ORGINAL SCIENTIFIC PAPER

Radomir Pržulj[1], Nataša Branković[2], Nemanja Bjelica[3]
[1] Faculty of Physical Education and Sport, University of East Sarajevo
[2] Faculty of Sport and Physical Education, University of Niš
[3] Faculty of Physical Education and Sport, University of East Sarajevo, student at Master Studies

UDK: 796.012.1-053.5
DOI: 10.7251/SIZ0117077P

EFFECTS OF PROGRAMMED CLASSES OF PHYSICAL EDUCATION TO THE DEVELOPMENT OF ANTHROPOLOGICAL FEATURES IN SCHOOL CHILDREN

Summary

Research was conducted on the sample of 106 students, 48 boys and 58 girls aged 11 and 12 who attended sixth grade at Elementary School "Pale" in Pale. The sample was divided into the experimental group (45) and control group (61). Area of research was determination of effects of programmed physical training in morphological characteristics and motoric abilities and research subject were: longitudinal dimensionality of the skeleton, body volume and mass, subcutaneous fat tissue, general balance, segmentary speed, flexibility, explosive strength of arms and shoulders and agility. Primary aim of research was determination of differences in morphological characteristics and motoric abilities of children at the sixth grade of elementary school. Research results suggest that the program of additional physical exercising in experimental group caused the reduction in overall body mass and justified the application of the experimental factor regarding morphological characteristics as well as more pronounced repetitive strength, running speed and somewhat movement coordination at experimental group at the final measuring.

Key words: *Anthropometry, experimental factor, motoric, students*

1. INTRODUCTION

Using the interpretation of anthropological status, we come across the terms growth and development of morphological, motoric and functional-cognitive abilities of children. Terms growth and development usually refer to quantitative increase in mass and size as well as qualitative changes in the form of the shape of children's body. Development of children refers to physiological changes including the changes in central nervous system and such changes also reflect to the motoric abilities of children. In the first case, we have in mind so called morphological maturity which is connected to mental (psychological) and motoric development. Growth and development of children are processes in mutual interaction so it is necessary to know not only quantitative levels but also the nature of relations between morphological and functional maturity of children at specific age but also for each gender. Development and perfection of physical abilities is certainly the most important task of physical education classes. Additional physical activity in form of organized training, according to most of contemporary research (Nićin, 2000; Petrović, 2010) increases the positive effects of not only physical development, but also basic motoric abilities. Many authors define physical activity in different manner. Physical activity is body motion

performed by skeletal muscles which results in energy consumption (Caspersen, Powel, & Christenson, 1985). Physical activity is one of the most important conditions of healthy growth and development of children and it starts immediately after birth in form of stimulation exercises. Hypotrophic, anemic infant is at greater risk to develop acute respiratory infections. As an infant turns into toddler and starts walking, physical activities increase, like walks and first games with the ball which involve movement, hiding games etc. Even at pre-school institutions children do physical activity which improves and restores good health. Children who attend kindergartens have organized physical activity, every day in the morning in form of 15-30 minutes of easy exercises (Lepeš, Halaši, 2002). Physical activity influences each system of organs in human body individually but we can not separate that influence, which means that entire human organism has a lot of benefit from any form of physical activity. Sciences which deal with human being apply interdisciplinary approach as basic form of methodological orientation and therefore subject of the science of sport is anthropological status of children. Under anthropological status we consider following human abilities and characteristics: morphological characteristics, functional abilities, motoric abilities, cognitive abilities, sociological characteristics and health features. Taking into consideration the influence of contemporary technological revolution to growth and development of children, there is strong need for continuous research and practical validation of specificities regarding individual parts or entire anthropological area.

2. METHOD

Research has longitudinal character which means that there were two measurements at the sample of elementary school children from Pale, East Sarajevo. The sample was derived from the population of elementary school children, total number of participants was 106, 48 boys and 58 girls aged 11 and 12 who attended sixth grade at elementary School “Pale” in Pale. Sample was divided to experimental group (E=45) and control group (K=61). First measuring was performed in the beginning of first semester of school year 2016/17 and the second immediately after completed program of physical training in the end of November 2016.

For the purpose of evaluation of morphological characteristics, we selected the following anthropometric measures:

For evaluation of longitudinal dimensionality of the skeleton:
Height (0.1 cm),
For evaluation of body volume:
Weight (0.1 kg),
For evaluation of subcutaneous fat tissue:
Belly skin crease (0.1 mm)

For the purpose of evaluation of motoric abilities of children, we used motoric tests by EUROFIT battery model prescribed by the CE Committee for the Development of Sport (Council of Europe, 1993): Flamingo balance test (sec), hand tapping (sec), sit and reach (cm), standing broad jump (cm), hand grip strength test (kg), sit up test (sec), pull up test (sec), 10x5 m shuttle run (sec). Experimental motoric trainings were realized in the circular work mode with total number of 24 classes of 45 minutes. Experimental trainings lasted for 8 weeks (three times a week at the scheduled time of PE classes) and their aim was increase of level of the selected anthropological features in children. Application of physical training for the purpose of development of the selected anthropological dimensions was balanced with the age appropriate physiological aspects according to individual characteristics of anthropological area. Participants performed the exercises by strictly ordered schedule of activating muscle groups.

3. RESULTS AND DISCUSSION

Tables of basic descriptive statistics of anthropometric variables of E and K group at the initial measuring are presented in the area of morphological characteristics.

Table 1. Basic descriptive statistics of anthropometric variables of E group

Variable	AS	S	MIN	MAX	Sk	Kurt
Height (mm.)	1,484.03	64.06	1,375.00	1,659.00	0.755	0.823
Weight (dk.)	398.55	37.27	329.00	523.00	0.739	2.167
Belly skin crease (mm.)	69.66	31.57	30.00	128.00	0.486	-1.325

AS – arithmetic mean; S – standard deviation; MIN – minimal recorded measuring result; Max – maximum recorded measuring result; Sk – skewness (result distribution); Kurtz – kurtosis (distribution elongation).

According to the results presented in Table 1 about the basic descriptive statistics of anthropometric variables for E group, we may note pronounced homogeneity of the group in morphological variables, regarding the fact that for all three variables three standard deviations may be placed in their arithmetic means. Measures for distribution shape show no significant discrepancies. Values for skewness do not go over 1.00 and kurtosis over 3.00 which shows generally good normality of data distribution. Certain discrepancy is noted in the variable *Belly skin crease* whereas pronounced leptokurtosis distribution can be found in the variable *Weight*.

Table 2. Basic descriptive statistics of anthropometric variables for K group

Variable	AS	S	MIN	MAX	Sk	Kurt
Height (mm)	1,432.47	58.4	1,325.00	1,564.00	0.683	-0.273
Weight (dk)	435.25	45.28	358.00	562.00	1.077	1.459
Belly skin crease (mm)	74.16	22.85	34.00	125.00	0.219	-0,206

AS – arithmetic mean; S – standard deviation; MIN – minimal recorded measuring result; Max – maximum recorded measuring result; Sk – skewness (result distribution); Kurtz – kurtosis (distribution elongation).

According to the results presented in Table 1 about the basic descriptive statistics of anthropometric variables for K group, we may note pronounced homogeneity of the group in morphological variables. Slight discrepancy may be noted in the value of kurtosis in the variable *Weight* but regarding the fact that the value does not go over the limit coefficient we may find it satisfactory. Tables of basic descriptive statistics of anthropometric variables of E and K group at the initial measuring are presented in the area of morphological characteristics.

Table 3. Basic descriptive statistics of anthropometric variables of E group

Variable	AS	S	MIN	MAX	Sk	Kurt
Height (mm)	1,485.15	53.37	1,369.00	1,581.00	0.060	-0.740
Weight (dk)	444.56	44.74	356.00	562.00	0.409	0.346
Belly skin crease (mm)	71.02	19.03	19.03	105.00	-0.102	-1.265

AS – arithmetic mean; S – standard deviation; MIN – minimal recorded measuring result; Max – maximum recorded measuring result; Sk – skewness (result distribution); Kurtz – kurtosis (distribution elongation).

According to the results presented in Table 3 on basic descriptive statistics of anthropometric variables for E group, we may note pronounced homogeneity in morphologic variables considering the fact that all three variables of three standard deviations may be placed in their arithmetic means. Distribution shape measures do not have significant discrepancies. Skewness values do not exceed 1.00 and kurtosis values do not exceed 3.00 which shows generally good normality of data distribution.

Table 4. Basic descriptive statistics of anthropometric variables of K group

Variable	AS	S	MIN	MAX	Sk	Kurt
Height (mm)	1,433.94	52.80	1,321.00	1,551.00	0.606	0.420

Weight (dk)	455.97	42.83	38.00	564.00	0.582	0.133
Belly skin crease (mm)	76.5	28.53	32.00	115.00	-0.049	-1.485

AS – arithmetic mean; S – standard deviation; MIN – minimal recorded measuring result; Max – maximum recorded measuring result; Sk – skewness (result distribution); Kurtz – kurtosis (distribution elongation).

According to the results presented in Table 3 on basic descriptive statistics of anthropometric variables for K group, we may note pronounced homogeneity in morphologic variables. If we compare arithmetic means with AS we can draw a conclusion that the participants are on average taller and lighter. There are no discrepancies on the basis of kurtosis values considering the fact that the values do not exceed allowed coefficient and therefore we conclude that the sub-sample of control group pronouncedly homogenous at final measuring. Table of analysis of differences at multi-variant and univariant level between overall sub-samples of E and K groups at the level of statistical difference of $p<0.01$ is presented in morphological area.

Table 5. Differences in morphological characteristics between E and K groups at multi-variant and univariant level

Variable	Sub-sample	AS	S	F	P
Height	E	1,459.37	65.96	0.089	0.766
	K	1,456.44	56.69		
Weight	E	415.33	44.781	21.906	**0.000**
	K	448.80	44.139		
Belly skin crease	E	71.71	27.831	0.109	0.742
	K	73.06	23.021		
F=11.824; P=**0.000**					

AS – arithmetic mean; S – standard deviation; f – univariant f test; p – statistical significance of univariant f test; F – multivariant Wilks' F test; P – statistical significance of multivariant Wilks' F test.

According to Table 6 and value of multivariant Wilks' test, we may note statistically significant difference between the groups of participants regarding morphological differences observed in comparison to overall sample by the groups. At univariant level some differences were noted in the variable *Weight* in favor of higher average values in the control group. In the area of motoric abilities, we present the tables of basic descriptive statistics of motoric variables for E and K group.

Table 6. Basic descriptive statistics of motoric variables for E group after initial measuring

Variable	AS	S	MIN	MAX	Sk	Kurt
Flamingo balance test	17.210	11.378	0.00	40.00	-.109	-.603
Hand tapping	16.031	2.384	12.50	22.70	.918	.998
Sit and reach	14.921	7.129	1.00	31.00	-.233	-.304
Standing broad jump	125.894	15.465	92.00	162.00	.162	-.269
Hand grip strength test	20.552	4.372	13.00	29.00	.223	-.960
Sit up test	18.263	4.137	10.00	26.00	-.282	-.685
Pull up test	7.207	3.804	0.00	26.50	1.071	.193
Shuttle run 10x5 m	24.268	2.103	21.10	30.00	.965	1.147

AS – arithmetic mean; S – standard deviation; MIN – minimal recorded measuring result; Max – maximum recorded measuring result; Sk – skewness (result distribution); Kurtz – kurtosis (distribution elongation).

According to the results presented in Table 6 on the basic descriptive statistics of motoric variables of E group after initial measuring and on the basis of arithmetic means and standard deviations, we may observe good discriminative measuring was performed regarding the fact that in most variables three standard deviations may be plated in their arithmetic means. In the sub-sample of experimental group that was not the case in the following variables: *pull up test*,

Flamingo balance test and Sit and Reach test. According to the measures of distribution shape we may conclude that all the skewness and kurtosis values are at the satisfactory level and that they do not exceed prescribed coefficients.

Table 7. Basic descriptive statistics of motoric variables of K group after initial measuring

Variable	AS	S	MIN	MAX	Sk	Kurt
Flamingo balance test	17.579	7.161	0.00	30.00	-.881	1.228
Hand tapping	15.742	1.758	12.00	19.60	.148	.516
Sit and reach	17.846	6.278	5.00	31.00	-.081	-.524
Standing broad jump	119.269	16.657	93.00	158.00	.393	.123
Hand grip strength test	18.192	3.033	12.00	23.00	-.236	-.940
Sit up test	17.461	4.071	9.00	26.00	-.139	-.167
Pull up test	3.842	2.748	0.00	11.20	.676	-.765
Shuttle run 10x5 m	25.642	3.912	20.00	34.00	.569	-.682

AS – arithmetic mean; S – standard deviation; MIN – minimal recorded measuring result; Max – maximum recorded measuring result; Sk – skewness (result distribution); Kurtz – kurtosis (distribution elongation).

According to the results of arithmetic means and standard deviations we may also conclude less discriminative measuring in the same variables as in sub-sample of E group: *Pull up test, Flamingo balance test and Sit and reach test.* After the analysis perform we may state that the Eurofit battery of tests for both groups is not as discriminative in measuring for all the variables. The recommendation is either to use standard motoric tests or to first perform metric characteristics of the motoric tests prior to realization of further research. Measures of distribution shape do not show major discrepancies.

Table 8. Basic descriptive statistics of motoric variables for E group after final measuring

Variable	AS	S	MIN	MAX	Sk	Kurt
Flamingo balance test	17.682	7.777	0.00	32.00	-.320	.072
Hand tapping	16.586	2.400	13.50	24.70	1.155	2.066
Sit and reach	15.763	6.724	0.00	28.00	-.438	-.106
Standing broad jump	132.578	14.598	92.00	163.00	-.434	.506
Hand grip strength test	20,157	3.613	14.00	29.00	.141	-.444
Sit up test	20.947	3.726	14.00	30.00	.136	.020
Pull up test	9.539	4.232	0.00	30.70	.692	-.531
Shuttle run 10x5m	22.434	1.878	18.90	27.10	.553	-.171

AS – arithmetic mean; S – standard deviation; MIN – minimal recorded measuring result; Max – maximum recorded measuring result; Sk – skewness (result distribution); Kurtz – kurtosis (distribution elongation).

According to the values presented in Table 8 on basic descriptive statistics of motoric variables for group E after final measuring we may note better measuring discrimination in comparison to initial measuring. However, certain discrepancies were noted in variables: *Pull up test* and partially in the variable *Sit and reach test.* In the variable *Hand tapping* in the sub-sample of control group we noted pronounced homogeneity which may be observed in the kurtosis value which is positive. Positive skewness value proves the easiness of executing the test for this particular sub-sample. In other variables, there are no significant changes which could be observed in the shape of distribution measures.

Table 9. Basic descriptive statistics of motoric variables for K group after final measuring

Variable	AS	S	MIN	MAX	Sk	Kurt
Flamingo balance test	16.076	8.404	0.00	35.00	.060	.088
Hand tapping	16.326	1.789	12.50	19.00	-.129	-.747
Sit and reach	16.730	7.307	1.00	32.00	.137	.146
Standing broad jump	124.115	19.064	101.00	170.00	.699	-.376

Hand grip strength test	17.923	2.938	14.00	25.00	.492	-.262
Sit up test	17.692	4.221	10.00	26.00	.167	-.500
Pull up test	7.019	3.489	0.00	19.20	.580	-.133
Shuttle run 10x5 m	24.357	1.975	19.30	28.10	-.551	.656

AS – arithmetic mean; S – standard deviation; MIN – minimal recorded measuring result; Max – maximum recorded measuring result; Sk – skewness (result distribution); Kurtz – kurtosis (distribution elongation).

In Table 9 are presented basic descriptive statistics of motoric variables for K group after final measuring and less discrimination may be observed on the basis of standard deviations and arithmetic means in variables: *Pull up test, Flamingo balance test* and somewhat unexpectedly in the variable *Sit and reach.* In all other variables there are no significant changes in terms of measures of distribution shapes.

In Table 10 are presented values of differences between values of E and K group after final measuring at the level of statistical significance p<0.01.

Table 10. Results of differences between E and K group in motoric abilities at final measuring by partializing initial measuring influence

Variable	AS*	F	P
Flamingo balance test (sec)	18.541	1.287	0,262
Hand tapping (sec)	17.601	0.213	0.647
Sit and reach (cm)	16.013	0.272	0.604
Standing broad jump(cm)	134.762	0.811	0.372
Hand grip strength test(kg)	21.217	5.787	0.020
Sit up test (sec)	21.812	6.792	**0.012**
Pull up test (sec)	9.961	0.973	0.328
Shuttle run 10x5 m(sec)	21.645	14.568	**0.000**
F=3,708; P=**0,003**			

AS – arithmetic mean; S – standard deviation; f – univariant f test; p – statistical significance of univariant f test; F – multivariant Wilks' F test; P – statistical significance of multivariant Wilks' F test.

According to the results presented in Table 10 on co-variant differences in motoric abilities at multi-variant and univariant level between E group and K group and on the basis of multi-variant Wilks' test, when we overlook the influence of differences of initial measuring, we may draw a conclusion that there are statistically significant differences in entire motoric area at the level of statistical significance P=0.01, or, to be more precise P=0.003 for the value of Wilks' lambda 3.708. As in the initial measuring, distance of group centroids explains the differences at multi-variant level. Individually observed, differences were present in the following variables: shuttle run 10x5 m in favor of experimental group and sit and reach test also in favor of experimental group. The same can also be noted in inspection of their arithmetic means in the tables of descriptive statistics of the tested variables at the final measuring. The differences basically confirm and justify application of additional training program directed towards the development of agility in children. Accomplishment of better results in favor of experimental group state higher level of explosive strength, segmentary speed of movement and body coordination, i.e. motoric ability agility is comprised of.

4. CONCLUSION

Regarding descriptive statistics of motoric variables for the tested groups E and K, we may conclude that measuring discrimination was good except for the following variables: *Pull up test, Flamingo balance test and Sit and Reach test.* Poor results are generally accomplished in these variables and therefore such results were expected. According to the shape of distribution measures we may conclude that all the values of skewness and kurtosis are at satisfactory level

and that they do not exceed prescribed coefficients. Better discrimination was noted in final measuring in comparison to initial measuring. Certain discrepancies are noted in the following variables: *Pull up test* and partially in *Sit and reach test.* In variable *Hand tapping* for sub-sample E there was pronounced homogeneity, observed through positive kurtosis values. Positive skewness values mean that this test was easily performed in case of this sub-sample. In other variables, there were no significant differences in terms of measures of distribution shapes. At the initial measuring control group achieved less discrimination in the same variables as in the sub-sample of E group: *Pull up test, Flamingo balance test and Sit and reach test.* After the analysis performed, it can be ascertained that Eurofit battery of test does not demonstrate the best discrimination of measuring for all the variables. The recommendation is to either use standardized motoric tests or to first perform metric characteristics of motoric tests prior to realization of the research. In terms of motoric variables, control group had worse discrimination at final measuring in the following variables: *Pull up test, Flamingo balance test* and a bit unexpectedly *Sit and reach test.* Regarding the fact that no work was done with that group for eight weeks, such results were expected at the final measuring. We can conclude from the research performed that the program of additionally organized exercising creates a habit of exercising for children which helps them to continue exercising, improve motoric abilities and reduce total body weight.

5. REFERENCES

1. Bala, G. (1981). *Struktura i razvoj morfoloških i motoričkih dimenzija dece SAP Vojvodine*. Novi Sad: Fakultet fizičke kulture.
2. Caspersen C. J., Powel K. E. & Christenson G. M. (1985). Physical activity, exercise, and physical fitness: Difinitions and distinctions for health-related research. *Public Health Reports*, 100(2), 126-131.
3. Jurendić, I., Dimitrijević, V. (2004). Uticaj organizovanog fizičkog vježbanja na antropološke karakteristike učenika od petog do osmog razreda. *Zborniku radova 13. Ljetnje škole kineziologa Republike Hrvatske*. Zagreb: Hrvatski kineziološki savez.
4. Katić, R., Dizdar, D., Viskić-Štalec, N. & Šumanović, M. (1997). Longitudinalna studija rasta i razvoja dječaka od 7 do 9 godina. *Zbornik radova 1. međunarodne naučne konferencije*, 45-48.
5. Lepeš, J. & Halaši, S. (2002). Jednake šanse u fizičkom vaspitanju. *Norma,* 28,29,30, 76-82.
6. Milanović, I. (2007). Efekti programirane nastave fizičkog vaspitanja u mlađem školskom uzrastu, *Fizička kultura,* 1-2, 43-70.
7. Nićin, Đ.A. (2000). *Antropomotorika – teorija*. Novi Sad: fakultet fizičke kulture
8. Petrović, A. (2010). Uticaj posebno organizovanog programa fizičkog vaspitanja na neke morfološke, motoričke i psihološke karakteristike učenika. *Godišnjak Fakulteta sporta i fizičkog vaspitanja*, 16, 203-218.
9. Pržulj, D. (2006). *Antropomotorika*, Istočno Sarajevo: Fakultet fizičke kulture.

Received; April, 4. 2017
Revision received; May, 18. 2017
Accepted; May, 20. 2017
Correspondence:
Mr Radomir Przulj, University of East Sarajevo,
Faculty of Physical Education and Sport
Strase, Stambulčić no,no, 71420 Pale
e-mail: radomir przulj@gmail.com