ANTHROPOMETRIC CHARACTERISTICS – THE DETERMINANTS OF VERTICAL AND HORIZONTAL JUMPING ABILITY

Milovan Bratić[1], Ratko Pavlović[2], Radmila Kostić[1] and Saša Pantelić[1]

[1] *Faculty of Sport and Physical Education, Niš, Serbia*
[2] *Faculty of Physical Education and Sport, East Sarajevo, Bosnia & Herzegovina*

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Abstract
Any aspect of sport integrates within itself certain human anthropological dimensions. Which of the dimensions will be dominant in the given physical activity, or sport, depends on the nature of the sport as well as the nature of the motor task which is being realized. A very frequent topic of study in anthropological space is morphological space, as well as anthropometric characteristics which are defined as the predictors of various motor manifestations. These manifestations can include all the segments of motor space. In this paper we will define a segment of explosive strength (the horizontal and vertical jumping ability) in the case of boys and girls, first-graders, with the aim of determining the influence of the manifested anthropometric characteristics, such as the determinants of the vertical and horizontal jumping ability of children.

Key words*: boys, girls, regression, plyometric jump, the standing depth jump*

Introduction

The part that anthropometric characteristics play in the explanation of the entire psychosomatic status of schoolchildren is significant, especially in the case of motor skills, which are a key factor in the evaluation of the ability to participate in sports activities. Various studies have been carried outon the topic of explosive strength, and involving participants of various ages. Šimeket al. (2007) determined the changes in agility and explosive strength, the type of jumping ability under the influence of a proprioceptive training program on a sample of physical education students. It was determined that, in the case of untrained participants, changes in vertical jumping ability are possible under the influence of proprioceptive training, and in the case of trained participants, the effects were smaller or not significant. Markovićet al. (2005) studied the results of sprint and plyometric training on the morphological characteristics of young, physically active participants. The research showed that these two methods have a limited effect on the morphological dimensions of younger men. A very interesting study was carried out by Temfemoet al. (2009)with the aim of comparing the performance of the vertical jump in the case of boys and girls who were still undergoing the process of development. Maximal results were obtained for the vertical jump and the squat jump. The regression between the average strength output, body mass and leg muscle volume was calculated for 240 boys and 239 girls (aged 11 to 16). Higher numeric values were determined for the boys than for the girls for body height, leg volume and body mass. Both groups had similar body mass indexes, irrespective of their age. Boys between the ages of 12 and 16 had greater values for jumping ability, strength output and the percentage of fatty tissue than girls of the same age. Significant correlations were obtained between average strength output and age, as well as between average strength output, body mass, and leg volume for each group of participants. It was concluded that the performance of jumps increased during the period of development. Differences in gender are manifested from the age of 14, due to increasingly greater leg length and leg volume of boys than girls. The purpose of the study carried out byBiskanakiet al. (2004) was to evaluate the specific motor skills of Greek children aged 8, according to gender and depending on whether they were obese or not. A total of411 children were tested (195 boys and 216 girls). The body mass index (BMI) was used as the obesity index, while the children took part in the following tests: the 30m run, the 20m run, the standing depth jump and the reach-and-toss of a medicine book, 1kg in weight. No greater difference was noted between the genders in terms of the BMI ($p>0.05$). The boys had better results than the girls on all the tests($p<0.01$). Less obese children had better results than obese children for the 30m run, and ($p<0.01$), the 20m run ($p<0.01$). On the other hand, obese children scored higher on the throwing of a one kilo medicine book ($p<0.05$).

As a result, it was concluded that boys had better motor skills than girls, and that obesity has a negative influence on the tested motor skills (except for throwing). Holmet al. (2008)carried out a study with the aim of providing normative values which are related to the influence of age and gender on muscle strength, power and endurance and of setting up a database of references for healthy schoolchildren aged 7 to 12. The relations between certain simple functional tests and isokinetic measures of strength were also studied. A total of 191 girls and 185 boys were tested using tests for the evaluation of muscle strength, such as the flexion-extension of the knees, hand grip strength, back extensions and the vertical jump. The results have shown that there is a significant linear increase in strength, with no differences in terms of gender of the participants aged 7 to 11, and a great variability within each age group.

The correlation between hand grip strength and quadriceps strength was high in value (r=0.84) and the correlation between the vertical jump and relative quadriceps strength was medium in value(r=0.50). It was concluded that with time, absolute strength values increase, and that there were no differences in relation to gender. The connection between hand grip strength, the vertical jump and quadriceps strength ranged from medium to high values. Zurc, Pišot, &Strojnik (2005) studied the differences between the genders on the motor test results of boys and girls aged 6.5. The sample numbering 138 children was measured using selected motor tests which cover the following hypothetical dimensions of motor skills: movement coordination, speed, strength and balance. The differences in gender in individual motor tests were tested using the Student t-test for independent samples. Statistically significant differences in relation to gender were noted for all of the tests: walking backwards through hoops, the backwards polygon, the standing depth jump, the triple jump, and the flamingo balance test on a cylindrical roller which has been positioned length-wise. The main differences in terms of gender when dealing with motor performance can be determinedfor coordination and tests of strength, while in the case of balance and speed the differences are insignificant. Brunet,Chaput, & Tremblay(2006) evaluated the physical fitness and body composition of 1140 children: 591 boys and 549 girls aged 7, 8 and 10. Waist volume was measured, and the body mass index was calculated (BMI).The physical fitness test included the standing depth jump, 1-min speed sit-ups and speed shuttle running. The relation between BMI and waist volume was very significant in the case of both the boys and girls (r= 0.90 and 0.86, P< 0.0001). This study showed that the BMI and waist volume are inversely proportional to physical fitness and that these relations are more pronounced in the case of older children. Stojanovićet al.(2006)carried out a study with the aim of evaluating the influence of anthropometric characteristics on the manifestation of explosive strength. The sample consisted of 40 volleyball players, aged 13, from Niš. The predictor system of variables consisted of 9 anthropometric measurements, and the criteria of three tests of explosive leg strength (the standing depth jump, the standing triple jump and the 20 m run with a high start). The data were processed by means of a regression analysis. Statistically significant coefficients were obtained, which indicated that it is possible to predict explosive leg strength among volleyball players aged 13 on the basis of anthropometric characteristics. Participants with smaller body mass, smaller upper arm volume and greater thigh volume will have better results on the standing depth jump. The regression coefficients have a negative sign so that the length of the standing depth jump and body weight, as well as upper arm volume, are inversely proportional. Thigh volume is directly proportional to the length of the depth jump, so the participants with greater thigh volume will have better results on this test. Participants with smaller body weight will have better results for the standing triple jump (due to the negative sign) as well as greater thigh volume. Ivković (2008) used a system of predictor variables (12 morphological and 12 motor variables) on a sample of 97 boys, aged 11+/-6 months with the aim of indicating their influence on the criteria (variables of explosive strength). He determined a positive and significant multiple correlation on the basis of which he concluded that morphological characteristics and motor skills are significant predictors of the explosive strength of children. Balaet al.(2006) in their monograph Measuring and defining the motor skills of children used a very large sample of children from Vojvodina to determine the trend of growth and development of certain motor skills, among which we defined both explosive strength and it sensitive periods, where the AS of the depth jump for the sample of boys was 124, 5cm and for the girls was 115,7cm. The obtained results have confirmed the relative growth trend of the results with age and the differences between the genders, which increase with age. The significant influence of primarily endogenic factors was confirmed, but the influence of egzogenic factors was also not negligible. On the basis of the insights into the research carried out to date and which encompassed the problem of explosive strength and its manifestations depending on the predictor, the aim of this research was to determine the level of the influence of anthropometric characteristics on the manifestation of the explosive strength of the horizontal and vertical jumping ability.

Methods

Sample of participants

The sample of participants was made up of 176 schoolchildren, 91 of whom were boys and 85 of whom were girls. All of the participants are first graders in the city of Niš, aged 7 to 8. The schools were picked at random, and the sample included participants whose parents gave signed consent for their children to participate in the study. Consent was obtained from the parents of children from the following elementary schools: Sveti Sava; Car Konstantin and Ratko Vukićević. All of the children were of sound health on the days during which the measurings took place. The measurings were carried out in the facilities of the schools which met certain criteria, and by a team of doctors, all specialists in the field of sports medicine,as well as physical education professors. The sample of measuring instruments

The predictors

The measuring instruments used to determine physical characteristics: 1. In order to determine longitudinal dimensionality, the following tests were used:body height (AVIST),leg length (ADUNO), arm length (ADURU); 2. In order to determine the transversal dimensionality, the following tests were used: shoulder width (AŠIRA), pelvic width (AŠIKA), hip width (AŠIKU); 3. In order to determine circular dimensionality the following tests were applied: average thorax volume (AOGKS), upper arm volume of an extended arm (AONAD), thigh volume (AOBUT), lower leg volume (AOPOT); 4. In order to determine subcutaneous fatty tissue the following test were used: upper arm skinfolds (AKNNA), back skinfolds (AKNLE), abdominal skinfolds (AKNTRB), thigh skinfolds (AKNBU), and lower leg skinfolds (AKNPOT). The criteria The measuring instruments for used to determine the jumping ability In order to determine explosive strength, the following tests were used: they plyometric jump (MPLS)and the standing depth jump (MSDM). The determination of anthropometric measures was carried out in accordance with the methodology recommended by the International Biological Program (IBP), Weiner &Lourie, 1969 (according to Đurašković, 2001). Standard instruments were used, which had been calibrated prior to use.

Experimental procedure
1. The plyometric jump-MPLS (Nazarenko, 2000). The aim: measuring the strength of leg extensors (primarily quadriceps, the gluteus and thigh hamstrings). Equipment and props: an even floor, a straight wall on which a measuring tape has been placed and a vaulting box 30 cm high. The task: The participants were told to stand next to wall and raise their right arm so that their middle finger was positioned on the measuring tape. The individual measuring noted the reached height.

Then the participants were asked to stand on the vaulting box, take off from it and swinging their arms jump upwards and touch the measuring tape on the wall. Marking: the participants jumped three times and each jump was noted. The height of the jump was calculated by subtracting the reach height from the height of the jump. Note: The take off from the vaulting box and the landing was on both feet. The person measuring stood opposite the measuring tape so that the level reached during the height was at eye level; 2. The standing depth jump -MSDM (Kurelić et al., 1975), *The aim*: measuring the strength of the leg extensors The task: The participants were asked to take off on both feel from a spring board which had been paced upside down and jump onto a mat, covering as great a distance as they were able. The landing was on both feet.

Three jumps were performed. The feet were kept close together. As preparation for the jump, the participants were allowed to swing both arms and lift themselves up on their toes prior to takeoff. The marking: The length of the jump was noted. The longest of three jumps was taken into consideration. The distance is measured in cm. Equipment and props: a spring board, a mat, measuring tape. Note: The participant had to be barefoot. In order to calculate the connection between physical characteristics and the vertical and horizontal jump, we used the regression analysis. The physical characteristics were used as predictors, and the vertical and horizontal jump as the criteria.

Results

Table 1 shows the basic statistical indicators of the anthropometric characteristics of the boys and girls. By gaining insight into the numeric values of the Std.Dev. for all four defined spaces, we can note a significant homogeneity in the case of the boys and girls in the space of transversal dimensionality for all three measured variables, while in the case of the girls that homogeneity was not as great, especially in the case of the shoulder width variable (AŠIR).The smallest homogeneity of the results for the boys and girls was found in the space of skinfolds, and the longitudinal dimensionality of the skeleton. Special heterogeneity was manifested in the skinfolds of children, both male and female, in favor of the girls (who showed smaller homogeneity of the results). Of all the measures of body voluminosity, body mass proved to be heterogeneous for both samples.

Table 1.The descriptive indicators of the anthropometric measures of the boys and girls

	Gender	Mean	Min	Max	Range	Std.Dev.
AVIST	m	129.03	116.80	142.80	26.00	5.35
	f	127.68	115.10	142.10	27.00	5.97
ADUNO	m	70.17	61.20	78.20	17.00	3.78
	f	70.23	60.50	80.00	19.50	4.20
ADURU	m	53.73	47.30	59.30	12.00	2.44
	f	53.61	34.20	85.20	51.00	4.85
AŠIRA	m	28.29	19.80	33.00	13.20	1.76
	f	28.75	21.60	72.50	50.90	5.13
AŠIKA	m	20.37	17.50	27.00	9.50	1.75
	f	20.32	17.00	28.50	11.50	1.68
AŠIKU	m	21.83	18.20	26.80	8.60	1.67
	f	21.91	17.60	26.20	8.60	1.62
AMAST	m	30.26	20.00	69.30	49.30	7.51
	f	29.66	19.40	47.00	27.60	6.28
AOGKS	m	63.28	54.80	90.50	35.70	6.07
	f	63.61	53.00	80.50	27.50	5.92
AONAD	m	19.18	15.00	29.50	14.50	2.72
	f	19.49	15.20	25.20	10.00	2.45
AOBUT	m	38.93	30.60	52.60	22.00	4.87
	f	39.30	21.50	53.30	31.80	5.03
AOPOT	m	27.20	22.20	36.30	14.10	2.80
	f	27.62	22.50	35.80	13.30	2.79
AKNNA	m	12.56	5.00	45.00	40.00	5.95
	f	12.86	4.00	25.00	21.00	4.28
AKNLE	m	9.85	3.00	44.80	41.80	6.93
	f	10.27	3.20	34.00	30.80	5.69
ANNTRB	m	10.82	2.60	31.40	28.80	7.30
	f	12.80	3.20	34.00	30.80	6.96
AKNBU	m	17.41	4.20	40.00	35.80	6.70
	f	19.26	5.60	38.00	32.40	7.02
AKNPOT	m	15.92	6.00	40.20	34.20	5.94
	f	14.68	4.60	46.40	41.80	7.05

Table 2.The descriptive indicators of the jumping ability of the boys and girls

	Gender	Mean	Min	Max	Range	Std.Dev.
MPLS	M	13.64	2.00	29.00	27.00	5.06
	F	11.58	1.00	23.00	22.00	5.14
MSDM	M	112.44	44.00	150.00	136.00	21.41
	F	102.68	45.00	150.00	105.00	17.78

The motor variables of the plyometric jump (MPLS) manifested almost identical values of the Std.Dev (m=5.06; f=5.14), which means that this is a homogenous sample in the case of this measure of motor space (Table 2). The probability of this occurrence should be sought for in the fact that all children at this age are still not sufficiently skilled for this type of motor task. A somewhat greater heterogeneity is manifested between the boys and girls for the depth jump, where it is assumed that the boys have better explosive strength of the lower extremities, Mean 112.44±21, when compared to the girls Mean=102.68±17.78. Nevertheless, the fact that the minimal and maximal achieved results for both genders were almost identical was of great interest.

Table 3. The regression analysis of the plyometric jump of the boys

	R	R Partial	Beta	Std.Err.	t(74)	P
AVIST	-0.02	0.20	0.43	0.25	1.75	0.084
ADUNO	-0.08	-0.17	-0.29	0.19	-1.49	0.140
ADURU	-0.04	-0.01	-0.02	0.18	-0.10	0.917
AŠIRA	-0.14	-0.03	-0.04	0.13	-0.29	0.771
AŠIKA	-0.21	-0.10	-0.11	0.13	-0.85	0.395
AŠIKU	-0.34	-0.15	-0.29	0.22	-1.33	0.186
AMAST	-0.28	-0.04	-0.07	0.19	-0.37	0.714
AOGKS	-0.28	0.07	0.17	0.29	0.58	0.566
AONAD	-0.32	0.07	0.19	0.30	0.63	0.528
AOBUT	-0.37	-0.19	-0.54	0.32	-1.67	0.098
AOPOT	-0.24	0.29	0.65	0.25	2.56	0.002
AKNNA	-0.29	0.19	0.32	0.20	1.63	0.107
AKNLE	-0.37	-0.12	-0.22	0.21	-1.02	0.310
ANNTRB	-0.48	-0.18	-0.39	0.24	-1.62	0.110
AKNBU	-0.44	-0.15	-0.25	0.19	-1.31	0.193
AKNPOT	-0.34	-0.01	-0.01	0.18	-0.05	0.961

(R= .619, R2= .383, F= 2.867, p= .001)

By means of the regression analysis, we obtained the values of the parameters for the plyometric jump for the sample of boys and girls (Tables 3, 4). The connection between the overall system of anthropometric variables of the boys and the motor test of the plyometric jump (MPLS) gives us the multiple correlation coefficient which with a value of R= .619, which explains the common variability between the system and criterion variable by approximately38% (R2 = .383).

The remaining 62% of the explanation of the overall variability of the motor test can be ascribed to the other characteristics and abilities of the participants, which were not taken into consideration during the study, and which primarily include motor skills (Table 4). The obtained results offer a statistically significant explanation of the criterion variable by using the system of anthropometric measurements at the (p=.001) level, which enables us to reach the conclusion that the system has an influence on the obtained results. A more detailed numeric analysis of the values of the regression coefficients clearly indicates that the variables of voluminosity and skinfolds, direct and inverse, are important for the prognosis of the results for the variable of the plyometric jump (MPLS), but are not statistically significant.

The only variable which had a statistically significant influence is the variable for lower leg volume (AOPOT). By means of the partialization of the correlation, we also obtained significant correlations betweenthe predictor and the criterion.

Table 4. The regression analysis of the plyometric jump of the girls

	R	R Partial	Beta	Std.Err.	t(68)	P
AVIST	-0.15	-0.02	-0.06	0.32	-0.18	0.858
ADUNO	-0.08	0.10	0.22	0.27	0.79	0.430
ADURU	-0.00	0.05	0.05	0.13	0.40	0.690
AŠIRA	-0.16	-0.16	-0.14	0.11	-1.30	0.196
AŠIKA	-0.35	-0.21	-0.25	0.14	-1.80	0.076
AŠIKU	-0.24	0.15	0.27	0.22	1.22	0.226
AMAST	-0.41	-0.21	-0.62	0.36	-1.73	0.028
AOGKS	-0.34	-0.06	-0.14	0.28	-0.49	0.624
AONAD	-0.29	0.12	0.30	0.31	0.97	0.337
AOBUT	-0.21	-0.02	-0.02	0.16	-0.13	0.897
AOPOT	-0.29	0.10	0.23	0.27	0.83	0.407
AKNNA	-0.32	-0.07	-0.14	0.24	-0.61	0.545
AKNLE	-0.33	0.02	0.03	0.21	0.17	0.869
ANNTRB	-0.32	-0.07	-0.12	0.22	-0.55	0.581
AKNBU	-0.25	0.03	0.05	0.19	0.27	0.785
AKNPOT	-0.35	-0.15	-0.20	0.16	-1.25	0.215

(R= .561, R2= .315, F= 1.953, p= .030)

Table 5. The regression analysis of the depth jump of the boys

	R	R Partial	Beta	Std.Err.	t(74)	P
AVIST	0.17	0.24	0.54	0.26	2.12	0.037
ADUNO	0.15	0.05	0.09	0.20	0.43	0.667
ADURU	0.05	-0.18	-0.30	0.19	-1.59	0.116
AŠIRA	-0.10	-0.20	-0.24	0.14	-1.75	0.084
AŠIKA	-0.13	-0.12	-0.14	0.13	-1.07	0.286
AŠIKU	-0.15	-0.09	-0.18	0.22	-0.80	0.426
AMAST	-0.05	0.11	0.18	0.20	0.92	0.363
AOGKS	-0.14	0.06	0.14	0.30	0.48	0.634
AONAD	-0.16	0.15	0.40	0.31	1.29	0.202
AOBUT	-0.21	-0.16	-0.46	0.33	-1.38	0.171
AOPOT	-0.12	0.14	0.32	0.26	1.22	0.226
AKNNA	-0.24	0.02	0.03	0.20	0.15	0.883
AKNLE	-0.29	-0.05	-0.10	0.22	-0.47	0.641
AKNTRB	-0.30	-0.09	-0.19	0.25	-0.75	0.456
AKNBU	-0.35	-0.27	-0.49	0.20	-2.45	0.017
AKNPOT	-0.23	0.11	0.17	0.18	0.92	0.358

(R=.576, R2= .332, F= .308, p= .008)

Table 6. The regression analysis for the depth jump of the girls

	R	R Partial	Beta	Std.Err.	t(67)	P
AVIST	0.06	0.09	0.23	0.31	0.74	0.459
ADUNO	0.07	-0.00	-0.01	0.28	-0.04	0.972
ADURU	0.06	-0.01	-0.01	0.13	-0.06	0.949
AŠIRA	-0.01	0.01	0.01	0.20	0.07	0.941
AŠIKA	0.03	0.02	0.02	0.11	0.16	0.876
AŠIKU	-0.19	0.00	0.00	0.14	0.00	0.997
AMAST	-0.20	-0.04	-0.06	0.22	-0.29	0.774
AOGKS	-0.23	-0.15	-0.43	0.36	-1.21	0.232
AONAD	-0.30	-0.08	-0.19	0.29	-0.66	0.510
AOBUT	-0.25	0.08	0.21	0.31	0.69	0.490
AOPOT	0.08	0.37	0.51	0.16	3.28	0.002
AKNNA	-0.20	0.04	0.09	0.27	0.35	0.730
AKNLE	-0.32	0.02	0.04	0.24	0.16	0.877
AKNTRB	-0.38	-0.09	-0.16	0.20	-0.77	0.447
AKNBU	-0.39	-0.17	-0.32	0.22	-1.43	0.156
AKNPOT	-0.25	-0.11	-0.17	0.19	-0.87	0.386

(R= .588, R2= .346, F= 1.912, p=.001)

Table 7. A comparison of the parameters found in previous research and the parameters in the current study

		AVIST		AMAST		MSDM	
	Gender	m	f	m	f	m	f
Bratić et al. 2011	Mean	129.03	127.68	30,26	29,66	112,44	102,68
	Std.Dev.	5.35	5.97	7.51	6.28	21.41	17.78
Ivanić, 1999	Mean	129.40	128.20	27.70	26.70	143.00	131.00
	Std.Dev	5.10	5.23	6.12	5.91	16.23	13.45
Burduk-iewicz, 2004	Mean	121.00	120.00	22.96	23.11	114.55	109.49
	Std. Dev	4.67	4.65	3.62	3.57	19.53	15.45
Lasanet al. 2005	Std.Dev	128.82	-	27.94	-	118.50	-
	Std.Dev	6.36	-	5.24	-	20.90	-

A high inverse influence was determined for skinfolds in all the measured variables, but with no statistical significance. For the sample of girls the regression analysis gave a multiple correlation of the system with a value of R=.56, by means of which we obtained a determinant coefficient of 31% (R^2=31). On the basis of these parameters, we can determine that the connections between the predictor variables of the anthropometric characteristics are different depending on gender. A somewhat better connection was determined for the sample of young boys. This occurrence can be explained by the fact that boys at this age are no longer included in some physical activities which require more natural forms of movement such as jumping, running, throwing, which lead to the strengthening of the locomotor apparatus and the realization of explosive strength, especially if we take into consideration the sensitive period for the development of this motor skill (Pavlović, 2010). The regression analysis of the depth jump variable (MSDM) for the boys has indicated somewhat different values of the multiple correlation between the opposing systems, where the multiple correlation with a value of R=.576, directly explains 33% of the common variability of the predictor and criterion. In comparison to the variable of the plyometricjump, we have a somewhat smaller connection and a smaller determinant coefficient. Nevertheless, of the overall number of anthropometric characteristics, only body height (AVIST) and thigh skinfolds (AKNBU) showed a statistically significant influence. What we have here is a case of a direct and indirect proportionality of the influence of the predictor on the results for the success for the depth jump, or in other words, the boys who had greater body height also had better results for the depth jump,while thigh skinfolds proved to be negative. By analyzing the results of the sample of girls, the regression analysis indicated a higher multiple correlation of the system with a value of R=.59, which led toa coefficient of determination of35% (R^2=35). Unlike in the case of the sample of boys, only one variable from the space of voluminosity had a statistically significant influence on the manifestation of the results for the successful performance of the depth jump.

On the basis of the defined predictor parameters and their values, we can determine that this motor test and the results are also the consequence of uneven values of the anthropometric measures applied in this study. This result would not be that surprising if we were to take into consideration the fact which supports previous opinions regarding thesensitivity phase of the manifestation of anthropometric characteristics and the role they play in the manifestation of explosive strength as the dominant motor skill. Compared to the research results of Burdukiewicz (Table 7), our results are different in terms of body height and body mass, where the sample from Niš indicated higher values, on average by 8cm for the boys and 7cm for the girls. In the case of the sample from Niš, we found higher values for both sexes, and a significant heterogeneity was manifested. Comparing the results with those of Lasanet al.2005 (Table 7), obtainedon the same population, we can note almost identical values for the sample of boys. Once we analyze the results for the depth jump, our defined sample showed weaker results in the test performance, especially in the case of the girls. Our sample from Niš showed almost identical values for the parameters of body height, when compared to the results of the research carried out by Ivanića et al. (1999) for both genders. Body mass had higher values and the greatest difference was manifested in the case of the depth jump variable, where the sample from Niš showed significantly smaller values, on average more than 20cm for both genders. More extensive research which has been carried out to date included a population of younger schoolchildren than the one that this research is based on (Ivanić 1988; Ahmetović et al. 1990; Ivanić et al., 1999; Bala et al., 2006; Oreb et al., 2008). The research obtained results which reflect a significant heterogeneity in terms of morphological dimensions and motor skills, which are different when compared to the age and gender of the participants. These differences increase with age, and are smallest during the ages of 6 and 7, when it comes to morphological status and certain motor skills (Đurašković, 2001). This research supports some previous findings from studies which focused on the influence of morphological dimensions of the manifestation of explosive strength, but to a smaller extent (Ivković, 2008; Stojanovićet al. 2006; Wion et al.2006).Nevertheless, it is important to note the fact that with age, the manifestation of explosive strength increases, as do motor skills, and so we have certain sensibility periods where it can be influenced to a certain extent (Kukolj, 1997; Stojiljković, 2003). Explosive strength, as a type of strength, is a part of motor space and is susceptible to various influences, both genotype and phenotype. In addition, it the study carried out by Kondrič (2000),it was determined that a significant bond exists between the morphological characteristics and motor skills of elementary schoolchildren aged from 7 to 18, following a comparison based on age. The consequences of these results can be ascribed to the influence of endogenic factors (inherited features, gender, endocrine glands) as well as that of certain egzogenic factors, primarily to the modern way of life and the decreased level of activity of children of this age, which spend more of their time in a passive state.Insufficient physical activity has an effect on the proper growth, development and maturity of a young body as a unified bio-psychological personality.

Conclusion

The results that were obtained by processing the data collected from our sample of boys and girls from Niš have confirmed some previous findings which treated the problem of the influence of and connection between anthropometric characteristics and the results for the successful performance of motor movements in the space of explosive strength (Zurc et al., 2005; Wion et al., 2006; Bala et al., 2006; Ružbarska, 2007; Holm et al., 2008). The results that we obtained and processed speak in favour of the fact regarding the significant connection between morphological dimensions and the variables of explosive strength. These connections differ depending on the age and gender of the participants involved in the testing. When we refer to gender, it is important to note that we have various results which speak in favour of the unequal manifestation of explosive strength. This is a result of the fact that explosive strength is under the influence of the mechanism for energy regulation (excitation intensity) and is highly genetically conditioned (over 95%), and thus is independent in its hypothetical space. Fatty tissue usually has a negative influence on it, especially in the case of participants from this age group, since children at this age find it much more difficult to performed a movement (jump) if they have greater body mass, which acts as an obstacle. Despite the great genetic influence on the manifestation of explosive strength, better test results were mainly obtained for the standing depth jump and the plyometric high jump in the case of participants with smaller values of body mass, smaller upper arm volume and greater thigh volume.

The regression coefficients have negative signs so that the relationship between the length of the standing depth jump and body weight, as well as upper arm volume, is inversely proportional. In addition to an exceptionally high influence of endogenic factors on the manifestations and status of morphological dimensions, a significant influence is manifested by egzogenic factors: the environment, socio-economic status, state of health and physical (in)activity.

References

Ahmetović, Z., Pavlović, D., & Popmihajlov, D. (1990). *Fizički razvoj i fizičke sposobnosti stanovnika Vojvodine* [The physical development and physical abilities of the population of Vojvodina. In Serbian.]. Novi Sad: Zavod za fizičku kulturu Vojvodine.

Bala, G., Stojanović, Mi., & Stojanović, Ma. (2006). *Merenje i definisanje motoričkih sposobnosti dece* [The measuring and definition of the motor skills of children. In Serbian.]. Noviad: Fakultet sporta i fizičkog vaspitanja.

Biskanaki, F., Panagiotou, A.K., Papadopoulou, S.K., Spiridou, N.G., Gallos, G.K., Gill, J., et al. (2004). The effect of sex and obesity on specific motor skills of Greek children aged 8 years old Pakistan. *J.Med Res, 43*(3), 99-103.

Brunet, M., Chaput, J.P., & Tremblay, A. (2007). The association between low physical fitness and high body mass index or waist circumference is increasing with age in children: the 'Québec en Forme' Project. *Int J Obes (Lond), 31*(4), 637-643.

Burdukewicz, A. (2004). Sex differentiation of morphological and motor features in children and youth. *Human Movement, 5*(1), 27-34.

Holm, I., Fredriksen, P.M., Fosdahl, M., & Vollestad, N. (2008). A normative sample of isotonic and isokinetic muscle strength measurements in children 7 to 12 years of age. *Acta Paediatrica, 97*(5), 602-607.

Đurašković, R. (2001). *Biologija razvoja čoveka sa medicinom sporta–praktikum* [The biology of human development along with sports medicine – a handbook. In Serbian.]. Niš: SVEN.

Ivković, I. (2008). The impact of morphological and motor dimension on explosive strength of boys aged 11-12. *Acta Kinesiologica 2*(1), 85-89.

Ivanić, S. (1988). *Istraživanje fizičkog razvoja, fizičkih i funkcionalnih sposobnosti dece i omladine SR Srbije uzrasta od 7-15 godina* [The study of the physical development, physical and functional abilities of children and the young of Serbia, ages 7 to 15. In Serbian.]. Beograd: JZFK.

Ivanić, S., & Ivanić, V. (1999). *Predselekcija-kriterijumi i norme za određivanje predispozicija dece i omladine za vrhunska sportska dostignuća* [The pre-selection of the criteria and norms for determining the predispositions of children and the young for top sports results. In Serbian.]. Beograd: Republičkizavodza sport Beograd.

Kondrič, M. (2000). *Promjene odnosa između nekih antropometrijskih osobina i motoričkih sposobnosti učenika od 7. do 18. godine* [The changes in the relationship between certain anthropometric characteristics and motor skills of school children ages 7 to 18. In Croatian.]. /Disetracija/. Zagreb: Fakultet za fizičku kulturu.

Kurelić, N., Momirović, K., Stojanović, M., Šturm, J., Radojević, Đ., & Viskić-Štalec, N. (1975). *Struktura i razvoj motoričkih dimenzija omladine* [The structure and development of morphological and motor dimensions of young people. In Serbian.]. Beograd: Institut – FFK.

Lasan, M., Pažanin, R., Pejčić, A., & Katić, R. (2005). The mechanisms of morphological-motor functioning in male primary school first-to fourth-graders. *Kinesiologia Slovenica, 11*(2), 25-32.
Oreb, G., Zović, M., & Marelić, N. (2008). Evaluation of the results assessing motor abilities of boys and girls aged 11-14 during selection in rowing. *Acta Kinesiologica, 2*(1), 47-51.
Ružbarska, I., & Turek, M. (2007). Hierarchy analysis of motor abilities at primary school children.Nadjenosawww. sportkinetics2007.com/Data/Ruzbarska.doc.
Stojanović, T., Nikolić, M., & Nešić, G. (2006). Uticaj antropometrijskih karakteristika na manifestaciju eksplozivne snage kod odbojkaša uzrasta 13 godina [The influence of anthropometric characteristics on the manifestation of explosive strength of volleyball players aged 13 In Serbian.]. *Acta Medica Medianae, 45*(2), 53-57.
Šimek-Šalaj, S., Milanović, D., & Jukić, I. (2007). The effects of proprioceptive training on jumping and agility performance. *Kinesiology, 39*(2), 131-141.
Temfemo, A., Hugues, J., Chardon, K., Mandengue, S-H., & Ahmadi, S. (2009). Relationship between vertical jumping performance and anthropometric characteristics during growth in boys and girls. *Eur J Pediatr, 168*, 457-464.
Zurc, J., Pišot, R., & Stojnik, V. (2005). Gender differences in motor performance in 6.5 year-old children. *Kinesiologia Slovenica, 11*(1), 90-104.
Wyon, M., Allen, N., Angioi, M., Nevill, A., & Twitchett, E. (2006). Anthropometric factors affecting vertical jump height in ballet dancers. *Journal of dance medicine & Science, 10*(3&4), 106-110.

ANTROPOMETRIJSKE ZNAČAJKE – ODREDNICE SPOSOBNOSTI VERTIKALNOG I HORIZONTALNOG SKOKA

Sažetak

Svaki aspekt sporta integrira u sebi određene ljudske antropološke dimenzije. Koja dimenzija će biti dominantna u određenoj fizičkoj aktivnosti, ili sportu, ovisi o prirodi sporta, kao i oprirodu motoričkih zadataka koji se ostvaruju. Jako često su teme istraživanja u antropološkom prostoru morfološke dimenzije, kao i antropometrijske karakteristike koje su definirane kao prediktori različitih motoričkih manifestacija. Te manifestacije mogu uključiti sve segmente motoričkog prostora. U ovom radu ćemo definirati segment eksplozivne snage (horizontalna i vertikalna sposobnost skoka) u slučaju dječaka i djevojčica, prvog razreda OŠ, s ciljem utvrđivanja utjecaja manifestnih antropometrijskih karakteristika, kao determinanti vertikalne i horizontalne sposobnosti skakanja djece.

***Ključne riječi**: dječaci, djevojčice, pliometrijski skok, skok u dubinu*

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Correspondence to:
Prof.Milovan Bratić, Ph.D.
University of Niš
Faculty of sport and physical education
18000 Niš, Čarnojevića 10a, Serbia
Phone: +381 (0)18 510 900
E-mail: bratic_milovan@yahoo.com