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Relationship between Pupils' Functional Capacity and Physical Activity

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Abstract

The aim of this study was to determine the relationship between primary school pupils' physical activity and their functional capacity. Many people are unaware that health is the most important aspect of any person's life, and that it is closely associated with movement. In recent decades the number of obese people, children and adolescents has significantly increased. Furthermore, the modern lifestyle of children and young people increasingly lacks movement and participation in outdoor games, and it is prevailingly sedentary (TV, Internet, Play Station ...), which can have adverse effects on the development of children's abilities and skills as well as their health status. The present study included 80 third grade primary school pupils, 43 boys (mean age 9.30 ± 0.46 years) and 37 girls (mean age 9.29 ± 0.47 years). The pupils attended two primary schools in the town of Petrinja, namely the First Primary School and Primary School Dragutin Tadijanović. The survey was conducted in the school year 2014/2015. The sample of variables consisted of anthropometric measures of body height, weight, upper arm skinfold, back skinfold, and abdominal skinfold. Functional abilities were measured with a 3-minute running test - F3, which is used to assess the level of pupils' functional ability at the primary education level in the Republic of Croatia. The level of physical activity was estimated with the PAQ-C questionnaire.

Based on the obtained results, it is evident that, of the total sample, 60% of pupils have a normal percentage of body fat, while 40% of pupils have excessive body fat. The results of this study indicate a high percentage of pupils who are overweight. Functional capacity was inversely associated with obesity indicators, which means that pupils with high levels of functional capacity have a lower percentage of body fat. School age is the best time to stimulate and exert positive impact on children's

growth and development, especially since the opportunities missed at that age cannot be compensated at later stages of life.

Key words: *aerobic capacity; functional abilities; obesity; pupils; school.*

Introduction

The time spent in physical activity has significant impact on the future health of children and adolescents. Insufficient physical activity of children and adolescents has negative effects on the development of their abilities and knowledge, as well as their health status. Physical activity is an important factor in achieving the optimal state of health, in addition to reducing the risk of various diseases, as confirmed by numerous studies conducted around the world (Blair, 1996; Eyler et al., 2003; Lee & Paffenbarger, 2000). The assessment of the level of physical activity today is considered the first stage in introducing intervention measures that can contribute to the health of the entire population (Dishman, Washburn, & Heath, 2004).

Some studies have shown that overweight participants had poorer results on the cardiorespiratory tests than the slimmer ones. Furthermore, low to moderately high inverse correlation between cardiorespiratory fitness and body fatness (Ara et al., 2007; Winsley et al., 2006) was demonstrated. Davidson et al. (2013) have shown in their research that increased body mass in children and adolescents is associated with overall pulmonary volume decrease, increased respiratory symptoms, and reduced functional status. Regular physical activity helps to achieve an optimal health condition, reduces the development of a number of chronic diseases (Blair, Cheng, & Holder, 2001), and can help prevent many diseases such as type 2 diabetes, cardiovascular disease, obesity, as well as some types of cancer (Warburton, Nicol, & Bredin, 2006). The aerobic capacity (VO2max) refers to the intensity of the aerobic process and indicates the maximum capability for transfer and usability of oxygen during exercise with increasing intensity (Shete, Bute, & Deshmukh, 2014), and is one of the key markers (along with blood pressure and heart rate) in cardiorespiratory fitness assessment (Magutah, 2013). Higher values of aerobic capacity in childhood and adolescence are strongly associated with a person's current health, but are also a significant predictor for the future (Ortega et al., 2011; Ruiz et al., 2007). Low levels of cardiorespiratory fitness and obesity in adolescence are associated with a higher risk of mortality in adulthood (Apor, 2011). It is also well known that cardiorespiratory fitness is an independent determinant of a healthy lifestyle (Ferreira, Twisk, van Mechelen, Kemper, & Stehouwer, 2005).

The aim of this research was to establish the correlation between physical activity and functional capacity in primary education pupils.

Research Methods

Research participants were 80 third grade primary school pupils, 43 boys (mean age 9.30 ± 0.46 years) and 37 girls (mean age 9.29 ± 0.47 years). The pupils attended two primary schools in the town of Petrinja (First Primary School and Primary School

Dragutin Tadijanović). The research was conducted in the school year 2014 / 2015. All pupils were healthy and, in accordance with the Code of Ethics for Research Involving Children, parents' consent was obtained for their participation in research. Variables in this research were anthropometric measurements of body height, body weight, upper arm skinfold, back skinfold, and abdominal skinfold. All measurements were implemented according to the International Biological Program (IBP). Body height was measured using anthropometers, and digital scales were used to measure body mass. Skinfolds were measured with Lange Skinfold Calipers. Functional abilities were tested by a 3-minute running test - F3, a standard test used to assess the level of functional abilities in primary education in the Republic of Croatia (Findak et al., 1996).

Body mass index (BMI) was calculated as a ratio of body weight and body height squared (kg / m^2=weight (kg) / height (m^2)). The sum of back skinfold and the upper arm skinfold according to Slaughter's Equation (Slaughter et al., 1998) was used for the estimation of body fat percentage.

Classification of research participants according to the percentage of body fat was done according to McCarthy, Cole, Fry, Jebb, and Prentice (2006) with defined centile curves specific for children with respect to gender, age and normal body weight (normal weight: 2-85 centiles), excessive body fat (overweight: 85-95 centiles) and obesity (obese: over 95 centiles).

The level of physical activity was estimated by the PAQ-C questionnaire (Crocker et al., 1997). It was designed for younger school-aged children (8 to 14 years old). The aim of the questionnaire is to estimate the overall level of pupils' physical activity over the past seven days. The questionnaire consists of 9 questions, and the overall result of physical activity is predicted on the basis of arithmetic mean of the responses evaluated on the Likert type scale (1 to 5), where 1 indicates a low level of physical activity and 5 indicates a high level (Kowalski, Crocker, & Donen, 2004). Pupils also evaluated the time they spent in front of television and on the internet.

Data processing was done with STATISTICA (data analysis software system), version 7.1. For all of the investigated variables basic descriptive parameters were calculated: arithmetic mean (M), standard deviation (SD), minimum (MIN) and maximum (MAX) result, and skewness and kurtosis.

T-test was used to calculate the significance of the difference between the functional capacities in the subsamples defined according to physical activity level. Relationship between functional capacity and body mass index were determined by Pearson correlation coefficient. Statistical significance of differences was tested at the significance level $p<0.05$.

Results

The results (Table 1) show descriptive parameters of anthropometric measurements and functional abilities as well as the level of pupils' physical activity.

Table 1

Descriptive indicators for the total sample of pupils

	N	M	SD	MIN	MAX	SKEW	KURT
Body height	80	140.96	8.17	126.00	156.00	0.13	-0.97
Body weight	80	37.25	9.58	21.00	63.00	0.96	0.37
Body mass index	80	18.56	3.52	12.57	29.84	0.91	0.69
Back skinfold	80	13.55	8.96	4.00	50.00	1.59	3.00
Upper arm skinfold	80	16.25	7.18	5.00	35.90	0.90	0.32
Abdominal skinfold	80	13.07	9.33	2.30	39.90	1.10	0.39
Body fat percentage	80	25.62	11.04	9.61	63.38	1.16	1.32
3-minute run	80	481.81	90.31	295.00	755.00	0.19	0.24
Time spent in front of TV	80	2.91	1.06	1.00	5.00	0.51	-0.57
Time spent on the internet	80	2.24	0.98	1.00	5.00	0.89	0.80
Physical activity	80	2.90	0.61	1.45	4.08	-0.12	-0.51

N= number of participants; M= arithmetic mean; SD= standard deviation; MIN= minimum result; MAX= maximum result; SKEW= skewness; KURT= kurtosis

The results presented in Table 1 show descriptive parameters for the total pupil sample. The results for skewness and kurtosis show normal distribution, except for the variable back skinfold, where a more pronounced flattening of distribution is observed.

Table 2

Descriptive indicators for boys

	N	M	SD	MIN	MAX
Body height	43	140.74	7.83	127.00	156.00
Body weight	43	36.09	7.83	25.00	63.00
Body mass index	43	18.11	2.85	12.57	27.63
Back skinfold	43	11.69	7.17	4.00	39.00
Upper arm skinfold	43	14.81	6.07	5.00	31.10
Abdominal skinfold	43	11.54	8.58	2.30	36.50
Body fat percentage	43	22.60	8.12	9.61	44.64
3-minute run	43	523.37	79.07	330.00	755.00
Time spent in front of TV	43	2.74	0.98	1.00	5.00
Time spent on the internet	43	2.19	0.96	1.00	5.00
Physical activity	43	3.11	0.52	2.10	4.01

N= number of participants; M= arithmetic mean; SD= standard deviation; MIN= minimum result; MAX= maximum result

The results presented in Table 2 show descriptive parameters for third grade primary school boys. It is noticeable that boys have an average height of 140.74 ± 7.83 and body weight of 36.02 ± 7.83, which indicates normal body height while body weight values are slightly higher than the reference values for the Republic of Croatia (Jureša, Kujundžić Tiljak, & Musil, 2011). The values for the body mass index are also somewhat higher

(18.11) than the reference values for children in the Republic of Croatia (Jureša et al., 2011).

Table 3
Descriptive indicators for girls

	N	M	SD	MIN	MAX
Body height	37	141.22	8.64	126.00	156.00
Body weight	37	38.59	11.24	21.00	63.00
Body mass index	37	19.08	4.14	12.82	29.84
Back skinfold	37	15.71	10.36	4.10	50.00
Upper arm skinfold	37	17.92	8.04	8.10	35.90
Abdominal skinfold	37	14.86	9.95	3.50	39.90
Body fat percentage	37	29.14	12.92	11.87	63.38
3-minute run	37	433.51	78.38	295.00	645.00
Time spent in front of TV	37	3.11	1.13	1.00	5.00
Time spent on the internet	37	2.30	1.02	1.00	5.00
Physical activity	37	2.66	0.63	1.45	4.08

N= number of participants; M= arithmetic mean; SD= standard deviation; MIN= minimum result; MAX= maximum result

The results in Table 3 indicate that girls' average height was 141.22 ± 8.64, which is higher compared to the reference values (Jureša et al., 2011). Body weight values (38.59 ± 11.24) and body mass index (19.08 ± 4.14) were significantly higher than the reference values for the Republic of Croatia (17.07) (Jureša et al., 2011).

Comparison of the results between boys and girls indicates that girls have slightly higher body height (141.22) than boys (140.74) as well as body mass and body mass index. Skinfold results also show higher values for girls, while boys are more dominant in running for 3 minutes. It is also apparent that boys spend less time daily (2.74 hours) in front of television than girls (3.11 hours). Also, girls spend more time surfing the internet (3.11 hours) than boys (2.19 hours). Finally, boys (M= 3.11) are more physically active than girls (M=2.66).

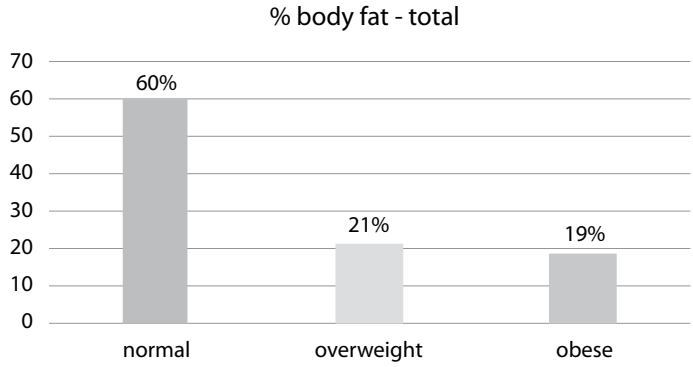

Figure 1. Body fat percentage according to degrees for the total sample

Figure 1 shows that 19% of pupils in the total sample belong in the obese and 21% in the overweight group. The percentage of normal body fat pupils is 60%.

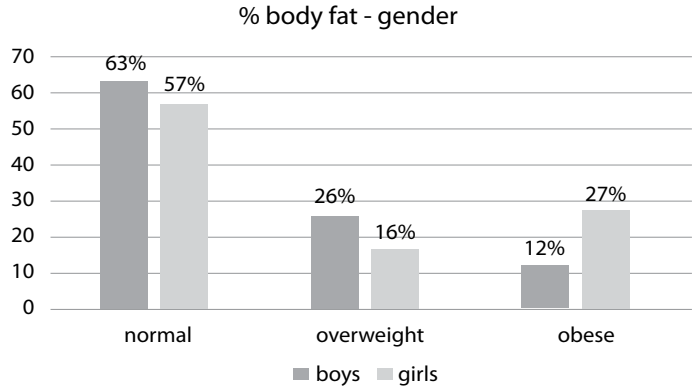

Figure 2. Body fat percentage according to degrees and gender

Figure 2 shows the percentage of body fat between girls and boys. It is evident that 27% of girls in the investigated sample are obese, compared to 12% of boys whereas in the overweight group there are more boys (26%), compared to girls (16%). There are 63% of boys with a normal percentage of body fat while the percentage of girls in this category is 57%.

Table 4

Pearson correlation coefficient for the tested variables in the total sample

	ATV	ATM	BMI	PML	PMN	PMT	%body fat	F3	PA
ATV	1.00	0.69	0.31	0.41	0.49	0.34	0.45	0.00	0.11
ATM	0.69	1.00	0.90	0.78	0.77	0.69	0.81	-0.27	0.05
BMI	0.31	0.90	1.00	0.77	0.70	0.71	0.78	-0.36	0.02
PML	0.41	0.78	0.77	1.00	0.78	0.73	0.94	-0.40	-0.06
PMN	0.49	0.77	0.70	0.78	1.00	0.74	0.93	-0.43	-0.08
PMT	0.34	0.69	0.71	0.73	0.74	1.00	0.75	-0.43	-0.06
% body fat	0.45	0.81	0.78	0.94	0.93	0.75	1.00	-0.47	-0.10
F3	0.00	-0.27	-0.36	-0.40	-0.43	-0.43	-0.47	1.00	0.13
PA	0.11	0.05	0.02	-0.06	-0.08	-0.06	-0.10	0.13	1.00

ATV = body height; ATM = body weight; BMI = Body Mass Index; PML = back skinfold; PMN = upper arm skinfold; PMT = abdominal skinfold; % body fat= body fat percentage; F3 = running for 3 minutes; PA = physical activity

Table 4 presents the results of the Pearson correlation coefficient among the researched variables. It is evident that anthropometric variables are interrelated in statistically significant correlations. The 3-minute F3 variable is highly negatively correlated with the variables which are indicators of the amount of body fat. Lower subcutaneous fat levels in the body significantly affect the increase in pupils' functional capacity. Physical activity indicators do not significantly correlate with neither of the investigated variables.

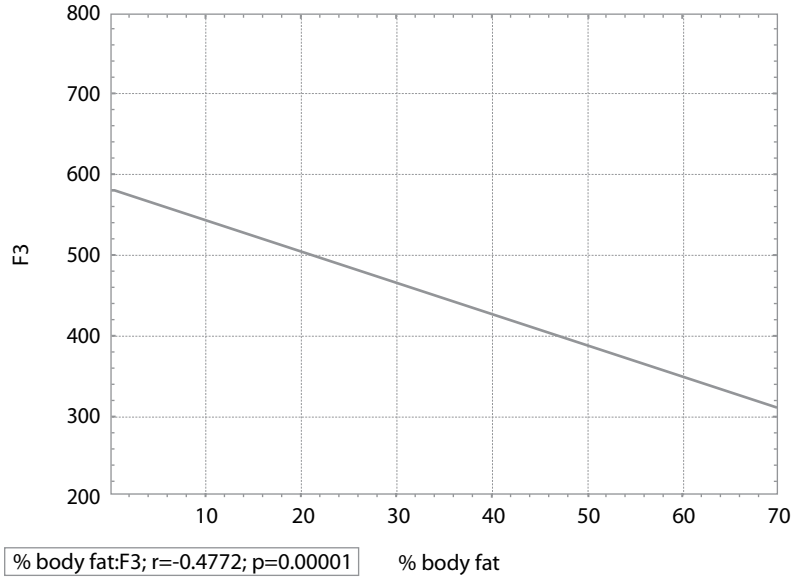

Figure 3. Relationship between body fat percentage (% body fat) indicators of aerobic capacity (F3) in the total sample

Based on the results presented in Figure 3 it can be observed that there is significant negative correlation between the aerobic capacity (AC) and body fat percentage (%BF) ($r = -0.47$; $p = 0.0000$).

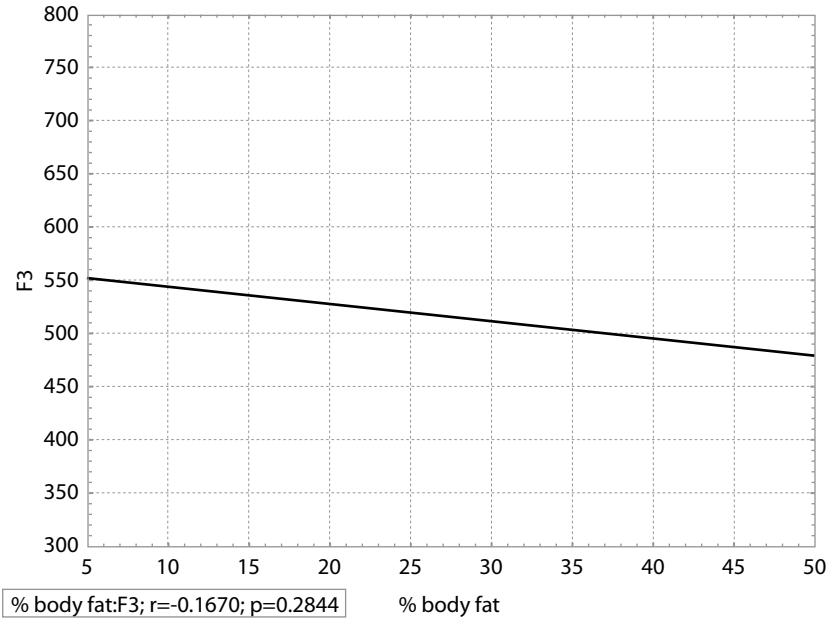

Figure 4. Relationship between body fat percentage (% body fat) indicators of aerobic capacity (F3) in the sample of boys

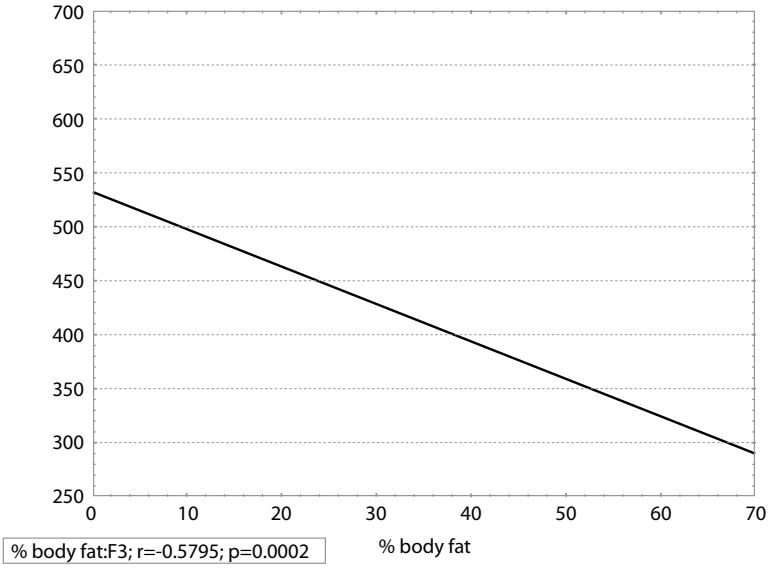

Figure 5. Relationship between body fat percentage (% body fat) indicators of aerobic capacity (F3) in the sample of girls

The results of Pearson correlation coefficient presented in Figures 4 and 5 are given for the sample of boys and girls. The results obtained for boys indicate that there is no significant correlation between the functional capacity (F3) and body fat percentage (% body fat) at the level r = -0.17; p = 0.2844 although the correlation is negative. In the sample of girls the correlation was statistically significant and negative (r = -0.58; p = 0.0002).

Table 5

Pupils' results according to the level of physical activity

	Low level of physical activity	%	Moderate level of physical activity	%	High level of physical activity	%
Number of pupils	9	11	67	84	4	5

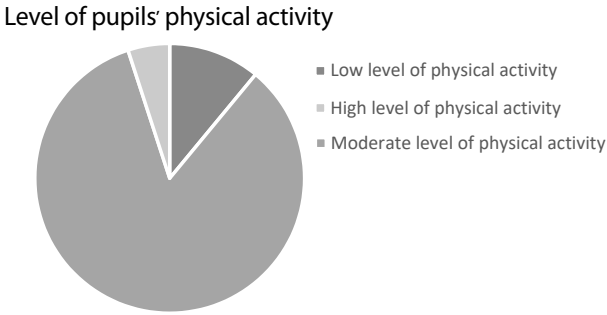

Figure 6. Pupils' results according to the level of physical activity

Table 5 and Figure 6 show pupils' results according to the level of physical activity for the total sample. It can be observed that 84% of the pupils prefer moderate level of physical activity while 11% of the pupils reported low level of physical activity. Only 5% of the pupils satisfy and maintain high level of physical activity.

Table 6

Results of the t-test for determining differences between the pupils according to the level of physical activity and aerobic capacity

	M-SD Low level of physical activity	M-SD Moderate level of physical activity	M-SD High level of physical activity	T-test	T-test	T-test
	0	1	2	0:1	0:2	1:2
N	9	67	4	p-level	p-level	p-level
3- minute running	437.78±62.85	486.49±93.63	502.50±67.02	0.1350	0.1206	0.7381

The results obtained for functional capacity (Table 6) according to the level of pupils' physical activity show that there is no significant difference in favour of the pupils with moderate or low physical activity compared to those with high levels of physical activity.

Discussion

The obtained results indicate that 60% of the total sample of pupils have normal body fat percentage, while there are almost 40% of the pupils with excessive body fat. It is also apparent that girls had a higher percentage of body fat than boys. Results of similar studies also confirmed that, compared to boys, girls had higher percentage of body fat (Nwizu, Njokanma, Okoromah, & David, 2014; Wang, Wang, Liu, & Ma, 2013). Malina and Bouchard (1991) demonstrated in their longitudinal studies that the differences between boys and girls in most anthropometric characteristics were almost insignificant up to about 14 years of age, i.e. until pupils enter puberty. Krističević et al. (1999) found that in most of the measured morphological characteristics there were no statistically significant differences with respect to gender among preschool children except in skinfold (upper arm, abdomen and back) and thigh circumference. The obtained measures for body height and weight of the third grade primary school boys and girls in this study indicate no statistically significant difference in body height, except that girls were slightly higher than boys compared to the reference values for the Republic of Croatia. According to the same reference values for the Republic of Croatia (Jureša et al., 2011), there is a difference in body weight and body mass index, which means that this study showed that a significant number of children were overweight and that their body mass index was significantly higher in comparison with their peers' BMI.

Research by Antonić Degač et al. (2004) showed that 70% of school children aged 7-15 had normal body dimensions, 11% were overweight, 5% were obese and 1% insufficiently nourished. The obesity trend is particularly noticeable in towns, as evidenced by the

doubling of the number of obese children over the past few years. Sallis and Owen (1999) concluded that there was an increasing number of obese children in the US due to the lack of physical activity and irregular diet, and they emphasized a great importance of physical activity in the prevention of obesity, increasing children's health, increasing bone density, strengthening self-confidence, and preventing osteoporosis and stress. According to the American Pediatric Academy, there is a significant relation between obesity in childhood and obesity in adulthood. The likelihood that obesity will continue into adulthood increases with age, in other words, it is 40% in four-year-olds, while in adolescents this percentage is extremely high, up to 80% (American Academy of Pediatrics, 2003). Parzikova (2008) concluded that obesity in children is closely related to parents' obesity, their education, nutritional habits and physical activity. The author, as well as many others, points out that more physically active preschool children have lower body fat, higher levels of HDL cholesterol, greater aerobic endurance, better motor skills and more motor knowledge.

The results of the Pearson correlation coefficient show the existence of a significant negative correlation between functional capacity measurements and anthropometric measurements for the assessment of body mass, skinfold, body mass index (BMI) and body fat percentage, where the highest value of -0.47 was still lower than in the research by Ostojić et al. (2011), who demonstrated a very high negative correlation between the percentage of body fat and aerobic capacity (r=-0.76). Similar results were obtained by other authors, who demonstrated a negative impact of fatness percentage on aerobic capacity (Ara, Moreno, Leiva, Gutin, & Casajus, 2007; Winsley, Armstrong, Midlebrooke, Ramos-Ibanez, & Williams, 2006). Likewise, there was no significant correlation between the level of physical activity and the pupils' functional capacity (r=0.13).

The results of the functional capacity show that the investigated boys had almost the same results as in previous research (Findak et al., 1996), while the girls achieved somewhat lower values compared to the same research. Boys had better results on the functional abilities test (523.37) than girls (433.51). Similar results were confirmed by previous research (Dencker et al., 2006), while Kovač et al. (2013) found that girls had better results on the aerobic abilities test than did boys.

Looking at the pupils' level of physical activity, it is evident that 84% of them have a moderate level of physical activity corresponding to the values that are at the threshold of meeting the daily needs for physical activity.

The t-test results in this study showed that there was no statistically significant difference between functional capacity and the level of physical activity. The reasons for these results can be attributed to the sample of participants who attended two primary schools located in the same area. Also, the participants' age may be significant for the obtained results because in children of this age the differences in functional abilities according to the level of physical activity are still not statistically significant although they are numerically visible. The results of this research cannot be generalized to the entire population because research was conducted in a single urban area, but key findings can be used in future research studies in this field.

Conclusion

Research results indicate a high percentage of pupils with excessive body weight. Functional capacity was inversely linked to obesity indicators, which means that pupils with higher functional capacity values had a lower percentage of body fat. The significance of physical activity is emphasized in all previous research studies, especially since insufficient movement by children and adolescents is becoming significantly pronounced and is increasingly becoming a public health problem. One of the negative consequences of physical inactivity, that is, lack of movement, is the development of obesity. Studies have shown that physical activity has a positive effect on the development of adolescents' bodies and that it has a positive effect on obesity reduction, increased level of motor abilities, as well as increase in the level of functional capacity.

Physical activity of primary school children has to be directed to physical education. However, play, as a child's need to satisfy the basic biotic needs for movement, should also not be neglected. Pupils should have more free time to participate in any kind of spontaneous play that promotes physical activity. Functional capacity from the early age requires constant upgrading and an incentive for their quality development. High negative correlation indicates the importance of reducing body mass and thus increasing the level of pupils' functional abilities.

It is necessary to emphasize the focus of experts on the development of intervention programmes to increase the overall level of functional capacity of primary school pupils. The school subject physical education needs to take the lead in planning more kinesiology activities aimed at raising the overall level of functional abilities, i.e. through the active syllabus of this school subject, pupils need to gain such competences that will direct them towards daily physical exercise with the aim of raising the level of motor and functional abilities.

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Odnos funkcionalnog kapaciteta i tjelesne aktivnosti učenika

Sažetak

Cilj istraživanja bio je utvrđivanje povezanosti tjelesne aktivnosti i funkcionalnog kapaciteta učenika primarnog obrazovanja. S obzirom na sve manju svijest o tome kako je zdravlje vrlo tijesno povezano s kretanjem, posljednjih je desetljeća broj pretilih osoba, djece i mladeži u značajnom porastu. U suvremenom načinu života djece i mladeži sve više nedostaje kretanja i igre na otvorenom, a prevladava sedentarni način života (TV, Internet, Play station...), što se nepovoljno odražava na razvoj sposobnosti i znanja djece, ali i na njihov zdravstveni status. U istraživanju je sudjelovalo 80 učenika trećeg razreda osnovne škole od kojih 43 dječaka (srednja dob 9,30±0,46 godina) i 37 djevojčica (srednja dob 9,29±0,47 godina). Učenici su pohađali dvije osnovne škole sa područja grada Petrinje i to Prvu Osnovnu školu i Osnovnu školu Dragutina Tadijanovića. Istraživanje je provedeno u školskoj godini 2014./2015. Uzorak varijabli činile su antropometrijske mjere: tjelesna visina, tjelesna težina, kožni nabor nadlaktice, kožni nabor leđa, kožni nabor trbuha. Funkcionalne sposobnosti provjeravane su testom trčanja 3 minute - F3, koji se koristi za procjenu razine funkcionalnih sposobnosti u primarnom obrazovanju u Republici Hrvatskoj. Razina tjelesne aktivnosti procijenjena je PAQ-C upitnikom. Na osnovi dobivenih rezultata vidljivo je da od ukupnog uzorka ispitanika njih 60% ima normalan postotak masti u organizmu, a da je gotovo 40% učenika s prekomjernim postotkom masti u organizmu. Zaključak ovog istraživanja ukazuje na visok postotak učenika koji imaju prekomjernu tjelesnu težinu. Funkcionalni kapacitet inverzno je povezan s indikatorima pretilosti, što znači da učenici s višim vrijednostima funkcionalnog kapaciteta imaju manji postotak masti u organizmu. Školsko doba najpovoljnije je vrijeme za stimuliranje i pozitivan utjecaj na pravilan rast i razvoj djece, a propuštene mogućosti u toj dobi ne mogu se nadoknaditi u kasnijim životnim razdobljima.

Ključne riječi: *aerobni kapacitet; funkcionalne sposobnosti; pretilost; škola; učenici.*