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FACTOR STRUCTURE OF MORPHOLOGICAL STATUS IN ADOLESCENTS

(Original scientific paper)

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Abstract

Using the sample group of male respondents (161) aged 15 (± 6 months), basic anthropometric measures were gathered. The aim of the research is to determine factor structure of morphological characteristics in adolescents. The factor analysis of anthropometric variables was used in order to single out two factors. The first distinguished factor can be interpreted as mass and voluminosity, consisting of: body mass, chest circumference, abdominal circumference and abdominal, subscapular and upper arm skin folds. The other factor was interpreted as a longitudinal dimensionality consisting of: body height, and the lengths of arms and legs.

Keywords: *physical development, male, anthropometric measures, factor analysis, cluster analysis, latent anthropometric dimensions, body mass and voluminosity, longitudinal skeleton dimensionality, factor analysis, cluster analysis,*

INTRODUCTION

Physical development represents a process of changing natural morphofunctional features of an organism during one's individual life (ontogenesis). It is widely known that during the course of our lives, different development periods consecutively follow one another: prenatal, early postnatal period (first years of one's life), childhood, juvenility, adulthood and old age. Each of these periods is characterized with its particular changes of form and functional possibilities of one's organism.

In essence, physical development is a natural process, as it follows the natural pattern transmitted from one generation to another and is subject to the laws of nature. However, it is evident that physical development is influenced not only by natural factors, but also by social, i.e. environmental factors. Therefore, certain authors correctly emphasize the fact that physical development is a synthesis of its own, or in other words, "an embodied result" of joint influences of genetic nature and environmental conditions (Krsmanović, 2010).

Growth and development are processes which take place intensively and are interdependent on both one another and numerous other factors. The first stage of growth and development includes the period lasting until three years of age. This is perhaps the most intense period followed by a somewhat slower growth and development. Then next one is the third stage, characterized again with rapid growth and development, known in literature as adolescence. Girls reach puberty between 11 and 14 years of age, while boys do so between 13 and 16. After these turbulent periods, a calmer period ensues again starting with the age of 14 in girls and 16 in boys (Medved et al., 1987). The ontogenesis of a human organism was long ago observed to manifest periods of unequal development. Numerous researches revealed a series of age-related development periods and characteristics of morphofunctional changes within the limits of different periods. It was determined that different organs and systems of an organism do not develop or mature at an even pace or at the same time, but with certain oscillations in time and intensity of development, which is often designated as development heterochrony.

When researches are focused on respondents who have not yet finished their growth or development, there is always a possibility of getting illogical results. Surely, prevention is essential, which is why researchers decide to focus on preschoolers and young school students. Adolescence (from the age of 11 till ossification is complete) is a very delicate and diverse period as growth and development of some respondents are nearly finished, while that is not the case with other respondents.

"The time of adolescence is certainly one of the most important periods of extrauterine growth and development. Properly guided stimuli have maximum efficiency at this point, just like incorrectly dosed or applied stimuli can lead to morphological or functional deviations. As growth reaches its end, which happens at the end of puberty, all the issued deviations in development

are more likely to remain permanently with no possibility of subsequent correction." (Medved, 1980).

By means of factor analysis of anthropometric measures, the entire system of the variables is reduced to only a few which represent latent dimensions of the skeleton. Factors and dimensions obtained this way can be used for any further analysis. A number of researchers have dealt with this subject matter. Momirović (1970) set up a four-dimensional model of morphological dimensions on adults: longitudinal dimensionality of the skeleton, transversal dimensionality of the skeleton, volume and body mass (circular) and subcutaneous adipose tissue. In adolescents, three-dimensional model was set up: skeleton dimensionality, volume and body mass and subcutaneous adipose tissue (Viskić-Štalec, 1974). When compared to the results obtained on older respondents, and as far as children are concerned (Bala, 1981), a two-dimensional model of the morphological dimensions is normally used: skeleton dimensionality and subcutaneous adipose tissue.

Preschoolers and younger school students are most often selected as respondents in the scientific papers. Analyzing the trend of growth and development of anthropometric characteristics and development of motor abilities, as well as the structure of these two spaces, Popović conducted his research (2008) which showed statistically significant differences between boys and girls. Statistically significant differences were determined in the matter of anthropometric characteristics referring to bone growth in length, in favor of boys. Anthropometric characteristics referring to voluminosity and subcutaneous fat are in favor of girls. As far as motor space is concerned, the same authors determined significant differences in functioning of a mechanism for the movement structure, mechanism for synergetic regulation and mechanism in charge of regulating the duration of excitation, all in favor of boys, while in the matter of functioning of the mechanism for muscle tone regulation the difference was determined in favor of girls.

The issue in this research was categorizing respondents in clusters based on their morphological characteristics, which made it possible to determine which morphological dimensions contributed to formation of respondent groups. The aim of the research was, therefore, to determine factor structure of the morphological characteristics in adolescents.

METHODS

The total sample of respondents numbered 161 boys aged 15 yrs (± 6 months). The sample of respondents was from the territory of Novi Sad. The respondents were students at "Svetozar Miletić" High School from Novi Sad. The data used for this research were collected for the purpose of designing Master's Thesis (Krsmanović, 2010).

The sample of variables consists of an initial matrix for anthropometric variables obtained using twelve anthropometric measures for each respondent: body height, body mass, arm length, leg length, thoracic circumference, abdominal circumference, upper arm circumference, calf circumference, upper arm skinfold, abdominal and subscapular skinfolds.

Factor analysis was used for data processing, reducing the system of variables to latent dimensions. Cluster analysis was used in order to divide respondents in groups according to their anthropometric characteristics. Central and dispersion parameters were analyzed for thus formed groups of respondents.

RESULTS

After the data, anthropometric characteristics had been collected and processed and latent dimensions were calculated as given in the Table 1.

By means of factor analysis of anthropometric variables, two factors were distinguished. The first distinguished factor can be interpreted as body mass and voluminosity. In order to define this factor the following is considered: body mass, thoracic circumference, abdominal circumference and all the variables for assessing subcutaneous adipose tissue. The other factor was

Table 1. The structure of selected factors based on anthropometric variables

Variables	Qlt	1 - factor			2 – factor		
		1F	cor	ctr	2F	cor	ctr
Body height	905	529	280	52	791	625	175
Body mass	903	950	902	166	42	2	0
Arm length	861	522	272	50	767	588	164
Left leg length	912	359	129	24	885	784	219
Right leg length	917	366	134	25	885	783	219
Thoracic circumference	861	911	831	153	-174	30	8
Abdominal circumference	859	894	799	147	-244	59	17
Upper arm circumference	197	439	193	36	-63	4	1
Calf circumference	314	554	307	57	-84	7	2
Upper arm skinfold	723	712	507	93	-465	216	60
Abdominal skinfold	775	722	521	96	-504	255	71
Subscapular skinfold	777	741	549	101	-478	228	64

Table 2. Central and dispersion parameters Group 1

Variables	SV	SD	Min	Max	KV	Trust Interval		P
Body height	1696.61	57.99	1506.0	1783.0	3.42	1679.95	1713.27	.301
Body mass	561.86	66.73	401.0	695.0	11.88	542.69	581.03	.560
Arm length	776.53	34.43	680.0	830.0	4.43	766.64	786.42	.669
Left leg length	1008.98	43.98	890.0	1100.0	4.36	996.34	1021.61	.136
Right leg length	1009.39	43.99	890.0	1100.0	4.36	996.75	1022.03	.228
Thoracic circumference	803.10	44.50	721.0	896.0	5.54	790.32	815.89	.204
Abdominal circumference	709.61	51.93	616.0	885.0	7.32	694.69	724.53	.014
Upper arm circumference	281.63	28.33	224.0	350.0	10.06	273.49	289.77	.646
Calf circumference	348.06	22.51	284.0	395.0	6.47	341.59	354.53	.036
Upper arm skinfold	92.78	33.66	50.0	216.0	36.28	83.11	102.45	.061
Abdominal skinfold	115.51	74.22	42.0	452.0	64.26	94.19	136.83	.000
Subscapular skinfold	83.67	38.46	50.0	290.0	45.96	72.62	94.72	.000

Table 3 .Central and dispersion parameters Group 2

Varijable	SV	SD	Min	Max	KV	Trust Interval		p
Body height	1815.99	56.60	1670.0	1963.0	3.12	1805.39	1826.59	.463
Body mass	715.66	90.44	492.0	1000.0	12.64	698.72	732.60	.012
Arm length	826.16	30.88	750.0	910.0	3.74	820.38	831.94	.206
Left leg length	1075.18	48.51	950.0	1190.0	4.51	1066.09	1084.26	.363
Right leg length	1075.18	48.27	950.0	1190.0	4.49	1066.14	1084.22	.360
Thoracic circumference	882.85	62.23	749.0	1155.0	7.05	871.19	894.50	.000
Abdominal circumference	775.90	67.46	659.0	1045.0	8.69	763.27	788.54	.018
Upper arm circumference	310.75	61.74	229.0	898.0	19.87	299.19	322.31	.000
Calf circumference	380.89	45.26	325.0	767.0	11.88	372.42	389.37	.000
Upper arm skinfold	117.89	54.98	48.0	300.0	46.63	107.60	128.19	.001
Abdominal skinfold	157.15	98.59	40.0	490.0	62.74	138.69	175.62	.000
Subscapular skinfold	111.34	57.68	60.0	484.0	51.81	100.54	122.14	.000

interpreted as longitudinal skeleton dimensionality, for the most part determined by: body height, arm length and leg length since these are particularly related to this factor.

Based on the singled out factors, two groups of respondents were formed. By means of factor analysis, representatives were selected for each factor, and then based on these representatives for each factor (body mass and height), cluster analysis was done, which helped divide the respondents in two groups. Due to the size of tabulation of the retrieved results, cluster analysis will not be presented. Based on the criteria composed of anthropometric factors, the respondents were divided into two groups. Tables 2 and 3 show central and dispersion parameters for each group of the respondents. Group 1 consists of 49 boys in total, while Group 2 consists of 112 boys.

According to anthropometric characteristics, the students who belong to the first group of respondents (Group 1) are those characterized by lower values in all the analyzed variables (Table 2), which results from the first factor, a previously done factor analysis, characterized as body mass and voluminosity.

The students with the results higher than those in Group 1 belong to the other group (Group 2) as shown in Table 3, which results from the second factor designated as longitudinal dimensionality.

DISCUSSION AND CONCLUSION

The results obtained here, on this respondent sample, indicate that at this age the four dimensionalities typical of adults have not been differentiated yet in the morphological space . Thus, analyzing the first group of respondents (Group 1), two assumptions can be made. The first one can be summarized as follows – even at this age, it is possible to discern an already formed type of a man known as pyknic type. According to the other assumption, this group of respondents has not yet reached its full growth in terms of height. The results offer bases for further researches, even more so, as this is the case of a smaller number of respondents (49).

The other group is made up of a larger number of respondents (112), whose height is evidently that of grown-up men. Similarly, if the respondents are observed from the aspect of a body type, we may say this is the case of leptosomatic body type. All of this is not to be taken for granted, as we know that men's growth does not finish until the age of 22 and even further, till the age of 24.

Adolescence is a very delicate period and, therefore, it would be rather interesting to compare results with the researches done so far on the population of the same age. The results range within the limits of normal distribution and have the value normally associated with this age. Average, minimal and maximum values with respect to body height, arm length and leg length are quite similar to those of the researches done by Kurelić and associates (1975), Marković (2005). Body mass value in this sample of respondents is a bit higher than the corresponding value in the given researches, but so are the values of circumferences, particularly the subcutaneous adipose tissue.

The results show that at this age characteristics have not been differentiated yet and a two-dimensional model can be observed at a younger age. Besides, it is important to point out that the obtained results are, in a certain way, indicative of a body type in boys of this age, which is of utmost importance in sport selection. It is widely known that there are no strict boundaries between body types and that athletic body type is the most desirable for the greatest number of sports. In addition, we need to be aware of the fact that there are sports requiring a specific body type (horseback riding, martial arts, weight lifting, gymnastics, etc.). Similarly, in collective and team sports, certain positions require specific body type (particular water polo, volleyball, handball positions, coxswain in rowing, etc.). Differentiation of children is not important in sport only, but in everyday physical activity and physical education, as well.

The results are of practical significance, as well, in the cases where there's need for dividing respondents into groups according to their body types, whether in sport or at school. As far as humanistic approach is concerned, the unequal cannot be treated equally. When setting requirements, body type of respondents must be taken into account, from the aspects of both load and technical requirements.

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