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MORPHOLOGICAL CHARACTERISTICS AND MOTOR ABILITIES OF HIGH-SCHOOL BOYS WITH DIFFERENT LEVELS OF ENGAGEMENT IN PHYSICAL ACTIVITIES

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Abstract. *Everyday activities of humans are greatly conditioned by their motor functioning, among other things. The modern lifestyle is determined by the high level of technological development which, through automation, makes life and work somehow easier for man, on the one hand, while on the other he is denied physical activity and the realization of his physical potential. The overall orientation of the research problem is focused on the physical activity of boys from the aspect of different levels of motor engagement and its impact on morphological characteristics and motor abilities with the intention to determine whether there are statistically significant differences between groups. A sample of 67 students, aged 17-18 (± 6 months), were divided into three sub-samples according to the level of physical activity: high (26), moderate (22) and low (19). The study carried out was of a transversal character. The data obtained in the survey were analyzed using univariate and multivariate statistical methods. The obtained results indicate the existence of statistically significant differences between groups in terms of motor skills, at the level of significance of $p<0.05$, while regarding morphological characteristics, statistically significant differences between groups were not observed.*

Key words: *morphological characteristics, motor abilities, physical activity, older school age, boys.*

INTRODUCTION

From birth, man has certain genetically predisposed physical potential. During biological maturation that potential is constantly evolving and improving, determining different physical characteristics of each individual. Properties acquired on the basis of genes are not always at a level that would satisfy all the demands that everyday life puts before a man. Therefore, man sought from the earliest stages of his existence to adjust

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these properties to the conditions of life and work, which is particularly applicable to motor skills that have always constituted an important, and sometimes crucial assumption of his survival. The focused development of motor skills during the earliest stages of life was adopted by humans not only as a biological necessity, but also as a social necessity (Krsmanović & Berković, 1999).

The everyday activities of humans are greatly conditioned by their motor functioning. The quality of motor functioning is conditioned by the good state of the central nervous system, locomotor apparatus and other functional properties of the body. Modern lifestyle is determined by the high level of technological development which, through automation, makes life and work somehow easier for man, on the one hand, while on the other he is denied physical activity and realization of his physical potential. As a result, the functions of the human body and its individual systems and subsystems are inactive, which threatens man's biological essence as a living being created from movement and formed by movement.

According to Kurelić et al. (1975) motor skills represent that part of the overall psycho-physical abilities of a man related to a certain level of development of the basic latent dimensions of man that affect the successful execution of his motion, regardless of whether they are innate or acquired. The same authors have defined the structure of basic motor skills: strength, speed, coordination, agility, accuracy, balance and stamina. Morphological characteristics are the most obvious space within the bio-psycho-sociological status of the human population . Morphological characteristics describe the body type based on a number of anthropometric data. Based on a multitude of research, such as Momirović (1969), Kurelic et al. (1975), Stojanović, Momirović, Vukosavljević & Dolarić (1975) and other authors, the model of morphological characteristics structure was defined, which consists of four morphological factors: the longitudinal dimensionality of the skeleton, transversal dimensionality of the skeleton, the volume and weight of the body and subcutaneous adipose tissue.

One of the basic human necessities is the need for mobility. Nowadays, it is increasingly difficult to find the time and motivation to engage in physical activity and to keep fit on a level that is necessary for a healthy life. Recent research indicates that approximately 60-70% of the population in developed countries does not achieve the minimum level of physical activity. (Trost, Owen, Bauman, Sallis & Brown, 2002), while according to data from the health survey of the Serbian population in 2006, more than two-thirds of the adult population in Serbia is physically inactive (67.7%) (National Health Survey Serbia, 2007).

Sport and physical activity play an important role in all areas of human life. Physical activity is one of the easiest ways to maintain and improve health. Youth health has multiple values and is the basis for the sustainable development of any society, and health is often seen as life's greatest good which largely depends on the efforts being made to preserve and enhance it. Based on these facts, this study has focused on the physical activity of boys aged 17-18 (± 6 months) from the perspective of different levels of motor engagement and its impact on morphological characteristics and motor abilities. Special attention is paid to the analysis of the difference between the different levels of physical activity of students in order to see whether, and to what extent, physical activity contributes to the improvement of the morphological characteristics and motor abilities of young people.

METHOD

The study included an assessment of morphological and motor status of older school-age boys. The study has a transversal character in which an experimental research method of the "ex-post facto" experiment were used.

The total sample in this study consisted of a population of 67 male students of high school "Svetozar Miletic" from Novi Sad, aged 17-18 (± 6 months), divided into three sub-samples according to their level of physical activity: high (26), moderate (22) and low (19).

To determine the morphological status and level of motor abilities of the students, with the aim of monitoring and comparing the results, all of the students in the sample were assessed by means of morphological characteristics and motor dimensions, based on which we obtained insight into: the longitudinal dimensionality of the skeleton, body volume and weight, body composition and motor skills. In order to determine the level of physical activity, a questionnaire on physical activities (Appendix) was used. The assessment of the level of physical activity was taken from Heyward (2006), who assessed the level of physical activity as follows:

- Low level: less than 150 minutes of physical activity on a weekly basis;
- Moderate level: 150 to 300 minutes of physical activity on a weekly basis;
- High level: more than 300 minutes of physical activity on a weekly basis;

Anthropometric measurements were carried out according to the methods recommended by the International Biological Program (Stojanovic et al., 1975). Body height was measured using the anthropometer developed by Martin, with a 1 mm accuracy. Body volume was measured by a centimeter measuring tape with a 1 mm accuracy, while the body mass, adipose tissue and muscle mass was measured using the system for determining body composition, the Omron BF511 (the device uses electrical resistance combined with respondent data on body height, body weight, age and gender. The BF511 releases a very weak current of 50 kHz and less than 500 μA through the body, to accurately determine body composition, i.e. the amount of adipose tissue and the amount of muscle mass. This electric current can be felt when the BF511 is on).

The body mass index (BMI) was calculated by a simple mathematical formula to show the relationship between body weight and body height, i.e. the mass index of the respondents:

$$BMI = \frac{mass(kg)}{\left(height(m)\right)^2}$$

The motor skills space was tested using the Eurofit battery (Moravec, Kampmiller & Sedlácek, 1996) composed of eight tests: the flamingo balance test, hand tapping, the sit-and-reach, the standing broad jump, sit-ups for 30 seconds, the bent arm hang, the shuttle run 10x5 m and the endurance shuttle run.

The tests were arranged so as to avoid the influence of one test on another. Before the start of the test, the respondents were acquainted in detail with the protocol of each test, followed by a practical demonstration.

Data processing included applying appropriate statistical methods to calculate the following central and dispersion parameters: the arithmetic mean (AM), the minimum value (Min), maximum value (Max), the coefficient of variation (CV%), the value of the Kolmogorov-Smirnov test (p). The data obtained in the survey were analyzed using univariate and multivariate statistical methods. The multivariate methods used were the MANOVA and discriminant analysis. The univariate methods applied were the ANOVA t-test and Roy's test.

RESULTS

After examining the results from Tables 1, 2 and 3, which show the central and dispersion parameters of the morphological variables for boys with high, moderate and low levels of physical activity, it can be concluded that the group of boys is fairly homogeneous regarding the variable used for the estimation of longitudinal dimensionality of the skeleton, as confirmed by the values for the coefficients of variation. Regarding the variables for estimating body volume and mass, it can be concluded that for all three levels of physical activity, the sample is also homogeneous, as indicated by values for the variation coefficients CV.

Table 1 Central and dispersion parameters of the morphological characteristics of boys with high levels of physical activity

Variables	AM	Min	Max	CV%	p
BH	1829.00	1730.0	2015.0	3.26	.450
BW	750.35	587.0	982.0	11.75	.783
BMI	22.43	17.2	27.6	10.44	.927
ATISS	14.74	6.7	28.4	38.11	.873
MMAS	42.30	31.8	46.8	7.33	.004
CHC	938.27	820.0	1070.0	6.13	.959
ABC	775.39	685.0	900.0	6.26	.718
UPLC	537.89	440.0	610.0	6.95	.924
UPAC	290.39	235.0	365.0	9.54	.991
LOAC	241.73	185.0	280.0	8.31	.879

Legends: AM – arithmetical mean, Min – minimal value, Max – maximal value, CV% – coefficient of variation, p – value of the Kolmogorov-Smirnov test.

Table 1 Central and dispersion parameters of the morphological characteristics of boys of moderate levels of physical activity

Variables	AM	Min	Max	CV%	p
BH	1798.77	1705.0	1910.0	2.90	.938
BW	747.41	515.0	1018.0	14.93	.846
BMI	23.06	17.7	30.7	12.94	.998
ATISS	17.22	7.0	28.8	31.17	.941
MMAS	41.17	35.1	44.6	6.11	.924
CHC	923.41	740.0	1060.0	7.66	.992
ABC	781.59	680.0	940.0	8.08	.758
UPLC	540.00	435.0	660.0	9.10	.772
UPAC	300.00	225.0	355.0	11.62	.987
LOAC	246.96	200.0	280.0	8.91	.874

Legends: AM – arithmetical mean, Min – minimal value, Max – maximal value, CV% – coefficient of variation, p – value of the Kolmogorov-Smirnov test.

Since the average results of the morphological characteristics of the boys for three different levels of motor involvement are different, we were interested in whether these three groups showed statistically significant differences in morphological variables. The significance of the differences between the groups in terms of morphological characteristics between boys with different levels of physical activity was tested by a multivariate analysis of variance and discriminant analysis.

Table 2 Central and dispersion parameters of the morphological characteristics of boys of low levels of physical activity

Variables	AM	Min	Max	CV%	p
BH	1805.84	1694.0	1907.0	3.06	.998
BW	700.37	582.0	1107.0	17.32	.604
BMI	21.47	16.7	32.6	15.95	.326
ATISS	14.93	6.4	38.9	51.08	.510
MMAS	42.21	29.8	46.4	9.49	.800
CHC	903.42	805.0	1150.0	8.12	.545
ABC	760.26	655.0	1000.0	9.71	.678
UPLC	507.63	450.0	600.0	8.63	.945
UPAC	277.89	225.0	330.0	10.90	.981
LOAC	234.21	205.0	260.0	7.34	.972

Legends: AM – arithmetical mean, Min – minimal value, Max – maximal value, CV% – coefficient of variation, p – value of the Kolmogorov-Smirnov test.

It can be seen in Table 4 that the results of the multivariate analysis of variance indicate that in the system of applied morphological variables there are no statistically significant differences between the levels of physical activity of boys at the level of significance of p= 1.000.

Table 3 Significance of differences between the levels of physical activity of boys relative to their morphological characteristics

Analysis	N	F	p
MANOVA	10	.000	1.000
Discriminant	7	1.764	.053

Table 4 Significance of differences of individual morphological variables between levels of physical activity of boys

Variables	MeH	MeM	MeL	F	p	Discrimination coefficient
BH	1829.00	1798.77	1805.84	1.918	.155	.014
BW	750.35	747.41	700.37	1.434	.246	
BMI	22.43	23.06	21.47	1.547	.221	
ATISS	14.74	17.22	14.93	1.124	.331	.070
MMAS	42.30	41.17	42.21	.855	.430	.020
CHC	938.27	923.41	903.42	1.500	.231	.094
ABC	775.39	781.59	760.26	.645	.528	
UPLC	537.89	540.00	507.63	3.546	.035	.128
UPAC	290.39	300.00	277.89	2.608	.082	.027
LOAC	241.73	246.96	234.21	2.080	.133	.028

Legends: MeH – arithmetical mean high level, MeM – arithmetical mean moderate level, MeL – arithmetical mean low level.

Based on the degree of discrimination, the characteristics of each level of physical activity of boys can be obtained. The coefficient of discrimination (Table 5) indicates that the largest difference between the different levels of physical activity in relation to the morphological characteristics is in the variable of the upper leg circumference (.128) as

evidenced by the level of statistical significance of the differences between groups within one variable (p= .035). It is assumed that the reason for the observed differences between the groups is higher muscle mass caused by physical activity, but it cannot be claimed with certainty because skinfold thickness was not estimated on the studied sample to determine whether the increase in the volume of the upper legs is caused by an increase in muscle mass or subcutaneous adipose tissue. Also, there is a difference in the variable of the upper arm circumference, but not at the level of statistical significance (p= .082).

It can be said that the differences in terms of the morphological space of boys are justified, because it is a usual population of school-age boys , which was not formed on the basis of growth and development, but on the basis of their motor involvement.

Central and dispersion parameters of the variables related to motor and functional abilities of boys with high, moderate and low levels of physical activity are shown in Tables 6, 7 and 8. The lower values of the variation coefficients in all three levels of physical activity in the variables used to assess flexibility, explosive strength of muscles of the lower extremities, agility and maximal oxygen consumption indicate considerable homogeneity of the results.

Table 6 Central and dispersion parameters of motor behavior of boys with high levels of physical activity

Variables	AM	Min	Max	CV%	p
SAR	629.23	430.0	830.0	17.59	.895
JUMP	236.73	184.0	286.0	8.63	.701
BAH	621.39	211.0	1323.0	42.61	.813
10x5	172.73	158.0	186.0	5.26	.845
BEEP	1438.46	620.0	2240.0	30.70	.879

Legends: AM – arithmetical mean, Min – minimal value, Max – maximal value, CV% – coefficient of variation, p – value of the Kolmogorov-Smirnov test.

Boys with high levels of physical activity had higher average values for variables for assessing flexibility, explosive strength and endurance of the lower extremities than boys with moderate and low levels of physical activity, while the boys with moderate levels of physical activity had higher values for variables for assessing static muscle force of arms and shoulders than boys with high and low levels. Regarding the variables for assessing agility, numerically speaking, boys with high levels of physical activity had worse results than boys with moderate and low levels of physical activity, but because better results are valued with lower values in this test (task execution in as short a period of time as possible), so the better results can be attributed to boys with high levels of physical activity.

Table 7 Central and dispersion parameters of motor skills in boys with moderate levels of physical activity

Variables	AM	Min	Max	CV%	p
SAR	586.82	390.0	720.0	13.13	.998
JUMP	227.18	170.0	272.0	11.70	.956
BAH	621.46	334.0	1093.0	35.30	.355
10x5	178.32	165.0	200.0	5.27	.644
BEEP	1104.55	360.0	1780.0	30.33	.900

Legends: AM – arithmetical mean, Min – minimal value, Max – maximal value, CV% – coefficient of variation, p – value of the Kolmogorov-Smirnov test.

Based on the review of the given tables and analysis of the Kolmogorov-Smirnov test (p) it can be seen that all values are within normal limits, i.e. that all the values are normally distributed in variables used for assessment of motor abilities in boys with high, moderate and low levels of physical activity.

Table 8 Central and dispersion parameters of motor skills in boys with low levels of physical activity

Variables	AM	Min	Max	CV%	p
SAR	554.21	270.0	670.0	18.16	.896
JUMP	220.05	114.0	257.0	13.51	.777
BAH	432.11	12.0	732.0	46.41	1.000
10x5	187.00	165.0	239.0	8.60	.251
BEEP	829.47	100.0	1300.0	41.17	.998

Legends: AM – arithmetical mean, Min – minimal value, Max – maximal value, CV% – coefficient of variation, p – value of the Kolmogorov-Smirnov test.

Based on the analysis of the given tables it can be concluded that boys with low levels of physical activity, numerically speaking, had significantly lower mean values compared to boys with high and moderate levels of physical activity in all of the variables used for the assessment of motor abilities.

The analysis of central and dispersion parameters of motor skills, numerically speaking, showed differences between the arithmetic means of the respondents, and for that reason it was necessary to determine whether these differences are statistically significant. The significance of the differences between groups regarding motor and functional abilities between boys with different levels of physical activity was tested by the multivariate analysis of variance and discriminant analysis.

Based on the value of the results of the multivariate analysis of variance for five of the observed features, it can be concluded from Table 9 that there are significant differences in motor skills between boys with different levels of physical activity at the level of significance of p= .001.

Table 9 Significance of the differences between the levels of physical activity of boys relative to the motor skills

Analysis	N	F	p
MANOVA	5	3.068	.001
Discriminant	5	3.066	.001

Based on the results of the discriminant analysis p= .001, it can be said that there are statistically significant differences, and a clearly defined boundary in the entire studied space of motor skills among boys with different levels of physical activity.

The characteristics of each level of physical activity of boys can be derived through analyzing the coefficient of discrimination. The coefficient of discrimination (Table 10) indicates that between different levels of physical activity in relation to motor skills, statistically speaking, the greatest difference is in the variables for assessing aerobic endurance (p= .000). Statistically significant differences exist in the variables for assessing agility (p= .001), static muscle strength of the arms and shoulders (p= .015) and flexibility (p= .043).

Table 10 Significance of differences in individual motor variables between levels of physical activity of boys

Variables	MeH	MeM	MeL	F	p	Discrimination coefficient
SAR	629.23	586.82	554.21	3.312	.043	.015
JUMP	236.73	227.18	220.05	2.444	.095	.021
BAH	621.39	621.46	432.11	4.477	.015	.000
10x5	172.73	178.32	187.00	8.355	.001	.063
BEEP	1438.46	1104.55	829.47	14.258	.000	.072

Legends: MeH – arithmetical mean high level, MeM – arithmetical mean moderate level, MeL – arithmetical mean low level

The analysis of the mean values of the results shows that the observed differences in most of the variables in favor of the respondents with high levels of physical activity compared to moderate and low levels of physical activity, and that respondents with moderate levels of physical activity in most of the variables have higher average values than the average values for respondents with low levels of physical activity, which is expected to some extent with respect to the intensive physical activity of the respondents with high levels of physical activity. Respondents with high levels of physical activity showed significantly better results compared to other levels of physical activity in variables for assessing flexibility, explosive strength, agility and aerobic endurance. Respondents with moderate levels of physical activity showed significantly better results in all the variables regarding motor abilities compared to those with low levels of physical activity.

In the study of motor space, three more ordinal scale variables were tested, so the data used for the assessment of variables were treated as categorical, by forming some assessment of the manifestation of the aforementioned motor skills. These variables are: the "flamingo" test, used for assessing balance; the "hand tapping" test, used for assessing the frequency of alternative movements; and the "lie-sit" test, used for assessing repetitive strength of the abdominal muscles. The test results were expressed in a number of repetitions, i.e. frequency.

Every assessment of the tests had several modalities, for example, the assessment of the flamingo test had three modalities: good, moderate and poor, the assessment of the hand tapping test had 3 modalities: good, moderate and poor, and the assessment of the lying-sitting test also had three modalities: poor, moderate and good. Individually, each of these assessments has its own measure on the basis of which it is classified.

Table 11 shows the numerical and percentage representation of variables for assessing balance, assessed by the flamingo test. Prior to a comparative analysis of the assessment of motor skills, it is important to define the categories. The respondents who belonged to the category "good" had 0 to 9 attempts while performing motor tests, the category "moderate" 10 to 14 attempts, and the category "weak" over 14 attempts.

Table 11 Representation of the assessment of the "flamingo" test in relation to the level of physical activity

Level of activity	good: 0-9		moderate: 10-14		poor: >14	
	N	%	N	%	N	%
High	10.	38.5	7.	26.9	9.	34.6
Moderate	9.	40.9	7.	31.8	6.	27.3
Low	1.	5.3	3.	15.8	15.	78.9

By analyzing this table it is possible to note that for the "high" level most of the assessments are of the category "good", consisting of 10 boys out of 26. This means that 10 boys from a group with a high level of physical activity had from 0 to 9 attempts when they tried to perform the test for balance assessment. At the "moderate" level of activity, the representation of the assessments "good" includes 9 boys, while at the "low" level of activity representation of assessments, "poor" includes 15 boys, which is significantly higher than the frequency of assessments "moderate" and frequency of assessments "good", which included only one boy who performed the test in the range of 0 to 9 seconds.

Table 12 shows the estimate of the speed of alternative movements assessed through the hand tapping test. Prior to the comparative analysis of the assessment of motor skills, it is important to define the categories. The respondents who belonged to the category "good" carried out the test in time interval from 0 to 12 seconds, the category "moderate" from 12 to 13.7 seconds, and the category "poor" over 13.7 seconds.

Table 12 Representation of the assessments of "hand tapping" test in relation to the level of physical activity

Level of activity	good: 0-12		moderate: 12-13,7		poor: > 13,7	
	N	%	N	%	N	%
High	15.	57.7	9.	34.6	2.	7.7
Moderate	15.	68.2	4.	18.2	3.	13.6
Low	9.	47.4	8.	42.1	2.	10.5

By analyzing this table it is possible to note that for the "high" level, most of the assessments were "good" including 15 boys out of 26, meaning that 15 boys with high levels of physical activity performed the test in the range of 0 to 12 seconds, which is significantly higher than the frequency of the assessment "poor", where only two boys in the group with a high level of physical activity completed the test in more than 13.7 seconds. At the "moderate" level of representation, the assessment "good" includes 15 boys, which is significantly higher than the frequency of assessment "moderate", followed by the assessment category "poor". At the "low" level of activity, the representation of assessment "good" includes 9 boys, which is significantly higher than the frequency of the assessment "weak", consisting of 2 boys.

Table 13 shows the numerical and percentage representation of assessments of repetitive strength of the abdominal muscles, assessed during the lying-sitting test. Prior to the comparative analysis of assessments of motor skills, it is important to define categories. The respondents who belonged to the category "poor" performed from 0 to 21 repetitions, the category "moderate" 22-26 repetitions, and the category "good" more than 26 repetitions.

Table 13 Representation of the assessments of the "lying-sitting" test in relation to the level of physical activity

Level of activity	poor: 0-21		moderate: 22-26		good: > 26	
	N	%	N	%	N	%
High	0.	.0	2.	7.7	24.	92.3
Moderate	2.	9.1	7.	31.8	13.	59.1
Low	1.	5.3	11.	57.9	7.	36.8

By reviewing the table below, it is possible to note that at the "high" level, most of the assessments are "good", including 24 boys out of 26, meaning that 24 boys from the group with a high level of physical activity performed over 26 repetitions during the lie-sit test, which is significantly higher than the frequency of the assessment "moderate", where only two boys from high level group performed 22 to 26 repetitions, while no boy from the group with a high level of physical activity performed less than 22 repetitions. At the "moderate" level of representation, the assessments "good" was awarded to 13 boys, which is significantly higher than the frequency of the assessment "moderate", followed by the assessment "poor". At the "low" level of physical activity, the representation of the assessment "moderate" is: 11 boys, which is significantly higher than the frequency of assessment "poor", p= .001.

Previous analyses revealed that the motor skills of respondents with different levels of physical activity were assessed as different, and for that reason it was necessary to determine whether these differences are statistically significant or not. A complete picture of basic-motor space was given by the univariate analysis of variance and the discriminant analysis.

Table 14 shows the results of the multivariate analysis of variance, and on the basis of the statistical value of p= .000 (the MANOVA analysis) and p= .000 (discriminant analysis), it can be concluded that there is a statistically significant difference and clearly defined boundary between the levels of physical activity of the boys.

Table 14 Significance of differences in the assessment of motor behavior in relation to the levels of physical activity

Analysis	N	F	p
MANOVA	3	5.762	.000
Discriminant	3	5.887	.000

Based on the discriminant analysis procedure in Table 15, the previously observed statistically significant differences were confirmed, and this means that there is a significant difference between the different levels of physical activity in boys regarding the following tests: the flamingo and the lie-sit. Further analyses of the table reveals that there was no significant difference between the levels of physical activity of boys regarding the following tests: hand tapping, but with a small contribution.

The discrimination coefficient indicates that there is the largest contribution to the discrimination between the level of physical activity of boys in relation to the assessment of motor skills, i.e. that the biggest differences for the tests are: the lie-sit, flamingo test and the hand tapping test.

Table 15 Significance of the differences in individual motor abilities of boys in relation to the level of physical activity

Variables	F	p	Discrimination coefficient
Flamingo	8.172	.001	.226
Hand tapping	1.486	.234	.041
Lying-sitting	9.882	.000	.294

DISCUSSION

Based on the average values of the results obtained for the body mass index (determined by Cole, Bellizzi, Flegal & Dietz, 2000; Cole, Flegal, Nicholls & Jackson, 2007) and based on the comparison with limit values (<17.54 malnourished; 17.54 – 24.5 normally nourished; 23.90 – 30 overnourished; and >30 obese), from the displayed table it can be concluded that in the group of high-level physical activity there are no obese boys, which is indicated by maximum BMI values, while in groups of moderate and low levels of physical activity, there are respondents who fall into the obese category, which is indicated by maximum BMI values. The results obtained clearly indicate that the level of motor engagement is correlated with the results of body weight.

A group of researchers (Marcelino, Melich-Cerveira, Paccaud & Marques-Vidal, 2012) examined the relations between the body mass index, hypertension and physical fitness (cardiorespiratory endurance). The research results showed that obese people with a high level of cardiorespiratory endurance are characterized by significantly lower blood pressure than people with low levels of aerobic abilities. Similarly, the average values of growth and development of boys are within the expected range for the studied age group. The average body height of boys with high levels of physical activity is 182.9 cm, of boys with moderate levels of physical activity is 179.8 cm, while of boys with low levels of physical activity the average body height is 180.5 cm, which is approximate to the average results obtained by Rakić (2009), who stated that boys aged 17 are of an average height of 182.1 cm and boys aged 18, 181.72 cm. The average body weight of boys with a high level of physical activity in our study is 75 kg, of boys with moderate levels of physical activity 74.7 kg, and of boys with low levels of physical activity 70 kg, which is similar to the results from the research by Pavlica, Rakić, Đuricanin, Korovljev & Srdić (2010).

Based on previous analyses of central and dispersion parameters of the morphological variables of boys of high, moderate and low levels of physical activity, it can be concluded that a group of boys with high levels of physical activity has, on average, greater body height and body weight compared to boys with moderate and low level. In boys with high levels of physical activity, there is less body fat and more muscle mass than in boys with moderate and low levels of physical activity. Boys with low levels of physical activity are at a slightly lower level than the average values of variables used for the assessment of body volume (average chest circumference, abdomen circumference, upper arm circumference, forearm circumference, upper leg circumference) compared to boys with moderate and high levels of physical activity. Boys with moderate levels of physical activity are more homogeneous than the groups of boys with high and low levels of physical activity.

By further analysis it can be observed that the system of 10 variables applied for the evaluation of morphological characteristics of boys with different levels of physical activity is reduced to a system of seven variables where, based on the value of the results of the discriminant analysis, it can be concluded that there are clearly defined boundary morphological characteristics between subjects with different levels of physical activity at the level of significance of p= .05 (Table 4).

If we look at the average values of the motor abilities of boys with high levels of physical activity, it can be concluded that they have higher average values than boys with moderate and low levels of physical activity, for variables used to assess flexibility, explosive strength of the lower extremity muscles, endurance and agility. Such results are expected for two reasons: increased motor activity contributes to the development of motor skills at this age on the one hand, and on the other hand the selection itself is

probably performed on the basis of certain indicators related to motor skills, because respondents with moderate levels of physical activity showed significantly better results in all the variables regarding the assessment of motor abilities compared to the respondents with low levels of physical activity. Similar results were also obtained by Ranđelović (2012) who compared the motor skills of male cadets of the Military Academy who are engaged in free sporting activities – sections (athletes) and of groups of cadets who do not participate in those sections (non-athletes). The results showed that cadets who are engaged in the sports section, on average, have better motor skills compared to cadets who are not engaged in this section.

The analysis of the results, used for determining the differences between the different levels of physical activity, has shown that there is a statistically significant difference between students with different levels of physical activity at the p=0.00 level (Table 14) and the same results were confirmed by the discriminant analysis. The results obtained show that there is a clearly defined boundary between different levels of physical activity. The differences obtained by the contribution analysis (Table 15) show that tests for the assessment of repetitive strength of the abdominal muscles and balance play a major role.

A group of researchers (Coe, Pivarnik, Womack, Reeves & Malina, 2012) examined the correlation between the level of physical fitness determined using a standardized test battery (fitnessgram), and school achievement. The results of the research showed that individuals with the best level of physical fitness also have the best marks in school. Tubić, Đorđić & Poček (2012) examined the differences in the various dimensions of self-concept in adolescent girls and boys, depending on their engagement in sports. The obtained results showed that adolescent boys and girls who are engaged in sports assess themselves more favorably in most of the examined aspects of self-concept compared to their peers who are not engaged in sports.

CONCLUSION

There is no doubt that physical activity performed through playing contributes to the growth and development of children and adolescents. Research conducted in this direction confirms that the effect of muscle efforts enhances the development of bone, muscle, cardiovascular and other systems of the human body. Systematic engagement in physical activity and sport not only increases the level of physical development, but improves its functional capabilities.

By comparing the morphological and motor indicators of boys with different levels of physical activity, statistically significant positive differences can be observed in the area of motor abilities in favor of boys with high and moderate levels of physical activity compared to boys characterized by low levels of physical activity, i.e. who are not engaged in any form of physical activity or that motor engagement is below average (<150 minutes of physical activities weekly), while no statistically significant differences were observed in the space of morphological characteristics between boys with the above mentioned levels of physical activity.

The relevance of this research was that it attempted to show how regular physical activity, even of a recreational nature, and sport play an important role in all areas of human life.

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APPENDIX

NAME:
GENDER: Male Female
YEAR OF BIRTH:

1. DO YOU USE SOME OTHER ACTIVITIES, SPORTS OR RECREATION IN FREE TIME BESIDES PHYSICAL EDUCATION:
   - YES (sports, actively train some sport, practice at least 4-5 times a week)
   - YES (recreation, ride the roller, running, gym, fitness programs…etc. at least 2-3 times a week)
   - NO, I do not do any form of physical activity

   If the answer is YES, please answer the following questions:

2. WHICH FORM OF SPORTS – RECREATION ACTIVITIES DO YOU DO IN YOUR FREE TIME: 3. HOW LONG YOU HAVE THESE ACTIVITIES: 4. HOW MANY TRAINING SESSIONS DO YOU HAVE DURING THE WEEK: 5. HOW MUCH TIME DOES ONE TRAINING SESSION TAKE:			
MORPHOLOGICAL AND MOTOR STATUS			
Body height			
Body mass			
Body mass index			
% body fat			
% muscle mass			
Flamingo balance test			
Hand tapping			
Sit and reach			
Standing broad jump			
From lying to sitting position for 30 seconds			
Bent arm hang			
10*5			
Shuttle run			

MORFOLOŠKE KARAKTERISTIKE I MOTORIČKE SPOSOBNOSTI DEČAKA SREDNJIH ŠKOLA RAZLIČITIH NIVOA FIZIČKE AKTIVNOSTI

Svakodnevne aktivnosti čoveka u velikoj meri, pored ostalog, uslovljene su njegovim motoričkim funkcionisanjem. Aktuelni način života uslovljen je praćenjem razvoja visoke tehnologije što je čoveku putem automatizacije omogućeno da na jedan izvestan način lakše živi i radi, sa jedne strane, a sa druge strane mu je uskraćena fizička aktivnost, odnosno angažovanje njegovog fizičkog potencijala. Celokupna problemska orijentacija ovog istraživanja usmerena je na fizičku aktivnost dečaka sa stanovišta različitih nivoa motorne angažovanosti kao i njenog uticaja na morfološke karakteristike i motoričke sposobnosti sa namerom da se utvrdi da li postoje statistički značajne razlike između grupa. Na uzorku od 67 učenika, starosne dobi 17-18 godina (± 6 meseci) podeljenih u tri subuzorka u odnosu na nivo fizičke aktivnosti: visok (26), umeren (22) i nizak (19), izvršeno je istraživanje transverzalnog karaktera. Podaci dobijeni istraživanjem obrađeni su univarijantnim i multivarijantnim postupcima statistike. Dobijeni rezultati ukazuju na postojanje statisički značajnih razlika između grupa u pogledu motoričkih sposobnosti, na nivou značajnosti $p<0,05$, dok se u pogledu morfoloških karakteristika ne uočavaju statistički značajne razlike između grupa.

Ključne reči: *morfološke karakteristike, motoričke sposobnosti, fizička aktivnost, stariji školski uzrast, dečaci.*