

COMPARATIVE ANALYSIS OF THE ANTHROPOMETRIC CHARACTERISTICS OF STUDENTS

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Abstract

Very frequent researches in physical culture for purpose have to find some new facts which would be a new real basis for confirmation and rejection of some earlier laws. Beside numerous researches that treat the problems of anthropological space of the human, most of it is directed in different segments of the same. Sometimes it is the mobility space, morphology, functional abilities, and very frequent of cognitive abilities and conative traits of the examined. Depending from the placed actual problem the direction and the action of the research will depend from. Regarding that the immediate bearer and doer of the physical culture is a human this is the reason why the researches are connected with human and his traits and characteristics. Looking at complex hierarchy of anthropological space the possibility of approach of its individual studying is imposed. Individual meaning about subspaces that are integrated in the anthropological space and their interaction with the same and other segments. In the research the comparative analysis of such one space in physical faculty students is conducted and certain laws are determined about growth and development of student's population.

Key words: *comparison, growth and development, anthropometric characteristics, students*

Introduction

Numerous researches that are connected with the problems of this work are published together with anthropological sciences much earlier than in the area of the physical culture. The researches of these problems in the area of physical culture were diverse and unequal in the beginning. This diversity was in the mere methodology of research, which did not give the possibility of results comparison. This was the reason for founding the ICSPFT (International Committee for Standardization of Physical Fitness Tests) in 1964 and in 1969 the IBP-International biology program (Weiner & Lourie) was published, which brought to standardization in the physical development research. With this the researches became significantly broader and all-inclusive. In so far researches relevant for the area of these problems the partial researches of physical development of the samples of different population are met. So far researches in the physical culture space can be divide in three groups which are: the researches that refer to determining the structure of some spaces with psychosomatic status; the researches of relations of segments and subsegments of the system human with special accent on mobility, morphological and functional space. In this case the accent of research will be on one subsegment of psychosomatic status that is on anthropometric traits of student's population. Anthropometric traits are manifested as latent morphology dimensions that began as a consequence of application of statistical procedures, mainly factors analysis where four latent dimensions were isolated that are most commonly interpreted, so called four-dimensional model.

Only in XX century in the second half, the more significant researches from morphology problems began to appear. Morphology traits as important segment of psychosomatic status present the system of anthropometric manifest and latent dimensions. The determining of latent structure of anthropometric dimensions is connected with the development of different factor analysis techniques. On the other hand the defining of morphology traits depends from age, gender, genetically and eco-social components, but also from some anthropometric measures which are included in the research. From many so far researches of anthropometric dimensions in this work the short review will be given on the researches that significantly influenced on the acceptance of the model that nowadays is interpreted and which is included in this research. Many researchers studied the problem of analyzing and defining the anthropometric traits as well as their relations. In certain number of researches the anthropometric traits of the school children of different ages were studied (Kurelić, 1975; Anastasovski, 1981; Ilić, 1991; Marušić et al., 1997; Koprivica, 1996; Jakonić et al., 1998; Doder, 1998; Kukulj et al., 2000; Krsmanović et al., 2000; Radovanović et al., 2001), youths of both gender different age (Škerlj, 1960; Momirović, 1969, 1970; Stojanović, 1971, 1975; Kurelić et al., 1978; Hošek, 1980; Ivanović, 1985), students of different faculties (Smoldaka, 1950; Brodar, 1960; Pogačnik, 1966; Gavrilović, 1972; Vlah 1983; Đurašković, et al., 1984; Caput-Jogunica, 2000). Somewhat less researches were conducted on the physical culture faculty students (Hošek, 1982; Momirović et al., 1987; Medved et al., 1992; Mišigoj-Duraković et al., 1995; Pavlović, 2004; Bratić, et al., 2007).

Mostly those were researches that treated the problems of anthropometric status, factors structure, nutrition of population of certain age etc. So far researches show that those were attempts in clarification and defining then still unknown area of morphology space. It was tried to define and exactly determine the field of anthropometric action, of different sample, gender and age of examinee. That contributed to a better and clearer understanding of these problems when talking about anthropology status. The research results of morphology traits of children and youths indicate that it is possible to talk about differences regarding anthropometric traits, so that longitudinal and transversal dimensionality of skeleton which are present in grown ups, do not differentiate so the unique trait –the dimensionality of skeleton is obtained. There are researches that point on one dimensionality, but also multy dimensionality of morphology space. Though, the important thing to mention is that all these results are obtained on the basis of indicator of anthropometric traits which are only relevant parameters when talking about morphology space, no matter which sample of examinee it is about. If we define any examinee population the first thing we define is the age chronological or biological age of the examinee. The mere growth and development of the human begins from the moment of fertilization in mothers womb. The growth of organism means changes of locomotor apparatus, primarily the growth of bones in high and width what leads to morphology noticeable changes of every individual, in contrast to development that means changes in the function of cells, tissues, organs and organic systems (Đurašković, 1997).

That process is relative and depends from different age periods. The growth and development is accompanied by physiological beside anatomical changes, that is by certain functional changes (Jakonić & Bajić, 1996; Mišigoj-Duraković, 2008). The necessity of knowing the influence of some factors is great. Of endogenous factors the heredity plays the most significant role in body growth and development. The influence of heritage is dominant on all variables of longitudinal body dimensionality and transverse dimensionality and amounts about 98%, in body mass the influence is less and amounts about 60%. The phenomenon of anomalies in the development, as well as much disease can be conditioned by heredity factors as well as by the factors of environment influence (Jakonić & Bajić, 1993). As second factor is race, that is the beam of race and national trait. It is known that in Europeans the highest growth is characteristic for Norwegians, British and that small body height is present in French and Spanish. Taner (1964) find on sportsmen the participants of Olympic games in Rome and Tokyo where he described race traits of physical development of sportsmen of black race. He got the results that the length of legs and arms in black sportsmen with regard to body length are greater while in white sportsmen in the same disciplines the lower leg was thinner and pelvis was narrower.

The musculature of black sportsmen in most cases fitted to the demands of athletics and especially on running with jumping across hurdles. Gender also has significant influence on growth and development and most properties are different already in childhood in male and woman gender and those changes are more expressed in grown-ups. Of physiological properties the pulse frequency in women is greater for 10 beats per minute in relation to average pulse frequency in men (Đurašković, 1997). As third important endogenous factor are endocrine glands, that is their functions. In postnatal period starting from the period of infant the significant influence has the thoracic thymus gland and also the effect of thyroid gland is expressed. The effect of pituitary is significant from 3-4 years and in the following years of growth and development, and the effect of adrenal glands is very significant in these phases where disruption of hormonal balance leads to certain somatic changes. From exogenous factors the significant role have geographic and climatic factors (Temperature, light, humidity, barometric pressure, air composition, electromagnetic waves and radioactivity). Also the influence of socio-economic factors in a series of researches that were carried out in the world show that the physical growth and development in economically stronger families, on average, better than the children who come from poorer families (eg, height, weight). The difference is determined by the quality of nutrition and housing conditions and social and hygienic factors. It is known that proper nutrition is necessary for normal growth and development and to achieve maximum genetic growth (Đurašković, 1997; Ostojic et al. 2003), taking into account the optimal nutrition that would be rich in animal protein, carbohydrate, fats, minerals, vitamins. Today's children are 10-15 cm higher than their peers from the beginning of this century (Mišigoj-Durakovic, 2008).

This phenomenon is marked acceleration in the development, and is characterized by a number of indicators. It is important to note, that if during the plastic period of human growth and development a person burdened with high physical work can lead to slowdowns and delays in physical development. Health status also has some influence as an exogenous factor .. This is manifested through various acute and chronic minor illness and minor injuries leave no significant effects on growth and development. However difficult chronic diseases and serious violations that occur during growth and development can leave a significant impact. In particular, the negative effects manifest diseases such as rheumatism, rickets, bone tuberculosis, chronic dysentery, some endocrine diseases and other (Nieman, 1990). As an important exogenous factor is physical activity and physical exercise. It is known that physical activities carried out through the game contribute to proper growth and development of children. Physical exercise develops muscles, increases the volume of muscle, strengthen the links and joints. For proper application of physical exercise is necessary to know the impact of exercise on the development of

cardio-vascular and respiratory (Jakonic and Bajic, 1996). Based on the results of previous research regarding the differences defined and addressed is also this study that treats possible differences regarding anthropometric parameters. The case study area is morphologically students from the Faculty of Physical Education in East Sarajevo presented through the prism of analysis of anthropometric parameters. The problem is to conduct research comparing these anthropometric characteristics of students on the basis of previous studies on the same population in order to possibly could determine certain legality in terms of growth and development stages, or acceleration, depending on endogenous and exogenous factors.

Methods

A sample of 154 respondents that were included in the research is defined as the population of students of the Faculty of Physical Education in East Sarajevo, aged 21-22 years. The research was carried out on a sample which is stationed in the development stage of morphological characteristics. All subjects voluntarily participated in the survey. For assessment of morphological area 14 anthropometric characteristics by method of IBP (Weiner & Lourie, 1969) is applied, that represented morphological area of the student population. Selection of anthropometric characteristics is taken from the four-dimensional model, which implies the existence of four latent dimensions of morphological space: *to assess the longitudinal skeleton dimensionality*: 1 body height (AVIT), 2 length of legs (ADUN), 3 length of the arm (ADUR); *to assess the volume and body weight*: 4 body weight (AMAS), 5 volume of the upper arm (AONL), 6 volume of the forearm (AOPL), 7 Thigh volume (AONK), 8 lower leg volume (AOPK) *to assess the transversal dimensionality of the skeleton*: shoulder width (ASIR), 10 width of the pelvis (ASIK), 11th diameter of the knee joint (ADZK) *to estimate body fat*: 12 upper arm skin fold (ANNL), 13 skin fold back (ANLE), 14 abdominal skin fold (ANTH). In order to obtain relevant results and enable interpretation of the same, statistical package was applied which included an analysis of central and dispersion parameters on the basis of whom was made a comparative analysis of the results obtained by applying T-test. As a comparative sample, and for clarity of analysis and insight in acceleration of growth and development of these populations were used the results of a sample of 176 students from the Faculty of Physical Education of Belgrade (1982.) and 160 students from Nis (2007).

Results and discussion

Table no. 1 contains the basic statistical parameters of anthropometric variables, students of East Sarajevo, Belgrade and Nis. For each variable were calculated the main central and dispersion parameters, which show us the normality of results distribution of applied variables.

For insight into the orientation and any comparisons in terms of growth and development of state that is acceleration in recent years in the same population, the results are the average values of anthropometric variables FFV students in Belgrade and Nis. Anthropometric measure knee joint diameter (ADZK) is not measured in a sample of students of Belgrade and Nis, so it is not entered in the statistical analysis for comparison of results.

Table 1 Descriptive statistics of morphological variables of students in Sarajevo, Belgrade and Niš

	Uzorak	AS	Min	Max	Rang	SD	Skew	Kurt	CV%
AVIT	SA	181.43	167.00	194.50	27.50	6.43	-.20	-.87	3.54
	BG	176.93	160.60	203.50	42.90	6.89	.43	4.17	3.89
	NI	180.13	165.00	198.80	33.80	6.75	.23	-.31	3.75
ADUR	SA	84.83	72.00	94.00	22.00	4.46	-.22	-.29	5.25
	BG	77.85	68.60	88.70	20.10	3.66	.19	2.94	4.70
	NI	78.49	71.20	86.80	15.60	3.29	.34	-2.32	4.19
ADUN	SA	102.54	84.00	120.00	36.00	7.26	.07	-.47	7.09
	BG	99.55	89.00	117.20	28.20	4.94	.55	3.74	4.96
	NI	102.40	86.70	117.80	31.10	5.21	-.67	1.50	5.09
AONL	SA	29.84	25.00	40.00	15.00	3.03	.80	.52	10.15
	BG	28.36	22.50	37.20	14.70	2.34	.62	4.51	8.27
	NI	26.55	22.00	34.50	12.50	2.04	1.91	2.03	7.67
AOPL	SA	27.24	22.50	39.00	16.50	1.96	8.67	3.67	7.19
	BG	26.51	21.70	31.00	9.30	1.62	.22	3.66	6.09
	NI	25.15	21.70	33.50	11.80	1.66	4.88	9.69	6.61
AONK	SA	55.15	45.00	68.00	23.00	3.98	.38	.21	7.21
	BG	54.30	46.00	64.90	18.90	3.30	.32	3.14	6.09
	NI	54.04	41.50	66.50	25.00	4.17	.79	7.24	7.72
AOPK	SA	37.25	32.00	42.50	10.50	2.34	.03	-.79	6.28
	BG	37.30	32.20	42.50	10.30	2.21	.04	2.75	5.94
	NI	36.87	25.50	47.50	22.00	2.68	-.90	7.88	7.28
AMAS	SA	76.82	55	110	55	9.31	.40	2.88	12.11
	BG	70.08	50.00	90.20	40.20	8.12	.08	2.77	11.59
	NI	74.35	50.00	98.00	48.00	8.69	.39	.19	11.68
AŠIR	SA	44.74	40.00	53.00	13.00	2.88	.52	.25	6.43
	BG	39.51	34.80	44.90	10.10	2.03	.36	2.82	5.14
	NI	40.00	35.00	45.03	10.03	1.99	.71	-.64	4.95
AŠIK	SA	29.67	24.00	36.00	12.00	2.09	-.09	.39	7.04
	BG	27.41	22.80	31.80	9.00	1.92	.07	2.47	7.00
	NI	29.80	25.00	34.30	9.30	1.68	2.65	.28	5.75
ADZK	SA	10.70	9.50	12.9	3.40	.74	.69	-.42	6.91
	BG	-	-	-	-	-	-	-	-
	NI	-	-	-	-	-	-	-	-
ANNL	SA	12.30	3	36	33	6.55	1.33	1.72	53.25
	BG	7.28	3.80	16.60	12.80	2.20	1.24	5.26	30.26
	NI	10.23	3.20	20.00	16.80	3.16	2.08	.12	31.09
ANLE	SA	9.93	2	25	23	3.94	1.10	2.05	39.67
	BG	8.62	4.60	17.30	12.70	1.83	1.12	5.87	21.28
	NI	10.03	2.20	23.20	21	3.54	1.15	2.45	34.67
ANTH	SA	12.79	4	35	31	6.63	1.65	2.64	51.83
	BG	9.40	5.30	22.40	17.10	2.95	1.33	5.36	31.45
	NI	10.20	3.60	23.00	19.40	3.83	2.96	.06	37.68

Table 4 Differences between the students East Sarajevo and Belgrade (t-test)

	SA (154) AS	SA (154) SD	BG (176) AS	BG (176) SD	T-test	p<0,05
AVIT	181,43	6,43	176,93	6,89	8,96	0,0000
ADUR	84,83	4,46	77,85	3,66	7,91	0,0000
ADUN	102,54	7,26	99,55	4,94	4,12	0,0000
AONL	29,84	3,03	28,36	2,34	3,03	0,0000
AOPL	27,24	1,96	26,51	1,62	2,94	0,0002
AONK	55,15	3,98	54,3	3,3	2,80	0,0347
AOPK	37,25	2,34	37,3	2,21	.67	0,8420
AMAS	76,82	9,31	70,08	8,12	8,13	0,0000
AŠIR	44,74	2,88	39,51	2,03	6,79	0,0000
AŠIK	29,67	2,09	27,41	1,92	8,92	0,0000
ADZK	10,7	0,74	-	-	-	-
ANNL	12,3	6,55	7,28	2,2	9,12	0,0000
ANLE	9,93	3,94	8,62	1,83	3,66	0,0001
ANTH	12,79	6,63	9,4	2,95	4,32	0,0000

Table 5 Differences between the sample of students East Sarajevo and Niš (t-test)

	NI (160) AS	NI (160) SD	SA (154) AS	SA (154) SD	T-test	p≤0,05
AVIT	180,13	6,75	181,43	6,43	2,24	0,0818
ADUR	78,49	3,29	84,83	4,46	10,24	0,0000
ADUN	102,4	5,21	102,54	7,26	.11	0,8441
AONL	26,55	2,04	29,84	3,03	8,76	0,0000
AOPL	25,15	1,66	27,24	1,96	9,01	0,0000
AONK	54,04	4,17	55,15	3,98	3,07	0,0165
AOPK	36,87	2,68	37,25	2,34	.45	0,1824
AMAS	74,35	8,69	76,82	9,31	2,86	0,0156
AŠIR	40	1,99	44,74	2,88	5,34	0,0000
AŠIK	29,8	1,68	29,67	2,09	1,89	0,5432
ADZK	-	-	10,7	0,74	-	-
ANNL	10,23	3,16	12,3	6,55	5,76	0,0004
ANLE	10,03	3,54	9,93	3,94	3,45	0,0023
ANTH	10,20	3,83	12,73	6,63	4,86	0,0016

In Table 4 using T-tests were obtained statistically significant differences between students of Sarajevo and Belgrade on the significance level of $p \leq 0,05$. The comparison of students from Sarajevo and Belgrade 1 from 4 morphological variables in 13 cases were recorded differences of arithmetic means with statistical significance. Slightly smaller difference that was not statistically significant at a given level was observed in the variable of voluminosity volume of lower leg (AOPK), where the values are consistent. In general it can be concluded that these two samples are significantly different in terms of numerical values of morphological features, as confirmed on the basis of the value of T-test variables tested. Practically, though it is the same population of students of physical education, differences are evident, which can be attributed to the influence of certain exogenous factors affecting the growth and development as well as the selection itself for admittance to studies leading to greater heterogeneity the comparative sample of students. Slightly smaller but statistically significant differences were present in the comparison of the Sarajevo students in relation to the Nis sample (Table 5). Compared sample of students of Sarajevo and Nis showed somewhat different situation in terms of morphological characteristics of the difference. These differences of means were achieved in 10 of the 14 defined measures with statistical significance. Variables that have not achieved significant large differences in the given value $p \leq 0,05$ are from the longitudinal space dimensionality of the skeleton: body height (AVIT), length of legs (ADUN), the voluminosity space variable volume of lower leg (AOPK), and from the transverse measures of the width of the pelvis measures (AŠIK). Also, T-test values are indicators of such relationships. Compared with the previous pattern that was compared it can be concluded that these two samples of students of Sarajevo and Nis are different in terms of morphological characteristics, which is confirmed by values t-test. However, Sarajevo and Nis students are more homogeneous in terms of morphological status as the arithmetic mean of these differences are less,

especially with four anthropometric measures that have not achieved the necessary difference.

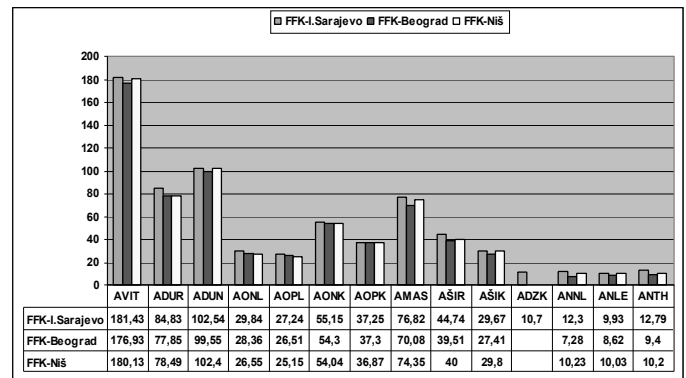


Figure 1. Diagram of means analyzed anthropometric characteristics

In order to better understand the value of obtained results below are in more detail presented central and dispersion values of the variables of all four latent dimensions. Average value (AVIT) of the East Sarajevo students is AS = 181.43 cm, and significantly higher than in the sample of students of physical education in Belgrade (AS = 176.93cm) where the value (T= 8.96) and students in Nis (AS = 180.13cm), for T = 2.24. The relative variability of the height of students body from East Sarajevo is the smallest (CV% = 3.54) while the other two samples are slightly higher, but still balanced. This result tells us of the considerable homogeneity when it comes to the variable height of the body. Distribution of the results of the anthropometric characteristic do not differ significantly from normal in terms of the curvature of (skew), but in terms of elongated, asymmetric platikurtic ($-0.87 < 2.75$). The consequence of slight negative asymmetry in terms of skewness (-0.20) can be characterized by the fact that in the measured sample is defined more students with something more than the average body height can be seen from the median value (183.00cm). Given the definition of skewness here is of a case of an inverse proportionality, where the negative asymmetry of height presents a better result. This phenomenon can be explained by the specificity of the sample of candidates who entered the college, ranging from the athletes, and they are known by what we know is characterized by greater heights. When talking about the blurring the results of heights that can be concluded on the basis of range of the minimum and maximum level of results where the lowest value of the result 167cm and maximum 194.50 cm. The value of arm's length (ADUR) sample of students of East Sarajevo is AS = 84.83cm, and greater by 6-7 cm relative to the sample of students of physical education in Belgrade (AS = 77.85cm) where T=7.91 and students in Nis (AS = 78.49cm) for the value of T=10.24. The relative variability of arm's length is slightly larger value (CV% = 5.25) while in the other two samples is lower and nearly equal. This result tells us about weaker homogeneity when it comes to arms length. This can be explained by the appearance of the body height is not always

linear and follows the length of the arms or legs but is evident disproportion of height and limbs during growth and development and leads to phenomena, penguin walk. "Distribution of the results of the anthropometric characteristic deviate from the normal distribution of East Sarajevo in terms platikurtic ($-.29 < 2.75$) where a number of blurring results, we can see a slight negative asymmetry as well as in body height (skew = $-.20$). The difference is expressed with the mean length of leg (ADUN) where in students of Sarajevo 102.54cm and is slightly larger than the sample Belgrade (AS = 99.55cm; T=4.12) and of Nis (AS=102.40m, T=0.11) population. Variability of this variable is of greater value (CV%= 7.09), in contrast to the analyzed values of compared student population. The tested parameters of leg length distribution results show that there is no significant deviation from normal distribution in terms of the degree of curvature, but the distribution is expressed in the direction of asymmetric negative platikurtic ($-.47 < 2.75$). The average value of the stretched upper arm volume (AONL) of students is 29.84cm, unlike compared samples where the value of AS = 25.15cm; T=3.03 for students of the Faculty of Nis, to the AS=28.36 cm, where the T-test = 8.76 for Belgrade sample. In the tested variable of East Sarajevo, students achieved a better result or a greater volume of the upper arm as a result of greater muscle mass. Status of the results can be explained by the fact that physical education students have a number of practical exams, where the strength is required as motor skill and leads to significant hypertrophy of active muscle mass. The differences are manifested with measures of variability (CV%=10.17) and slightly less for students of other faculties. The parameters of the distribution of results of the volume of the upper arm also differ as to the degree of elongation where we measure a positive asymmetric platikurtic. The mean value of the volume of the forearm (AOPL) in Sarajevo students is AS=27.24cm, which showed a higher value than the population of Belgrade and Nis Faculty for value (T=2.24; T=9.01). In the variable tested students of I. Sarajevo achieved a better result or a greater volume of the forearm. Similar differences are manifested in the measures of variability (CV% = 7.22) and slightly less for students of other faculties. The parameters of the distribution results show that this variable is significantly different from the normal in the direction of leptokurtic distribution of positive asymmetry (kurt.=8.67), where the results are very compressed, while the degree of curvature does not deviate from normal distribution. Also, the average value of the Sarajevo students thigh volume (AONK=55.15) is greater than the value of the Belgrade sample (AS = 54.30 cm, for T=2.80) and the value of Nis students (AS=54.04cm, T=3.07). These differences are manifested with measures of variability, where CV=7.23% and slightly less in students from other faculties (Ilić, 1991). To highlight is the significant values of the voluminous measures from students of the Belgrade University.

The parameters of the distribution of results show that the upper leg volume do not differ significantly in terms of the degree of curvature, but only to the degree of elongation, positive asymmetry of platikurtic distribution. The mean volume of the lower leg (AOPK) sample East Sarajevo is 37.25cm and is greater than the value of the Belgrade sample (37.30 cm, T=0.67) and values of students at the University of Niš (36.87 cm T=0.45). The relative variability of the lower leg volume was slightly higher (CV% = 6.28) than students in Belgrade (CV%=5.94), and a smaller than the sample of students from the University of Nis (CV% = 7.28). The parameters of the distribution of results show that the volume of the lower leg do not differ significantly in terms of the degree of curvature, in contrast to the elongation degree, platikurtics in the direction of negative asymmetry (kurt.= $-.79 < 2.75$). The average value of body mass of students (AMAS) is 76.82 kg, a slightly higher value compared to Belgrade (AS = 70.08kg; T=8.13) and Niš (AS=74.35kg; T=2.86) population of students. This positive trend is observed of these anthropometric characteristics of what is sometimes characterized as negative, and sometimes as a positive measure of morphological status. Depending on the type of activity, its positive or negative role depends of it also. If it comes to some martial arts (sumo wrestling), athletic events (shot put, discus, javelin, etc.) it can be said to have a positive effect on sports scores, unlike some other disciplines (running, jumping, cycling, sports and rhythmic gymnastics, swimming, etc..) where the body weight has a negative impact. The relative variability of body weight follows values of arithmetic means. Thus, we have value (CV% = 12.11) slightly higher than in the remaining two samples where for the student population from Belgrade amounts (CV%=11.59), and for Nis (CV% =11.68). The parameters of the distribution results show that there is no significant deviation from normal distribution with respect to the degree of curvature, but only in terms of positive asymmetric platikurtics, where the measured range of students is even 55kg. The average value of the width of the shoulders (ASIR) Sarajevo sample is AS = 44.74cm and below the value of Belgrade and Nis, which also reflects the value of the t-test. When compared the relationship of variability in the observed populations, then it is a little higher in the Sarajevo students (CV% = 6.43). The parameters of the distribution of the obtained results show that the width of the shoulder is a normal distribution in terms of curvature. In terms of elongated asymmetric we have a positive platikurtic of the variable (kurt.=.25<2.75). The mean width of the pelvis (ASIK) the Sarajevo students is 29.67cm. Similar values we perceive also in the other two observed sample results with small variations in the value of T = 1.89 Nis T = 8.92. This measure of the transversality possess the relative variability (CV% = 7.06) as well as so far most of the analyzed parameters. The parameters of the distribution of the results obtained of the pelvis width say that it is a normal distribution in terms of curvature, while in

terms of elongation the normality is violated in the direction of positive asymmetric platikurtic. The average value of the diameter of the knee joint (ADZK) students of East Sarajevo is 10.70 cm. And this measure of transversality has a relative variability (CV% = 7.06) as well as so far most of the analyzed parameters. On this fact indicate the values of T-test for both samples. The parameters of the distribution of the obtained results indicate that the width of the pelvis is a normal distribution in terms of curvature. In direction of elongation we observe a negative asymmetric platikurtic ($kurt. = -.42 < 2.75$). The average value of the upper arm skin fold (annlove) in students is 12.30mm. The value of the upper arm skin fold is slightly higher than the students of Belgrade (AS = 7.28mm T=9.12) and Niš (AS=10.23mm; T=5.76). The result is a consequence of the higher range of volume and voluminosity of upper extremities of students so we have that voluminosity is contained in the joint variance of skin folds. Value T-test, the relative variability was significantly higher (CV= 53.25%). It is noticeable that the variable fold of the upper arm has a very poor homogeneity and that students are not homogeneous with respect to the upper arm skin fold. The parameters of the distribution results show that the variable deviates from the normal distribution in direction of epikurtic distribution when it comes to the degree of curvature (skew. = 1.33) or in the direction of platikurtic distribution when it comes to the level of elongation that is dispersion of results ($kurt. = 1.72$). Arithmetic mean of skinfold back (ANLE) for students of East Sarajevo is 9.93mm and it is of the greater amount from the students of Belgrade University (AS=8.62mm; T=3.66) and students in Nis (AS=10.03; T=3, 45). The result is a consequence of larger body mass values of the Sarajevo students (AS=76.82kg) so we have that the mass of bodies contained in the shared variance of skinfold back. The relative variability is slightly lower than the value of the upper arm folds (CV%=39.67). It is also noticeable that the variable of skin fold back has very weak homogeneity, and that students are not homogeneous with respect to this parameter. Also this parameter almost always has a negative effect on physical activities. The parameters of the distribution results show that this variable is slightly different from normal distribution in the direction of epikurtic distribution when it comes to the degree of curvature (skew. = 1.10) or slightly more in the direction of positive platikurtic distribution when it comes to the level of elongation, that is the dispersion of results ($kurt. = 2.05$). The mean skinfold of the abdomen (ANTH) in the Sarajevo students is 12.79mm, and significantly higher than students of Belgrade (AS = 9.40mm T = 4.32) and Niš (AS = 10.20mm; T = 4.86). The result is generally a result of higher values of volume and voluminosity of upper limbs and body mass of students, so we have that voluminosity and body mass is contained in a common variance of abdominal skin fold. The relative variability was significantly higher (CV=51.83%). It is noticeable that the variable fold of the stomach also has a weak distribution and

that students are not homogeneous in terms of abdominal skin fold. The tested parameters of the distribution results show that the variable does not deviate from normal distribution in the direction of epikurtic distribution when it comes to the degree of curvature (skew. = 1.65) or in the direction of mezokurtic distribution when it comes to the level of elongation that is dispersion of results ($kurt. = 2.64$). By inspection of the table 1 first can be seen that certain parameter values of anthropometric characteristics have a greater range of performance and value of standard deviation, especially when it comes to measures of longitudinal skeleton dimensionality and some measures of voluminosity. Based on the expressed and contained a range of values we can conclude that the main cause of such variation is found in the sample of students given that it is not selected sample of students from the Faculty of Physical Education. According to the obtained values of CV% students least vary within the range of variables of longitudinal skeleton dimensionality (CV% = 3.54 to 7.10), where we have a very good homogeneity of the measured morphological variables. The smallest is the homogeneity of the results expressed in subcutaneous adipose tissue variables where the CV% ranges from (39.67-53.25), we conclude that here we have the largest variation in results. Transversal values of variables showed (CV%=6.43 to 7.06), as opposed to variables of voluminosity and mass of the body where the values are slightly higher and range from (CV%=6.28 to 12.11). Distribution of results shows that it is mostly a normal distribution when analyzing degrees of distortion (skewness). The largest positive values (epikurtics) expressed skinfold variables. However, although the epikurtic distribution is dominant for these variables, the value skewness presents a weaker result. It would be logical that the distribution is hipokurtic. With this value of epikurtics data leads to the inverse proportionality of skewness with other variables. The parameters with which we analyze the levels of elongation give somewhat different picture. In almost all variables we have higher positive and negative platikurtic that occurs as a result of lack of a homogeneous sample. No matter here is about the physical education students, at the time of testing showed a phase of growth and development that does not correspond to a phase of stagnation, when it comes to growth and development of morphological characteristics. Obtained state can be explained by insufficiently differentiated and insufficiently integrated anthropometric characteristics of students that would contribute to the formation of a stable model that is appropriate to the sample defined this way.

Conclusion

Comparison of anthropometric parameters of students from the Faculty of Physical Education of Belgrade and Nis, has shown that students of the Faculty of Physical Education from East Sarajevo showed higher values of all longitudinal and transverse variables (dimensionality), the

voluminosity and mass of bodies, and the measured parameters by which evaluated the subcutaneous adipose tissue is evaluated. This shows that the morphological status with representative: body height, length of legs and arms, the width of the shoulders, pelvis, knee joint and the extent of the upper arm, forearm, thigh and lower leg, which recorded a rise in the value what changes the image of the population. It is also evident in the differences of Belgrade students' of physical education (1982) and Nis Faculty students (2007.) where values are defined in favour of the Belgrade population (scopes, subcutaneous adipose tissue), and others in favour of Niš population (longitudinality, transversality, the mass body). These different values of variables would define the different morphological structure of populations of students at different geographical positions. Compared with students of the Faculty of Physical Education of East Sarajevo those differences are higher in all the observed anthropometric

characteristics. The obtained values are much higher if compared to the last century researches (Smodlaka, 1950; Pogačnik, 1966; Stojanović, 1971; Momirović et al., 1987; Ilić, 1991; Medved et al., 1992; Krsmanović et al., 2000.)

Dominant values are the indicator of:

- Acceleration of growth and development in the last twenty years that are consequence of favourable endogenous and exogenous factors in relation to earlier periods.

- Faculty of Physical Education and Sports, are attended by students from different regional places as well as from regions where certain climate changes, influence positively on growth and human development.

- The nature of faculty that primarily enter sportsmen according to their psycho-physical abilities and preferences as well as innovations in curriculum, which also affects on the changes of analyzed characteristics.

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KOMPARATIVNA ANALIZA ANTROPOMETRIJSKIH ZNAČAJKI STUDENATA

Sažetak

Jako učestala istraživanja u kineziologiji za svrhu imaju pronalaženje nekih novih činjenica koje mogu biti stvarni novi temelj za potvrdu ili odbacivanje nekih prethodnih pravila. Uz brojna istraživanja koja treiraju problem antropološkog prostora čovjeka, većina ih je usmjerena u različite segmente istoga. Ponekad je to prostor kretanja, morfologije, funkcionalnih sposobnosti, a jako često i kognitivnih sposobnosti i konativnih osobina ispitanika. Na taj način, istraživanje će ovisiti o postavljanju aktualnog problema, usmjerenja i akcije. U svezi s trenutnom barijerom, a i izvršitelj je čovjek, ovo je razlog što su istraživanja povezana s čovjekom i njegovim osobinama i značajkama. Sagledavajući složenu hijerarhiju antropološkog prostora, nameću se i mogućnosti pojedinačnog pristupa. Pod pojedinačnim se misli na značenje podprostora koji je intrigantan u antropologijskom prostoru i interakciji s istim ili drugim segmentima. U istraživanju komparativne analize jednog takvog prostora provedenog kod studenata kineziologije pokazani su određena pravila su utvrđena i to o rastu i razvoju studentske populacije.

Ključne riječi: usporedba, rast i razvoj, morfološke značajke, studenti

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