the study by Mahar et al. (2006) pupils had lower initial on-task behavior when compared to the results of the present study. They found a significant increase of on-task behavior after introduction of classroom-based physical activity by 8%, from 70.9% to 79.2%.

Effects on participants are mainly characterized by on-task behavior such as their improved assignment completion, organization, planning and impulse control. Due to these positive effects, teachers in general strongly preferred the incorporation of 5-minute classroom-based physical activity. The practical effects of the experiment allowed them to help their pupils cope with academic lessons, which was also favorable to them. Hence, this study's results also established that incorporating physical activities in the classroom could be an aid to educators to fulfill their duties as teachers.

These positive reactions help account for the growing number of stakeholders reinforcing the incorporation of physical activities inside the classroom, despite its challenges and limitations. The benefits offered by classroom-based physical activity contribute to an increase in physical awareness in schools and educational institutions, an improved academic performance, the effective transfer of knowledge to pupils, and the proliferation of institutions that offer and reinforce the advantage of incorporating physical activity and physical education. Overall, the inclusion of physical-based activity programs in schools creates an ideal environment not just for attaining positive learning results but also for effectively implementing learned ideas in the classroom.

There are many implications of this result showing that participants improved their on-task behavior after the intervention. According to Clare, Jenson, and Bray (2000), on-task behavior pertains to "children's classroom skills including the ability to work independently and to attend to teacher directed activities." It also includes "student behavior such as eye contact with the teacher, working quietly, and appropriately orienting to a task" (Clare, Jenson & Bray, 2000, p. 517). The result of this section therefore implies that the integration of classroom-based physical activity can improve pupil's cognitive function. Blair (2008) asserts that cognitive and behavioral school readiness depends largely on the development of a

child's executive regulatory systems during the preschool period. This claim corresponds with the results of other researches that have been conducted before this study.

There have been numerous studies that link physical activity and achievement of cognitive function. For instance, Rovio et al. (2005) argued that physical activity enhances cognitive function and decreases the risk of dementia. In their experiment, they assume that physical activity such as daily exercise promotes the health of the brain. Consequently, physical exercise prevents the decline of the cognitive function of an individual and decreases the risk of dementia. In addition, the authors also conclude that depressive signs and socioeconomic factors may affect the ability of an individual to take part in physical activities. This claim was also supported by a study conducted by Flicker (2009). In his experiment, he concluded that increased cardiovascular exercise leads to better cognitive function. This delays the onset of dementia. Moreover, auditory attention and motor function positively affect the cognitive function of individuals. In fact, even a short-duration exercise can positively affect the cognitive performance of a person (Middleton & Yaffe, 2009).

Rovio et al. (2005) found that physical activity during midlife reduces the risk of dementia. Individuals who perform leisure physical activity at least twice a week have a 50% lower chance of developing dementia than sedentary individuals. The result of their experiment also uncovered that physical activity had a stronger association with Alzheimer's disease (AD) than other types of dementia. Physical activities such as dancing and running may lead to lower risk of AD, but had no association with other types of dementia. It is also worth mentioning that physical activity has an equal effect on both men and women. Conversely, a study conducted in Japan asserted that there is no association between physical activity and the onset of dementia. One major flaw of this study is the fact that it combined occupational and leisure physical activity. Rovio et al. (2005) claimed that physical activity in occupation should not be labeled leisure physical activity.

In the context of the study conducted, observers rated participants with increased or improved on-task behavior. One of the observations that raters noted is the eye contact of students to their teachers. Eye gaze has been perceived as a good measure of pupil's visual and focused attention. Another observation of pupils' on-task behavior is their conversing with their peers when the teacher asked them to discuss an idea with their classmates. Lastly, student engagement in classroom-based tasks was also seen as a common characteristic of pupils after engaging in physical activity.

Physical activity improves pupil's cognitive function by developing their on-task behavior. But how important it is to develop this aspect of a child? Teachers base cognitive

development capabilities on formal learning while parents base the capabilities to acquire cognitive skills on social experiences. These two perspectives are not different, given Blair's (2006) claim that memory and experience is associated with cognitive development. Memory is one of the neurological elements that has been found to contribute towards cognitive development through retention of information, retrieval at the stipulated time and re-use of the stored information. Knowledge and readiness to join schools was therefore founded on neuroscientific considerations, since, as Diamond and Amso (2008) asserted, it was through biological functions that children acquire knowledge and cognitive skills. The level of competence and development of these constructs therefore determines readiness. In addition to memory and reasoning, emerging literacy and cognitive development influence a child's potential to learn, made decisions, differentiate objects and argue according to some pre-existing functions. Therefore, on-task behavior goes beyond the eye gaze, alertness, and active participation of pupils. It covers many cognitive skills that are deemed essential inside and outside the classroom.

6.6 Effects on on-task behavior during entire academic lesson

A separate analysis was conducted for pupils who started the intervention after 4 weeks and for pupils who started after 8 weeks. Therefore, two groups were observed to discern the effects of 5-minute classroom-based physical activity on on-task behavior during the entire academic lesson. A brief summary of the results will first be given, followed by a discussion of their implications.

To test whether on-task behavior systematically improves after classroom-based physical activity is systematically introduced, mean on-task behavior during the entire academic lesson was calculated separately for classes that started the intervention after 4 weeks and for classes that started the intervention after 8 weeks. On-task behavior was statistically significantly different at the different time points during the 12-week observational period for the two age groups. On-task behavior of pupils aged 6–8 significantly increased after the 4^{th} week in classes that started participating in classroom-based physical activity after 4 weeks. Similarly, classes that started participating in physical activity after 8 weeks exhibited higher on-task behavior after the 8^{th} week. Results indicate that the implementation of classroom-based physical activity was effective in increasing on-task behavior of 6–8-year-old pupils because, in general, after physical activity was systematically implemented into the classrooms, on-task behavior systematically improved. A similar effect

was found for 8–10-year-old pupils but to a lesser extent – namely, even though on-task behavior significantly increased after the 4th week in classes that started participating in classroom-based physical activity after 4 weeks, this was not true for classes that started with physical activity after the 8th week. Their on-task behavior did not change significantly.

The result implies that the inclusion of physical activity in the classroom promises positive effects to students. The perception of 5-minute classroom-based physical activity as a good learning option was based on the higher rate of assignment completion, organization, planning, and impulse control. The impact of incorporating classroom-based physical activity was significantly realized in several perspectives, including physical and academic perspectives.

As seen from the previous result, this subchapter still proved that incorporating classroom-based physical activity helped to improve the cognitive function of pupils. Additionally, cognitive capacities such as the ability to sustain attention and monitor one's thoughts also are defining features of self-regulation. In the early childhood classroom, the need for self-regulation is greatest when there is a pause in structured, teacher-directed activities (Cassidy, Rucker, & Boon, 2003). Self-regulation is important when attempting to achieve a stated goal by means of initiation or completion of a given routine. Additionally, when failure at usual activities occurs, self-regulation is crucial to maintaining decorum in the classroom. The concept of self-regulation also includes capacities such as goal setting, self-monitoring, self-activation, and the use of set goals to achieve intended purposes (McCloskey et al., 2009).

Improvements in cognitive function offer a great deal to pupils and educators. For instance, the educator Vygotsky mentioned that there is a direct relationship between pupil interaction with peers and cognitive development. It was mentioned earlier that one characteristic of improved on-task behavior is the ability of students to interact with their peers when the teachers asked them to discuss an idea with their classmates. This is corroborated by the ideas of Vygotsky, who claimed that cognitive development takes place in children through socialization or interaction with other individuals. Vygotsky viewed language as developing thought. Vygotsky argued that two-way communication with adults reinforces children's cognitive development (Selbie, Clough, & Nutbrown, 2008). To Vygotsky, the central role of language in children's intellectual development was due to their need to effectively receive the transmission or flow of information in order to think effectively. In other words, interaction can lead to the development of one's language.

Favorable environments should be provided by both family and academic institution as keys to successful development of the aforementioned capabilities. While teachers and parents concentrate on behavioral changes, Blair (2006) considers that neuroscience can help identify the fundamental factors contributing to a child's cognitive development. Academic success requires awareness on how experiences affect the developing brain of a child, as well as his behavior. Many of these experiences may greatly influence his socioeconomic background, and they have to be thoroughly considered in order to possibly plot an effective educational program for children. Needless to say, a stressful environment forms an unpleasant experience for a child that may eventually affect his cognitive achievements. Every child's reading and verbal skills may show significant variances depending on the family and environmental structures. Children who were raised in a constantly stressful situation may exhibit intermittent behavior due to the increased stress hormones (Noble, Tottenham, & Casey 2005). Working on this assumption, all academic institutions are tasked with creating a harmonious environment for their students, in the sense pertaining to a lively interaction of pupils and educators.

6.7 Effects on on-task behavior among the least on-task pupils

Aside from the age group, the analysis was further divided according to intervention time - first 16 minutes and second 16 minutes for the least on-task pupils. For pupils aged 6–8, the baseline median on-task behavior was recorded as being 50.0% during the first 16 minutes, and increased to 59.38% during the second 16 minutes. After the intervention, the median for the first 16 minutes (50.0%) increased to 68.75% during the second 16 minutes. Obviously, there was an increase of on-task behavior after the intervention. For pupils aged 8–10, there was a significant difference in baseline on-task behavior during the first 16 minutes (56.25%) and second 16 minutes (78.13%). The same result was reflected after the intervention, where on-task behavior increased from 62.5% during the first 16 minutes to 68.75% during the second 16 minutes.

As mentioned in the previous subchapters, this part of the experiment proves that the inclusion of classroom-based physical activity has good effects on the academic performance of students, such as their on-task behavior. Teachers' perceptions of their pupils' on-task behavior may have important repercussions on teachers' behavior in the classroom and their instructional strategies. For instance, as reported by Rimm-Kaufman and Associates (2000), teachers express concerns that many of their pupils have difficulties following instructions

and completing tasks independently, and have inadequate academic abilities. Hence, pupils without adequate social learning and academic abilities (i.e. on-task behavior) are more likely to fail early on as their teachers may look for a specific degree of social skills deemed crucial to successful academic learning. Perceptions and expectations of teachers have vital impacts on children about their academic performance. This is because these perceptions concern offering positive, comprehensive training for pupils with specific or special requirements. Attempts to help children be sufficiently "ready" for school may be strengthened by incorporating physical activity in their respective classrooms.

6.8 Effects of a 5-minute classroom-based physical activity on physical activity volume

In this section, results indicate that physical activity of pupils seems to decrease as the school year progresses. Results of the implementation of classroom-based physical activity indicate that for both groups of participants, there is a significant increase or improvement in physical activity volume and energy expenditure during the school day. Improvement is more noticeable for pupils whose age falls between 6–8 years old, while implementation of classroom-based physical activity increases physical activity levels of pupils whose age fall between 8–10 years old to a lesser extent.

The fact that physical activity level only increases after the intervention implies that pupils performing a 5-minute classroom-based physical activity achieved greater physical activity volume and energy expenditure during the school day.

This links the incorporation of classroom-based physical activity and physical education to the nourishment and proper health of pupils. This subchapter elaborates on this implication, because it is important to realize the positive effects of incorporating physical activity and physical education in every academic institution.

Education is basically understood as a process of acquiring knowledge. The knowledge being acquired here is a broad knowledge that includes not only reading and writing but also cognitive, academic and technical skills. One issue that challenged the notion that education needs to take place in a traditional classroom set-up is the incorporation of physical education amidst the growing demand in primary subjects, such as mathematics, science, and English. In the past decades, the educational institution used the cascade model, where physical education was taken for granted, and sometimes not required to be included in the schools. In contrast to this model, many scholars are advocating the inclusion of physical

education or even classroom-based physical activity. While there is an incomplete and unbalanced body of knowledge in the empirical literature on the effectiveness of this program, its influence on individuals, student insights regarding this model, and challenges teachers experience using this model, the advantage of inclusion in education surpass its shortcomings, and it thus needs to be strictly adopted nowadays.

Pertinent data showed that incorporating physical activity in the classroom is an effective means of educating and at the same time helping the teachers and students. Specifically, empirical data showed that students have higher or better on-task behavior than those who have no physical activity within the classroom. The interaction of these students with their peers and the improved cognitive skills within the classroom are all positive factors that help the individual to achieve his optimum potential. Given this fact, future studies should focus on improving the constructive aspect of education. By constructivism, this means the basic theory of cognition that provides inference on how the mind operates and how we understand things. The new educational institution should see to it that the framework or method of teaching being used inside the classrooms is not obsolete. This is where the role of teachers comes in. The teacher is the epitome of "knowledge": they deliver or pass the knowledge to their learners. In the case of inclusion of physical activity and physical education, teachers should always give importance to the effects of such activity not only to students but also to teachers. Incorporating physical education should call the attention of parents, teachers and school staffs to develop mission, vision and strategic planning of achieving it based on the school culture the school wishes to embrace. The whole idea of incorporating physical activity in the classroom goes beyond the pedagogical aspect of the issue.

Analyzing the impact of physical activity through these perspectives and the effects on the participants helped in attaining an understanding on how such activity affects students, parents, and teachers. The positive effects of the experiment on the participants matched the impact of incorporating classroom-based physical activity through an academic perspective in the postmodern era. One important academic dimension of this study is the reinforcement and promotion of classroom-based physical activities to the current education system, which enabled students to perform better in academic work and improved "lifestyle behaviors and physical health status measures" (Dobbins et al., 2009). In addition, since more parents and teachers desire and require their children/pupils to stay physically fit, classroom-based physical activities had the capacity to fulfill this by ensuring that children avoid obesity, being overweight, and the risk of chronic diseases (Dobbins et al., 2009, p. 5).

According to the World Health Organization, health is a state of complete physical, mental and social wellbeing and not merely the absence of disease (Population Reference Bureau, 2008). This definition that does not tend to concentrate on specific observations. In reality, information about health is gained by observing the mortality and morbidity among groups of individuals over specific periods. The balance between physical, mental and social wellbeing is inferred from analysis of data relating mortality and morbidity, and provided information about the causes of death, the high risk, advance treatment, prevention and specific health counseling. One of the best ways to improve physical wellbeing is to maintain good eating habits and physical activity levels. However, due to various different factors, a large portion of the population is affected by poor physical activity habits that contribute to obesity and being overweight or underweight. There is a significant difference between the percentage of children, teenagers and adults that were affected by obesity and being overweight or underweight.

The physical condition of children inside the school is very important. As a matter of fact, school readiness involves at least five specific domains: 1) social and emotional competence, 2) physical health and wellbeing, 3) language and communication skills, 4) learning style, and 5) cognition and general knowledge. Physical health and wellbeing is ranked as the second most important factor that parents should consider in enrolling their children. Physical health and wellbeing includes components such as self-care abilities, disabilities, medical conditions, physical fitness, and motor skills.

A number of researchers emphasize that having healthy and normal physical development and motor coordination was also crucial to school readiness. Lewitt and Baker (1995) found that at least 75% of teachers perceive physical wellbeing as an important component of school readiness. They also perceive physical health and good motor coordination as well as the capacity to follow instructions and communicate skillfully with peers and adults as vital abilities children should have in order to succeed in formal schooling. Most of these teachers do not regard cognitive or academic abilities, even language acquisition, as key school readiness domains.

The dimensions of school readiness that teachers believe are more important include social competence, language development, and physical health and wellbeing (e.g. self-care abilities). Physical wellbeing and motor coordination skills including physical endurance and healthy physical growth; other skills concern listening and visual capacity, which play an essential part in learning to read and write. Teachers' perceptions of readiness may have important repercussions on teachers' behavior in the classroom and their instructional

strategies. As reported by Rimm-Kaufman and Associates (2000), teachers express concerns that many of their pupils have difficulties following instructions and completing tasks independently, and have inadequate academic abilities.

Overall, this section of the study discovered that teachers give greater value to training children to meet the school's social needs than on early academic abilities. The teachers emphasized their preference for programs that focus on the capacity of children to follow instructions, socialize, express themselves, and relate to others. This was successfully carried out during the experiment. Furthermore, as discovered in this study, teachers highly expect students to show self-discipline in the classroom, completing activities and sitting silently, all of which can positively impact academic performance. In the study conducted, all teachers agreed that the inclusion of classroom-based physical activity helped the pupils to achieve these goals.

7. CONCLUSION

A large amount of research has been carried out to investigate whether classroom-based physical activity affects the academic performance of students. The results of this study have certainly provided students, teachers, and academic practitioners with a better understanding of the effects of a 5-minute classroom-based physical activity.

With the advent of new and better technologies, there is an increasing preference of students to engage in online games instead of outdoor physical activity. The effects gained by students who engaged in classroom-based physical activity were found to be diverse, primarily due to different ages of samples, structure, and duration of physical activities, though there was agreement about some aspects of the experiment. The results of the study were particularly important in understanding the effects, types of challenges experienced, and perceptions of students in the course of engaging classroom-based physical activities.

The results of this study and discussion above indicate that 5-minute classroom-based physical activity can improve the following and thus improve school readiness of pupils:

1. Motivational and social skills: focus, attention, attitude, motivation. Self-esteem and self-awareness should help the child adjust effectively and confidently to the present social circumstances, and view him/herself as part of a larger group and as an individual.
2. Cognitive skills: ability to critically and logically think or evaluate, vital memory capacities, auditory and visual skills, and ability to create and understand concepts, particularly those related to objects and numbers.
3. Physical wellbeing and motor coordination skills, including physical endurance and healthy physical growth.

In addition, teachers who participated in the investigation agreed that incorporating five-minute classroom-based physical activity offers a learning opportunity, specifically perceiving it as a tool for improved learning. Meanwhile, no teachers perceived the incorporation of classroom-based physical activity as a contributor of learning deficiency.

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9. APPENDIX

Appendix 1. Conceptual definitions

Academic Performance is used broadly to describe different factors that may influence student success in school. They are grouped into three primary areas (Rasberry et.al., 2011): Cognitive Skills and Attitudes, Academic Behaviors and Academic Achievement.

Academic behaviors include a range of behaviors that may have an impact on students' academic performance. Common indicators include on-task behavior, organization, planning, attendance, scheduling and impulse control.

On-task behavior is verbal or motor behavior that is following the class rules and was appropriate to the learning situation. Additionally, on-task behavior pertains to "children's classroom skills including the ability to work independently and to attend to teacher directed activities". It also includes "student behavior such as eye contact with the teacher, working quietly, and appropriately orienting to a task" (Clare, Jenson & Bray, 2000, p. 517)

Classroom-based physical activities are short physical activity breaks (5-20 minutes) during academic lessons in classroom. They are either design to promote learning through physical activity or provide pupils with a pure physical activity break.

Physical activity is defined as any bodily movement produced by contraction of skeletal muscle that increases energy expenditure above resting level (Physical Activity Guidelines Advisory Committee, 2008)

MET refers to "metabolic equivalent", a unit used to estimate the metabolic cost of physical activity. The value of 1 MET is approximately equal to a person's resting energy expenditure.

Appendix 2. Timetable of on-task behavior assessment

	1A	1B	2B	2C	3A	3B	4A	4B
Week 1	20.1._8:50	20.1._8:50	23.1._8:00	23.1._8:00	20.1._8:50	20.1._8:50	22.1._8:00	22.1._8:50
Week 2	29.1._8:50	29.1._8:50	28.1._8:00	28.1._8:00	27.1._8:50	27.1._8:50	30.1._8:50	30.1._8:50
Week 3	4.2_8:50	4.2_8:50	3.2._8:50	3.2._8:50	6.2._8:50	6.2._8:50	5.2._8:00	5.2._8:00
Week 4	12.2_8:00	12.2_8:00	10.2._8:50	10.2._8:50	13.2._8:50	13.2._8:50	11.2._8:50	11.2._8:50
Week 5	18.2_8:50	18.2_8:50	19.2._8:00	19.2._8:00	17.2._8:50	17.2._8:50	20.2._8:50	20.2._8:50
Week 6	24.2_8:50	24.2_8:50	27.2._8:00	27.2._8:00	26.2._8:50	26.2._8:50	25.2._8:50	25.2._8:50
Week 7	5.3._8:00	5.3._8:00	4.3._8:00	4.3._8:00	6.3._8:50	6.3._8:50	3.3._8:00	3.3._8:00
Week 8	12.3._8:00	12.3._8:00	11.3._8:00	11.3._8:00	13.3._8:50	13.3._8:50	10.3._8:00	10.3._8:00
Week 9	19.3._8:00	19.3._8:00	18.3._8:00	18.3._8:00	20.3._8:50	20.3._8:50	17.3._8:00	17.3._8:00
Week 10	27.3._8:00	27.3._8:00	26.3._8:00	26.3._8:00	24.3._8:50	24.3._8:50	25.3._8:50	25.3._8:50
Week 11	1.4._8:50	1.4._8:50	31.3._8:50	31.3._8:50	2.4._8:50	2.4._8:50	3.4._8:50	3.4._8:50
Week 12	7.4._8:50	7.4._8:50	8.4._8:00	8.4._8:00	9.4._8:50	9.4._8:50	10.4._8:50	10.4._8:50

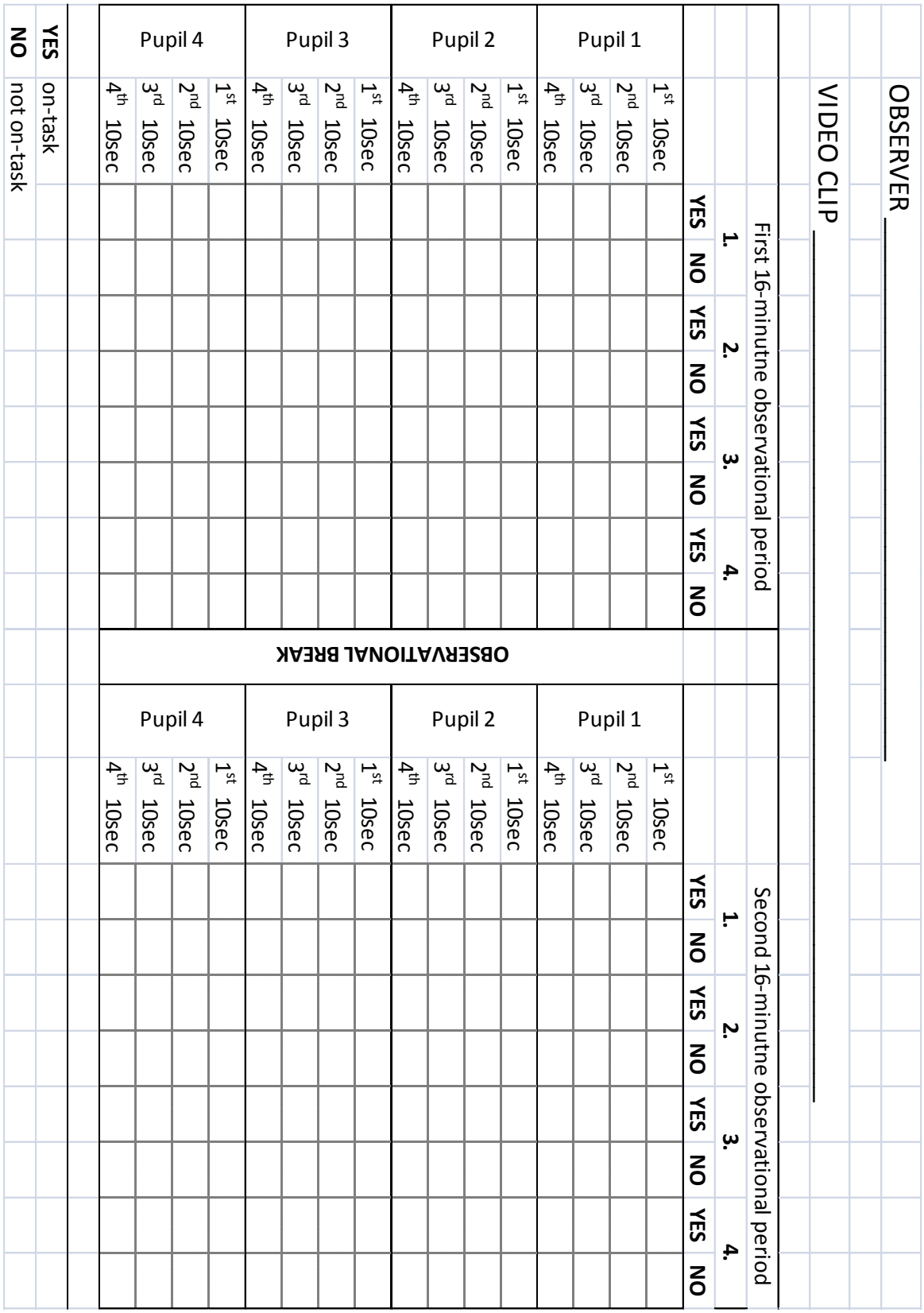
(bold box) - Assesment of physical activity volume and energy expenditure

date_time - date and time of on-task assesment

* Non-shadowed parts represent the baseline period (no intervention) and shadowed parts represent the intervention period

Appendix 3. A screenshots of video recording used for on-task behavior assessment

Appendix 4. On-task behavior assessment list



10. AUTHOR BIOGRAPHY AND PUBLICATIONS

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WORK EXPERIENCE

2015. – Research Associate, University of Zagreb, Faculty of Kinesiology

Jan – Sep 2014. University Assistant, University of Zagreb, Faculty of Kinesiology

2013. – 2015. Professional Associate, University of Zagreb, Faculty of Kinesiology

2012. – 2013. Sport program manager, Kindergarten "Remetinec" and "Lanište"

2011. – 2012. Physical Education Teacher, Elementary School F.Frankopan, Brod na Kupi

EDUCATION

2011 – Present Doctoral study of Kinesiology, University of Zagreb, Faculty of Kinesiology

2005. – 2010. Master's Degree in Kinesiology, University of Zagreb, Faculty of Kinesiology

RESEARCH INTERESTS AND ACTIVITIES:

He published eight research papers in scientific journals and 20 research papers and abstracts in scientific conference proceedings. He is a research associate on three international research projects. He presented six paper presentations and participated in over 10 scientific conferences. He is a member of Scientific Committee at Global Forum for Physical Education Pedagogy 2016. He was a keynote speaker at IV. Croatian Congress of School and University medicine and a member of Working Committee at 12th and 13th International Conference „Physical Conditioning 2014 & 2015".

AWARDS AND ACHIEVEMENTS:

He was awarded full scholarship for gifted students during undergraduate and graduate university study of kinesiology by Ministry of Science, Education and Sport, Republic of Croatia which he finished in top 10% of most successful students (grades average 4,78). He was awarded for best professional paper at 20th Summer school for Kinesiology in 2010. He was second on the list of applicants for Doctoral study of kinesiology at which he is doctoral candidate (grades average 5,0).

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