MORPHOLOGICAL CHARACTERISTICS AND FUNCTIONAL ABILITIES IN ELEMENTARY SCHOOL STUDENTS

MORFOLOŠKE KARAKTERISTIKE I FUNKCIONALNE SPOSOBNOSTI UČENIKA OSNOVNE ŠKOLE

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ABSTRACT

The main aim of the study is to establish whether there are any differences in growth and development of functional abilities between boys and girls. For the evaluation of functional abilities, growth and development in students the following parameters have been used: height, body mass, body mass index, vital lung capacity, resting heart rate, active heart rate and modified Harvard step test index. The results of multivariate analysis (MANOVA) have shown that there is no statistically significant difference between male and female students. A statistically significant difference has been found by means of univariate analysis of variance (ANOVA) in active hearth rate variables (F=8.36; p=.004) and modified Harvard step test index (F=6.67; p=.011) in favor of male students. Comparing the results obtained in the earlier and recent studies it can be concluded that the current physical exercise program does not produce desired results, furthermore it does not contribute nor does it improve functional abilities of male and female younger elementary school students.

Key words: *Morphological characteristics, functional abilities, physical exercises, younger students, Harvard step test.*

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INTRODUCTION

Physical education is part of general upbringing and plays a significant role in the educational system of young people as well as their upbringing. It is realized through a series of general and specific tasks. It starts in preschool institutions and finishes in the institutions of higher education. During this process there should not be any room left for improvisation, nor accidental influence, especially the kind of influence that may have a negative impact on the personality development (Milanović, 2011). Bearing in mind the fact that 97% of children attend elementary school and have physical education classes on regular basis, it is the obligation of the school to promote physical activity as an important social institution. Teachers are also obligated to constantly stress the importance and value of physical exercises, and develop a habit in students to take care of their body and improve their abilities so that physical exercises become a part of their daily needs.

The development of our civilization, besides its positive aspects for the progress of our humanity, has negative aspects as well. Life without sufficient time spent in nature and without enough movement decreases the development of motor and functional abilities. In addition, it leads to various diseases among which cardiovascular diseases take the first place (Đurašković, 2002). V. Pelagić (1952) stressed the importance of exercises by stating the following: "Thousands who by their own weakness and gloom represent a burden to their beloved ones and spend miserable lives without any joy, could have been happy, diligent and healthy people, had they exercised their bodies in their youth. Do not ever forget that the happiness of our children depends on their exercise. "Even though cardiovascular diseases are not common in children, children who are less active have a predisposition to cardiovascular diseases (Armstrong, Williams, Balding, Gentle, & Kirby, 1991; Wedderkopp, Froberg, Hansen, Riddoch, & Andersen, 2003). Serbia takes the first place based on the mortality rate caused by cardiovascular diseases in Europe. It is especially alarming that health threats begin in an early childhood (Đokić, Međedović & Smiljanić, 2011). The situation is similar worldwide because 60 to 70% of the population in the developed countries does

not engage in the minimum level of physical activity (Trost, Owen, Bauman, Sallis, & Brown, 2002).

Research conducted on students 7 to 9 years of age during the period from 1995 to 2016 (Gajević, 2009; Zrnzević, 2007; Zrnzević N. & Zrnzević J., 2015) shows that the number of obese children is gradually increasing. Obese children have a great chance of staying obese even as adults (Strong, Malina, Blimkie, Daniels, Dishmann et al., 2005; Schlegel-Zawadzka, 2013).

Since growth and development are the best indicators of general health in children, the increase in height and body mass are the most sensitive indicators of health and living standards of the examined population (Smajić, Marinković, Đorđić, Čokorilo, Gušić et al., 2017). This especially refers to younger elementary school students as one of the most important elements in the process of upbringing and education. In the past, a healthy and capable child used to be the one with good motor skills essential for a certain sport, today a child with good "physical endurance" which means optimal functioning of all physiological systems within a body, especially cardiovascular,

respiratory and skeletal system (Committee on Sports Medicine, 1987).

There is a relatively small number of studies and published papers which deal with the functional abilities of younger school children in Serbia (Stojanović, 1977; Đurašković, 2002; Kragujević & Rakić, 2004; Zrnzević, 2007; Radovanović, Aleksandrović, Stojiljković, Ignjatović, Popović et al., 2009; Mitrović & Stević, 2017). The authors who dealt with the efficiency of school curriculum state that the program of physical education does not cause significant changes in any segment of anthropological status of children, and therefore does not have a positive influence on the increase of functional abilities (Zrnzević N., Lilić, & Zrnzević J., 2013).

The main aim of this research is to establish whether or not there are any differences in morphological characteristics and functional abilities of the examined students of both sexes, for the purpose of curriculum revision, as well as the size of the morphological characteristics and functional abilities of the analyzed age in the region of Kosovo and Metohia, due to insufficient information about the given sample in a long period of time.

METHODS

The sample comprised 71 male (G1) and 63 female (G2) first-grade students, age 7.0 ± 6 months, from Zvečan and Leposavić (Kosovo and Metohia, the Republic of Serbia). The testing was performed on healthy students who regularly attend physical education classes. Their teachers were present during the tests. The school principal as well as the parents had given their consent to the testing and agreed that the measurements of morphological characteristics and testing of functional abilities of students be conducted during the regular PE classes.

Measures used for the assessment of morphological characteristics included: body height (BH), body mass (BM) and body mass index (BMI). Morphological characteristics were measured according to IBP protocol (Weiner & Lourie, 1969).

Body response to the physical load during physical education classes is best monitored by means of respiratory and cardiovascular system (vital lung capacity, heart rate at rest, active heart rate and heart rate after exercise). The following parameters were used for the assessment of cardiovascular system function and general

functional ability of the students who participated in the study: VLC – a spirometer was used to measure the vital lung capacity up to $7500cm^3$. Vital capacity measurement is of great value and represents screening for the general health of respiratory system, the same way as blood pressure gives general information of the state of the cardiovascular system (Miller, Hankinson, Brusasco, Burgos, Casaburi et al., 2005); RHR - resting heart rate in beats per minute was measured by a stethoscope placed on the chest of students in the projection of the heart top; HRAE – heart rate after exercise was measured by a stethoscope placed on the chest of students in the projection of the heart top and HAST – Harvard step test for the evaluation of cardiovascular and respiratory system adaptability to physical exertion expressed in index points (Mazur & Woynarowska, 2003), which is acceptable in mass examination, easy for measuring, does not require expensive instruments, equipment and special conditions.

Tests used for the assessment of functional abilities of children should: engage large muscle groups, the effort must

be measurable and repeatable, conditions must be comparable and repeatable, children should be able to perform the test and it should not be harmful to their health, the necessary physical exertion should be easy and children with different levels of physical ability should be familiar with it (Đurašković, 2002).

Descriptive parameters are shown as arithmetic mean (Mean), standard deviation (Std.Dev.), minimum results (Min.), maximum results (Max.), skewness (Skew.), kurtosis (Kurt.) and Kolmogorov-Smirnov coefficient (K-S). The differences between the male and female students for all morphological measures and physiological characteristics were measured by means of the analysis of variance and multivariate analysis of variance (MANOVA/ANOVA). Percentage difference (Difference %) between male and female students for all variables was calculated by the following formula: $[(G1–G2)/G1] \times 100$. Statistical package STATISTICA 10.0 for Windows (StatSoft, Inc., Tulsa, OK, USA) was used for the analysis of the obtained results and statistical significance of difference was established at $p < 0.05$.

RESULTS

Observing the obtained results of basic statistics of morphological characteristics and functional abilities of male and female students we can observe that the results are normally distributed, given that the values of Kolmogorov-Smirnov test coefficient are lower than the limited values. It is observed that there are numerical differences between the male and female students regarding all the variables in favor of boys (Table 1 and 2).

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Table 1. *Descriptive parameters of morphological characteristics and physiological abilities in first grade male students*

Variable	N	Mean	Std.Dev.	Min.	Max.	Skew.	Kurt.	(K-S) d
BH (cm)	71	126.08	5.47	112.10	141.00	0.44	1.16	.083
BM (kg)	71	26.96	5.48	18.50	46.50	1.89	3.83	.209
BMI (kg/m^2)	71	16.98	3.38	12.32	31.38	1.84	4.47	.212
VLC (cm^3)	71	1267.61	169.68	900	1800	0.24	0.73	.157
RHR (o/min)	71	95.87	5.68	84	116	0.80	1.30	.167
HRAE (o/min)	71	131.01	6.92	119	146	0.38	-0.60	.118
HAST	71	41.73	2.19	37.36	45.84	-0.17	-0.75	.114

Legend: Mean - arithmetic mean; Min. - minimum recorded result; Max. - maximum recorded result; Std.Dev. - standard deviation; Skew. - inclination of distribution of results; Kurt. - elongation of distribution of results; (K-S) d - Kolmogorov-Smirnov coefficient.

Table 2. *Descriptive parameters of morphological characteristics and physiological abilities in first grade female students*

Variable	N	Mean	Std.Dev.	Min.	Max.	Skew.	Kurt.	(K-S) d
BH (cm)	63	125.13	114.00	135.20	4.22	0.19	0.46	.092
BM (kg)	63	26.66	20.00	39.50	3.96	0.93	1.52	.122
BMI (kg/m^2)	63	17.09	11.75	25.04	2.87	0.93	0.78	.122
VLC (cm^3)	63	1225.40	700	1700	185.76	-0.21	0.63	.164
RHR (o/min)	63	96.94	88	108	4.81	0.31	-0.21	.196
HRAE (o/min)	63	134.62	120	152	7.51	0.43	-0.44	.120
HAST	63	40.75	36.36	45.45	2.16	-0.18	-0.55	.095

Based on the results of multivariate analysis we can conclude that there is no statistically significant difference in terms of morphological characteristics and functional abilities between male and female students at a multivariate level (Q=.186) (Table 3).

Table 3. *Multivariate differences in morphological characteristics and functional abilities between first grade male and female students*

Wilks Lambda	F	Effect - df	Error - df	Q
0.925	1.46	7	126	0.186

Legend: Wilks lambda - the value of the coefficient of the Wilks test for the equality of group centroidS; F - value of the F-test coefficient for the significance of the Wilks lambda; Df effect, Error df - degrees of freedom; Q - coefficient of significance of centroid differences.

Statistically significant differences have been established regarding heart rate after exercise (HRAE) (p=.004) and Harvard step test (HAST) (p=. 011) by means of univariate analysis, in favor of boys (Table 4).

Table 4. *Univariate differences in morphological characteristics and functional abilities between first grade male and female students*

Variable	Mean G1	Mean G2	Difference	Difference %	F (1; 132)	p
BH (cm)	126.08	125.13	0.95	0.8	1.24	0.267
BM (kg)	26.96	26.66	0.3	1.1	0.13	0.721
BMI (kg/m^2)	16.98	17.09	-0.11	-0.6	0.04	0.840
VLC (cm^3)	1267.61	1225.40	42.21	3.3	1.89	0.172
RHR (o/min)	95.87	96.94	-1.07	-1.1	1.35	0.247
HRAE (o/min)	131.01	134.62	-3.61	-2.8	8.36	**0.004***
HAST	41.73	40.75	0.98	2.3	6.67	**0.011***

Legend: Mean G1– arithmetic mean of a male group students; Mean G2 - arithmetic mean of a female group students; Difference - the difference in the arithmetic means of male and female group of students; F - value of F-test for testing the significance of differences in arithmetic means; p - coefficient of significance of differences of arithmetic means.

DISCUSSION

Body height is one of the most stable indicators of physical development and reflects the process of longitudinal growth. Unlike body height, body mass and subcutaneous adipose tissue are susceptible to transformation under the influence of external and internal factors (Đurašković, 2002). Physical activity decreases subcutaneous adipose tissue to a great extent and increases muscle mass (Zrnzević, 2007; Pejčić, Malacko, & Muvrin, 2014; Malacko, Stanković, Doder, & Pejčić, 2015). In this case, by analyzing the average body height (BH) and mass (BM) results in male and female students we can observe that the values of body height are somewhat lower and body mass higher in comparison with the results obtained in the studies conducted so far (Zrnzević, 2007; Malacko et al., 2015).

The values of vital lung capacity (VLC) depend on the general physical development of a child (Stojanović, 1977). Vital capacity at the beginning of the younger elementary school age is 1450cm^3 in boys and 1400cm^3 in girls (Kragujević & Rakić, 2004; Zrnzević et al., 2013) and until the end of this age period 2250cm^3 in boys and 2100cm^3 in girls (Kragujević & Rakić, 2004) because of the relatively weak muscle structure involved in the process of breathing. Male and female students of this study have lower values of vital lung capacity (VLC) in comparison to the values obtained in the earlier studies (Kragujević & Rakić, 2004; Zrnzević, 2007). This only

confirms the observation that the functional abilities are at a low level of development and that after finished school they either stay at the same level as at the beginning or decrease (Marković & Findak, 1997). Physical activity can greatly improve vital lung capacity (Radovanović et al., 2009). School activities should be exclusively performed in aerobic conditions (Janssen & Le Blanc, 2010). Aerobic capacity is developed most successfully by fast and slow running in nature, long distance running of moderate intensity 60-70%, with the heart rate around 150-160 beats per minute (Brown, Ferrigno & Santana, 2000; Malacko & Rađa, 2004).

The intensity of exercises should be at least 50% of the maximum intensity in order for it to lead to positive changes and satisfactory results

(Donnelly, Blair, Jakicic, Manore, Rankin et al., 2009).

The values of heart rate at rest and after exercises in male and female students are greater than the ones obtained in the earlier studies conducted on the same population which is considered as negative (Đurašković, 2002; Kragujević & Rakić, 2004; Zrnzević et al., 2013). In trained people, there is a decrease in the values of the heart rate at rest and after exercises (Radovanović et al., 2009).

Results of a Harvard step test (HAST) indicate that male and female students are at an intermediate level of functional abilities (Mazur & Woynarowska, 2003). The obtained values are lower than the ones obtained in the studies conducted earlier (Kragujević & Rakić, 2004; Zrnzević et al., 2013).

CONCLUSION

The results of this research have shown that there are no statistically significant differences between male and female first-grade students in terms of growth and functional abilities. No significant difference has been established regarding the growth and development variables (height, body mass and body mass index) by univariate analysis. By analyzing variables for the assessment of functional abilities of male and female students there is statistically significant difference at the univariate level in heart rate after exercises and Harvard step test in favor of boys. These results are expected, given that boys at this age are more active than girls in physical activities that significantly improve aerobic capacity (sports games such as football and basketball), while girls are more oriented to games that are not demanding in terms of engaging aerobic capacity (rubber bands skipping, hopscotch, etc.)

Teachers should pay special attention to the development of functional abilities of their male and female students. They should gain a lot of knowledge in this field especially concerning the application of appropriate learning and exercise methods, selection of the appropriate amount of physical load, selection of exercises and methods used for the analysis of exercising effects. Requirements should be raised to another level as well as the motivation for work.

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SAŽETAK

Osnovni cilj je bio utvrditi da li postoje razlike u rastu i razvoju i funkcionalnim sposobnostima između učenika i učenica. Za procenu rasta i razvoja i funkcionalnih sposobnosti učenika primenjeni su sledeći parametri: telesna visina, telesna masa, indeks telesne mase, vitalni kapacitet pluća, puls u miru, puls posle opterećenja i index modifikovanog Harvardskog step-testa. Rezultati multivarijantne analize (MANOVA) pokazali su da ne postoji statistički značajna razlika između učenika i učenica u analiziranim varijablama za procenu rasta i razvoja i funkcionalnih sposobnosti. Statistički značajna razlika univarijantnom analizom varijanse (ANOVA) utvrđena je samo u varijablama puls posle opterećenja (F=8.36; p=.004) i indeksu modifikovanog Harvardskog step testa (F=6.67; p=.011) u korist učenika. Upoređujući rezultate nekih ranijih i sadašnjih istraživanja, može se zaključiti da aktuelni program fizičkog vežbanja ne daje željene rezultate i ne doprinosi u dovoljnoj meri poboljšanju funkcionalnih sposobnosti učenika i učenica mlađeg školskog uzrasta.

Ključne reči: *morfološke karakteristike, funkcionalne sposobnosti, fizičko vežbanje, mlađi školski uzrast, harvardski step-test.*

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