VZTAH MEZI POHYBOVOU AKTIVITOU A KOMPONENTAMI ZDRAVOTNĚ ORIENTOVANÉ TĚLESNÉ ZDATNOSTI U DĚTÍ VE VĚKU 9 – 11 LET

THE RELATIONSHIP BETWEEN PHYSICAL ACTIVITY AND HEALTH-RELATED PHYSICAL FITNESS COMPONENTS IN 9-11-YEAR-OLD CHILDREN

D. Bešič & V. Balaban

Palacký University Olomouc, Faculty of Physical Culture, Department of Adapted Physical Activities

ABSTRACT

Regular participation in physical activity (PA), good level of physical fitness (PF) and normal value of body mass index (BMI) provide important health benefits for children and adolescents. Many studies were already carried out with purpose to investigate relationships among these health related variables but very few were conducted on children aged 9-11 years. The primary aim of this research was to investigate and present the relationships between different components of health related physical fitness (HRPF), BMI and different levels of children's physical activity. The secondary aim was to examine gender differences in BMI, PA levels and components of the HRPF. The study sample includes 174 children aged 9-11 years (90 boys and 84 girls) who attended two primary schools in Olomouc, Czech Republic. The components of health related fitness were assessed by FITNESSGRAM® test. Physical activity levels were monitored by accelerometers. Boys had higher BMI, spent more time in vigorous physical activity (VPA) and showed better results in HRPF tests than girls. The greater correlation coefficient in both genders was found in association between the time children spent in VPA and results from PACER test ($r = 0.98$). Children who spent more time in VPA are more likely to have better cardiorespiratory fitness. There is a need for constant or frequent identification of children with signs of poor HRPF, abnormal BMI values or insufficient activity at early stages of their development.

Keywords: motor test; middle childhood; physical activity; health

SOUHRN

Hlavním cílem této studie bylo zkoumání a prezentace vztahů mezi rozlišnými komponentami zdravotně orientované zdatnosti, BMI a různými úrovněmi pohybové aktivity u dětí. Dílčím cílem bylo zkoumání intersexuálních rozdílů mezi sledovanými proměnnými. Studie se zúčastnilo celkem 174 dětí (90 chlapců a 84 dívek) ve věku 9-11 let ze dvou základních škol v Olomouci (Česka republika). Úroveň zdravotně orientované zdatnosti u výzkumného souboru byla zjišťována pomoci FITNESSGRAM® testu, zatímco úroveň pohybové aktivity byla sledována pomoci přístroje akcelerometr Actigraph. Kromě rozdílu v čase stráveného v pásmě lehké a střední intenzitě pohybové aktivity. Mezi chlapci a dívkami byly nalezeny signifikantní rozdíly u všech sledovaných proměn kromě času stráveného v pásmu lehké a střední intenzitě pohybové aktivity. Výsledky testu kardiorespirační zdatnosti ukázaly, že 98 % dětí z této studie dosáhlo zóny zdravotně orientované zdatnosti, která je doporučen FITNESSGRAMEM®. Na závěr dodáváme, že je důležité trvale sledovat úroveň zdravotně orientované zdatnosti a pohybové aktivity u dětí, protože jsou významnými ukazateli jejich zdravého růstu a rozvoje. Důležitě je trvale sledovat a identifikovat úrovně zdravotně orientované zdatnosti a pohybové aktivity u dětí, protože jsou ony významným ukazatelem zdravého růstu a rozvoje.

Klíčová slova: motorický test; střední školní věk; pohybová aktivita; zdraví

Introduction

Numerous studies have already documented how regular physical activity (PA), good physical fitness (PF) and normal value of body mass index (BMI) provide important health benefits for children and adolescents (Howley & Thompson, 2012; Paffenberg & Lee, 1996; Smith et al., 2014; Warburton, Nicol, & Bredin, 2006; WHO, 2007). These facts also indicate that both, the level of PA and the level of PF could be used as good predictors of an individual's health status (De Araujo et al., 2015; Tell & Vellar, 1988). Although they present two different meanings, the terms PA and PF are often used as the equivalents (Plowman & Meredith, 2013). Caspersen et al. (1985) defined PA as any bodily movement produced by skeletal muscles that results in energy expenditure. To achieve health benefits from PA most national guidelines of the EU countries recommended at least 60 minutes of MVPA each day for children and adolescents (Kahlmeier et al., 2015; WHO, 2010). Sigmund and Sigmundová (2014) suggest that children aged 6 to 11 years should be involved in PA of moderate intensity for at least 90 minutes daily. Howley and Thompson (2012) described term physical fitness as a set of health- or skill-related attributes that can be measured by specific test. According to Howley and Thompson these two attributes are two main parts of PF. Health-related physical fitness (HRPF) is a complex issue that consists of components associated with good health (Plowman & Meredith, 2013). Those components are: body composition, cardio-respiratory fitness, muscular strength and endurance, and flexibility (Caspersen et al., 1985). Considering that PA, HRPF and BMI could affect health in many ways (Plowman & Meredith, 2013), it is important to determine how those factors correlate between each other and whether the change in one is followed by any changes in other two components. Many studies were already carried out with purpose to investigate these relationships but very few of them were conducted on children aged 9-11 years.

Cardio-respiratory fitness (CRF) is one of health-related fitness components (Warburton, Nicol, & Bredin, 2006) which more than other affects health (Boreham & Riddoch, 2001). Relationship between CRF and habitual PA is already documented, but strength of this relation differs from study to study. Ortega et al. (2008) consider that this association mainly depend on intensity of PA. Findings from a longitudinal study conducted by Baquet et al. (2006) correspond with previous statement and show that those children who were more physically active and reached a higher level of PA, had a better level of CRF (Baquet et al., 2006). Bürgi et al. (2011) conducted longitudinal study on preschool children and found a strong relation between VPA and CRF. Gutin et al. (2005) suggest that improvement in CRF in youth depend on time that they spent in MVPA. In study conducted by Dencker et al. (2006) the strongest correlation occurred among VPA and CRF in children 8-11 years old. In the study conducted by Ruiz et al (2006) beside VPA also MPA was correlated with CRF. Froberg (2014) reported association between isometric strength of abdomen and back and cardiovascular diseases in children. Froberg also noted that greater strength in this two regions is followed up by better cardiovascular condition. Froberg mentioned that CRF can be used as a predictor of changes in child's amount of body fat throw childhood. De Moraes et al. (2015) found weak and moderate negative associations between MPA, VPA and the body composition in boys and weak negative correlation between VPA and body composition in girls. Ruiz et al. (2006) found significant inverse correlation between VPA and body fat in children 9-10 years old. They conclude that those children who spent more time in VPA had lower level of body fat. WHO (2010) reported that children who were more physically active, have higher level of CRF, show better muscular strength and endurance, have lower rates of body fat and also show the other well-documented health benefits from PA than inactive children. After conducted 3-years longitudinal study on 11-19 years old participants, Aires et al. (2010) find out how PA influenced CRF while at the same time CRF affected BMI. In the same study Aires et al. did not found significant correlation between PA and BMI.

The main aim of this study was to examine relationships between components of health related fitness, different levels of physical activity and BMI in children 9-11 years old. The secondary aim was to investigate gender differences in relation to variables used in this study.

Methods

Participants

A cross-sectional mode was performed to collect data in this study. The target group were elementary school-aged children from two public schools located in the city of Olomouc in Czech Republic. A total of 174 children (90 boys and 84 girls) aged 9-11 years, were enrolled in this study.

Physical activity

The Actigraph models GT3X and GT3X+ are used in this study to assess child's physical activity behavior. Both devices are light and of small size thus appropriate to be used in a research like this, especially for testing child's PA (Hänggi, Phillips, & Rowlands, 2012; John & Freedson, 2012). Children were instructed to wear the Actigraph on a hip during the entire day, from waking up and to have it removed before going to sleep. Additionally, they were allowed to take off the device during the daily activities that could potentially damage it (Godfrey et al., 2008). Only data from children who wore the accelerometer at least ten hours a day (Cain et al., 2013), for four consecutive days, including one weekend day (Corder et al., 2008) were taken into consideration. Trost et al. (2000) found out that PA monitoring in duration between 4 and 5 days in children grades 1-6 offer reliability coefficient of 0.80 compared to the 7 days monitoring. Freedson physical activity cut-off points for children are used to determine physical activity intensity (Freedson, Pober, & Janz, 2005). According to them, cut-off points were as follows: light intensity, 150-499 counts min^{-1}; moderate intensity, 500-3 999 counts min^{-1}; vigorous intensity, 4 000-7 599 counts min^{-1}; and very vigorous intensity, $> 7\,600$ counts min^{-1}. For the purpose of this study values of child's PA at the levels of vigorous intensity and very vigorous intensity are united and presented as one value. So in total three different levels of the PA are used as outcome variables derived from the Actigraph: light intensity of physical activity (LPA), moderate intensity of physical activity (MPA) and vigorous intensity of physical activity (VPA). Accelerometers were set to record movement counts in 1-min epochs.

Body mass index

For the purpose of obtaining data in relation to child's BMI the body composition analyzer InBody 720 was used (Biospace Co., Ltd.; Seoul, Korea). Prior the measurement of BMI, child's body height was obtained by using portable anthropometer P 226 (Trystom; Olomouc, Czech Republic) to the nearest 0.5 cm. Body weight was measured by using DSM-BIA device to the nearest 0.1 kg. During the measurement children were in standing position, barefoot and lightly dressed. Weight status was classified as normal, underweight and overweight/obese using international age- and sex-specific BMI cut-off points (Cole, 2000; Cole, 2007).

Health-related physical fitness

For the purpose of assessing child's health-related physical fitness three tests from FITNESS-GRAM® are used in this study. FITNESSGRAM® represents widely used set of tests for estimation level of health related fitness in youth (Plowman & Meredith, 2013). Progressive Aerobic Cardiovascular Endurance Run (PACER) multistage test was conducted to estimate aerobic fitness in children. It involves running back and forth across a 20-meter course in time to music played from an audio recording. Beeps on the sound track indicate when a person should reach the end of the course. The test begins at a slow pace, and each minute the pace increases. A participant continues running until the pace can no longer be maintained (Plowman & Meredith, 2013).

To assess child's upper body strength and endurance 90° push-up test is administered. The task for children was to complete as many push-ups as possible in time specified by audio signal (Meredith & Welk, 2010). During every repetition child should maintain correct body position with a straight back and legs. Every push-up consists of two movements. Participant lowers the body using the arms until the elbows bend at a 90° angle and the upper arms are parallel to the floor. Then should push up and continue the movement until the arms are straight (Plowman & Meredith, 2013).

The curl-up assessment from FITNESSGRAM® was used to estimate child's abdominal strength and endurance. The test begins from a lying position with the knees bent at an angle of approximately 140°, and arms placed by side on the floor. Participants have a task to make as many repetitions as possible up to 75 according to an audio signal (Plowman & Meredith, 2013).

Based on the results from FITNESSGRAM® tests it is possible to classify participants into Healthy Fitness Zones (HFZs) or Needs Improvement Zones (NIZs) considering their gender and age. According to FITNESSGRAM® manual, if a child reach HFZ it means that he has a low risk of metabolic syndrome and has a good level of fitness (Plowman & Meredith, 2013).

Prior to the commencement of testing, children were informed about procedure for each FITNESS-GRAM® test. They wore appropriate sports clothes and shoes and during these tests they were motivated to give their best and get the highest score.

Statistics

Descriptive statistics (percentage, means and standard deviations) are calculated to describe the sample characteristics. Independent t-test was performed to determine gender differences in relation to all variables. Pearson's correlation coefficient was run for the purpose to assess relationships between PA levels (the time children spent at various PA intensities) and health-related physical fitness components. The strength of the linear association between observed values is evaluated by Cohen's criteria: $0.1 \leq r < 0.3$ = small; $0.3 \leq r < 0.5$ = medium; $r \geq 0.5$ = large (Cohen, 1992).

Results

In the Table 1 are presented values regarding to all variables for both genders. The results from t-test show that there were no significant differences between boys and girls in relation to the time spent in LPA ($t = -1.63$, $p = 0.10$) and MPA ($t = -0.3$, $p = 0.76$). A significant difference between genders were found in the relation to all other variables used in this study. Results from this study showed that boys had a greater BMI than girls ($t = 3.79$, $p = 0.0001$) and also spent significantly more time in VPA ($t = 3.46$, $p = 0.0006$). From three FITNESSGRAM® tests that are used in this study, the biggest gender difference has occurred in relation to the results from PACER test ($t = 4.33$, $p = 0.00002$). Boys showed significantly better results in 90° push-up test ($t = 2.32$, $p = 0.02$) and in the curl-up test too ($t = 2.44$, $p = 0.01$).

Tabulka 1./ Table 1.
Charakteristiky vzorku ve vztahu k Indexu tělesné hmotnosti, Úrovni pohybové aktivity a Komponent zdravotně orientované zdatnosti představených pomoci Aritmetického průměru a Směrodatné odchylky./ Characteristics of the Sample in Relation to Body Mass Index, Physical Activity Levels and Components of the Health Related Fitness presented as Mean and Standard Deviation.

	Boys (N 94)	Girls (N 80)	Total (174)
BMI	17.56 (2.13)	16.45 (2.05)	17.08 (2.16)⋆
LPA	133.51 (27.11)	138.76 (19.2)	135.87 (23.97)
MPA	189.69 (46.05)	191.58 (46.07)	190.54 (45.96)
VPA	13.63 (10.85)	9.32 (6.69)	11.69 (9.44)⋆
Curl-up Test	36.87 (21.03)	29.61 (19.83)	35.54 (20.76)⋆
90° push-up	5.24 (4.26)	3.84 (3.73)	4.61 (4.25)⋆
PACER	34.40 (12.55)	27.32 (8.11)	31.15 (11.28)⋆

Legenda./ Note. N – počet dětí; BMI – index tělesné hmotnosti; LPA – mírná intenzita PA; MPA – střední intenzita PA; VPA – vysoká intenzita PA; PACER – vytrvalostní člunkový běh; ⋆$p < 0.05$./ N - number of children; BMI - body mass index, LPA - light physical activity; MPA - moderate physical activity; VPA - vigorous physical activity, PACER - progressive aerobic cardiovascular endurance run, ⋆$p < 0.05$.

In the table 2 are presented percentages of children with different levels of BMI and also children that are reached HFZ established by FITNESGRAM. Almost 20 % of boys were recognized as obese or overweight while 26 % of girls showed signs of underweight. Results from curl-up test showed that 96 % of all children reached HFZ recommended by FITNESSGRAM®. Data from this study revealed that 63.5 % of all children did not meet HFZ established by FITNESSGRAM® in relation to push-up test. Good results in PACER test showed 98% of the children. All participants reached recommendation

of at least 90 minutes of physical activity performed at the level of moderate intensity (Sigmund & Sigmundová, 2014).

Tabulka 2./ Table 2.
Procenta dětí ve vztahu k Indexu tělesné hmotnosti a dětí splňujících Zónu zdravotně orientované zdatnosti (ZZOZ) doporučenou FITNESSGRAMEM®./ Percentage of the Children in Relation to the Body Mass Index (BMI) and Children who reached Healthy Fitness Zone (HFZ) recommended by FITNESGRAM.

	Boys (N 94)	Girls (N 80)	Total (174)
Normal BMI	74 %	63 %	70 %
Obese/Owerweight	19 %	11 %	15 %
Underweight	7 %	26 %	15 %
Curl-up Test HFZ	94 %	95 %	94.5 %
90° push-up HFZ	37 %	31 %	34.5 %
PACER test HFZ	98 %	97 %	97.5 %

Legenda./ Note. BMI – index tělesné hmotnosti; HFZ – zóna zdravotně orientované zdatnosti./ BMI - body mass index; HFZ - healthy fitness zone.

Table 3 presents results of correlation with boys. The Pearson correlation coefficient revealed weak positive relationships between BMI and all of the three levels of PA in boys. Moderate negative relationship was found between LPA and PACER test ($r(92) = -0.42$, $p < 0.0001$). Between VPA and all of the three FITNESSGRAM® tests significant correlation was found. A small positive correlation between VPA and curl up test ($r(92) = 0.25$, $p = 0.01$) was noted. Moderate positive correlation was found between VPA and push up test ($r(92) = 0.33$, $p = 0.001$). The strongest correlation coefficient occurred between VPA and PACER test ($r(92) = 0.98$, $p < 0.0001$).

Tabulka 3./ Table 3.
Korelace mezi Časem tráveným v úrovně různých intenzit a Komponentami zdravotně orientované zdatnosti u chlapců./ Correlations Between the Times Spent at Various Intensity Levels and Health-related Physical Fitness Components in Boys.

	BMI	Curl-ups	90° push-ups	PACER
LPA	−0.25★	−0.16	−0.06	−0.42★
MPA	0.20★	0.08	0.02	0.05
VPA	18★	0.33★	0.26★	0.98★

Legenda./ Note. BMI – index tělesné hmotnosti; LPA – mírná intenzita PA; MPA – střední intenzita PA; VPA – vysoká intenzita PA; PACER – vytrvalostní člunkový běh; Hodnoty představující Pearsonův koeficient r, ★$p < 0.05$./ BMI - body mass index, LPA - light physical activity; MPA - moderate physical activity; VPA - vigorous physical activity, PACER - progressive aerobic cardiovascular endurance run, Values are presented as a Pearson's correlation coefficient r, ★$p < 0.05$.

In the Table 4 are presented results of correlation between variables with girls. Pearson's correlation coefficient revealed a small negative correlation between BMI and PACER test ($r(78) = 0.28$, $p = 0.01$) while between BMI and push-up test was found small positive relationship ($r(78) = 0.26$, $p = 0.02$). Moderate positive correlation was found between MPA and PACER test ($r(78) = 0.35$, $p = 0.002$). The time girls spent in VPA was positively correlated with all three FITNESSGRAM® tests. Between VPA and curl up test was found small positive relationship ($r(78) = 0.26$, $p = 0.03$) while between VPA and push up test a moderate positive relationship was found ($r(78) = 0.34$, $p = 0.004$). Also, with girls the strongest positive correlation was noted with VPA and PACER test ($r(78) = 0.98$, $p < 0.0001$).

Tabulka 4./ Table 4.

Korelace mezi Časem tráveným v úrovně různých intenzit a Komponentami zdravotně orientované zdatnosti u dívek./ Correlations Between the Times Spent at Various Intensity Levels and Health-related Physical Fitness Components in Girls.

	BMI	Curl-ups	90° push-ups	PACER
LPA	−0.31⋆	0.05	−0.06	0.17
MPA	−0.06	−0.03	0.08	0.35⋆
VPA	−0.38⋆	0.26⋆	0.34⋆	0.98⋆

Legenda./ Note. BMI – index tělesné hmotnosti; LPA – mírná intenzita PA; MPA – střední intenzita PA; VPA – vysoká intenzita PA; PACER – vytrvalostní člunkový běh; Hodnoty představující Pearsonův koeficient r, ⋆$p < 0.05$./ BMI - body mass index, LPA - light physical activity; MPA - moderate physical activity; VPA - vigorous physical activity, PACER - progressive aerobic cardiovascular endurance run, Values are presented as a Pearson's correlation coefficient r, ⋆$p < 0.05$.

Discussion

The evidence points to the difference of PA level between genders, where boys were more physically active than girls (Cooper et al., 2015; Riddoch et al., 2004;). The findings from current study only partially correspond with this suggestion. We have found that significant gender difference occurred only at the level of VPA. We want to mention that in most of the previous studies, when children's PA was examined, researchers have rarely taken into consideration different levels of PA (LPA, MPA, VPA). In the recent years children's PA decreased rapidly that implies children often failed to reach health related recommendation in most countries all around the world (Tremblay et al., 2014). It is interesting that all children in current study met both PA recommendations, of at least 90 minutes at the level of moderate intensity daily (Sigmund & Sigmundová, 2014) and recommendation used in most EU countries of at least 60 minutes of moderate to vigorous-intensity PA each day (Kahlmeier et al., 2015; WHO, 2010;). We suspect that this phenomenon has occurred due to lower physical activity cut-off points used in this study. Though Freedson's cut-off points are recommended for measuring child's PA, Trost et al. (2011) suggest that these cut-off points may enhance an overall time that children spend in MVPA. But considering that almost all of the children in the current study showed good performance in the PACER test, we assumed that PA cut-off points used in this study did not misinterpreted data. World Health Organization constantly warns that problems with overweight or underweight in childhood increase the risk of obesity, non-communicable diseases, premature death and disability in adulthood (WHO, 2014). Findings from our study confirmed the statement that boys constantly showed a greater BMI than girls (LeBlanc et al., 2015). The potential reason this occurred in our study is due to the fact that 26 % of girls were recognized as an underweight while on the other side 19 % of boys were obese or overweight. In our study boys showed significantly better performance than girls in all of the three FITNESSGRAM® tests. While both genders in current study achieved very good results in curl-up test, at the same time children have shown surprisingly poor performance in the test of upper body strength. Data point out that 22 % of the children were unable to perform even one push-up. The explanation why this weak performance occurred may be attributed to the fact that basic daily activities and modern life style do not offer enough possibilities for development of adequate upper-body strength. However, health benefits from muscular fitness are already known (Smith et al., 2014) and results from this study in regards to upper body strength are worrisome. Regarding the gender difference in relation to CRF results of our study confirmed the statements from Dencker et al. (2006) and Silva et al. (2011) that boys have a better VO2 capacity and show better results on PACER test than girls. We need to mention that participants of both gender achieved good results in the PACER test and all children met HFZ established by FITNESSGRAM®.

Very few of the previous studies examined associations between PA and components of HRPF in children. In most of the studies, when this issue was investigated, data were presented as a sum of HRPF components or children's PA is measured by a questionnaire which makes difficulties to compare their results with ours.

It is already well documented that association between PA and CRF exist. According to Baquet et al. (2006) and Aires et al. (2010) more time children spent in regular PA is guarantee for improvement in child's CRF. Also it is well known that vigorous intensity of PA offers additional health benefits for children (Janssen & LeBlanc, 2010). Ortega et al. (2008) reported that strength of this correlation depend mainly on the levels of PA what is clearly seen from the results of our study. Tucker et al. (2014) found an inverse correlation among sedentary behaviors and components of HRPF in children 11-15 years old. In our study we found an inverse relationship between LPA and HRPF components only in boys. With that being said our study revealed significant correlation between, less time boys spent in LPA and better results on the PACER test. In girls this correlation did not show inverse direction and also was not at significant level. The greatest correlation coefficient shown in our study was found in association between VPA and results from PACER test in both genders where correlation coefficient had the same value in both genders ($r = 0.98$).

Ruiz et al. (2006) reported that beside VPA, MPA also correlated with CRF. Our results correspond with their statement but only regarding to girls. There was no significant correlation of this kind in boys between MPA and CRF. Martinez et al. (2011) reported positive correlation between VPA and muscular fitness score in adolescents. To obtain muscular fitness score they computed scores from the three muscular tests which assessed upper body strength, abdominal strength and lower body strength. Aires et al. (2010) carried out a longitudinal study on the students aged 11-19 years and found a positive and significant correlation between index of PA and standardized scores derived from curl-up, push-up and PACER tests. All these findings imply that increasing time that children spent in VPA is followed by better performance in PACER test. Many studies reported inverse correlation between time children spend in moderate and vigorous PA and BMI (De Moraes et al., 2015; Ruiz et al., 2006; WHO, 2010). In most cases the strength of this correlation differ from study to study. Rauner, Mess and Woll (2013) noted that different strength and direction of the correlation between PA and BMI may be occurred due to the various methods for assessment of PA that are used in different studies. The same authors in their study added that even in case when PA is measured by objective methods, the correlation between different levels of PA and BMI are expected to show various strength. According to our results there is difference between gender in regards to direction and strength of the correlation between BMI and the time children spent in various levels of PA.

We want to underline that in this study has been assessed only a pure relationship between variables without taking into account the impact of a third variable. Under natural conditions the relationships between PA and HRPF components rarely occurs without impact of some other variable (Aires et al., 2010). It is already well documented how all of the variables used in this study play important role in maintaining healthy status in children (Howley & Thompson, 2012; Paffenberg & Lee, 1996; Smith et al., 2014; Warburton, Nicol, & Bredin, 2006; WHO, 2007). Therefore, constantly monitoring of these health related factors and proper selection of methods for assessment of PA levels, BMI and HRPF components could help in an early stage of detection of children with poor performance. Considering that negative effects of low fitness, insufficient PA or an anomalous BMI often explode in adolescence or even later in adulthood, the public actions should be directed on the prevention and establishing health-related physical activity habits already in childhood. To have an impact on child's overall health status, physical activity programs should be focused to improve not only the level of PA or CRF but also to enhance muscular strength and maintain normal BMI. We need to mention that despite the fact that ActiGraph provides an objective measure of child's habitual PA (Hänggi, Phillips, & Rowlands, 2012), the absence of universal PA cut-off points for children may put researcher in unenviable situation. Findings from this study suggest that in further research child's PA outcome needs to be presented not only at the level of MVPA but also in relation to all PA levels considering gender differences. Also, according to evidence, we strongly recommend that differences between boys and girls when components of HRPF are measured have to be taken into consideration.

There are few limitations of this study that should be mentioned. The sample used in the present study was small and in the purpose to obtain more objective data on correlations between PA, HRPF and BMI further research should be conducted on a larger sample size. Also there is a need for additional longitudinal research that could help in exploring the facts how these relationships are changed over the time.

Conclusion

The findings from the present study state that associations between PA and HRPF components in children are complex issues. The strength and direction of these correlations mainly differed among genders. The greater correlation coefficient in both genders was found in association between time children spent in VPA and results from PACER test ($r = 0.98$) what imply that more time children spend in VPA the greater is the level of cardio respiratory fitness. Impact of all variables used in this study on health status is well known. Therefore, there is a need for frequently identification of children with signs of poor HRPF or insufficient activity at early stages of their development.

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Mgr. Damir Bešič
Tř. Míru 644/113
Olomouc, 779 00
damir.besic01@upol.cz