COMPONENT ANALYSIS OF ANTHROPOMETRIC VARIABLES OF BOYS AGES 7-9 WHICH ARE CLASSIFIED BY AGE GROUPS

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Summary
Following of growth, functional and psychomotor capabilities of pupils enables better perceiving of influences of certain living conditions as well as success of teaching process and measures that need to be taken to have better development. The main goal of this work comes from research project called "Static and explosive strength of 7-9 year old boys in relation to the proportionality of body structure". The goal of this research is establishment of significant main components of anthropometric variables of 7-9 year old boys classified by age groups (+- 6 months). Structure in the area of anthropometric variables of boys aged 7-9 was analysed by using a sample of 286 boys by using a Hotelling component analysis.

Key words*: dynamics of body development, body segments, group types, statistical procedures.*

INTRODUCTION

Researches of anthropometric measures of human bodies and some its parts have been the subject of researches since ancient period until today. Establishment of anthropometric measures is especially important at children and youth whose development process is still in progress. By intensifying research in this field and improving methodology bases new findings have been reached. On the basis of component analysis of anthropometric variables for estimation of body structure of 7-9 years old boys growth and development dynamics can be predicted with higher certainty. At this age programming of educational process in the schools of sports can be eased. With goal of adequate individual programming, planning and dosage of physical exercises we need objective presentation of anthropometrical status of 7-9 year old boys classified in 5 groups with age difference of 6 months.Knowing of characteristics of 7-9 year old boys enables individual approach in inducement and prognosis of development of moving activities.Milicerova, H. (1960) has modified the method of Parnell A. W. (on Sheldon's maxim of classification with a seven degree points scale) adjusting it to special demands of somatic typology of children and youth in order to evaluate the impact of environmental factor, especially physical training and sport on human organism. Four types have been selected by using this method: ectomorph type and mean type dominated by the skeleton length, mezomorphic type and mean type dominated by the skeleton width and muscularity, endomorph type dominated by the body size, and the ideal type and mean type with the balanced relation of the explicitness of the four somatic typology factors. The appliance of taxonomic procedures for classifying examinees into related groups according to morphological and psychomotor characteristics is important in the terms of theoretical researches just as much as for the purpose of classifying examinees into taxons of either the assigned or the natural morphological and psychomotor structures in accordance with the specific needs of physical training and sport practice (Katić, 1995). The researches conducted by: Polič, B., Šepa, M., Stojanović, M., Radmili, V., Horvat, V. in 1962 made possible for Radojević, Đ. i Lešić, V. to develop tables for the evaluation of physical development and physical performance for the school population in Bosnia and Herzegovina. These tables were published in two brochures in 1965 and 1966. Tables for the evaluation of physical development in male and female student in Bosnia and Herzegovina were established in the first publication, while the latter presents the method of monitoring and evaluating students' physical development and physical performances. Szirovicza, L., Momirović, K., Hošek, A., and Gredelj, M. (1980) analysed the anthropometric latent dimensions on the grounds of factor and taxonomic mode. Three latent dimensions have been obtained and presented as longitudinal dimensions of skeleton, subcutaneous connective tissue and body volume. According to body structure, the size of active body mass is largely genetically determined. Body creases are genetically better determined then the upper

extremity creases. Hereditary quality does not have a big effect on somatic type only, but also on the shape and certain components in somatic type (Ervanova, E., 1985). In his works, Derjabin, I.E. (1987), was presenting the procedure for determination of morphological typology (the system of skeleton size, body size, musculature and creases) he elaborates the system of total body structure typology. Kondrič, M.; Mišigoj – Duraković, M. and Mekitoš, D. (2002) conducted a research on junior class students in schools of Republic Slovenia, between the age of seven and nine. Based on the results, a significant connection between anthropometric characteristics, manifest variables as well as latent dimensions and motor performances has been established.

The problem and subject of this research is extraction of significant main components of anthropometric variables 7-9 year old boys who were classified according to age groups +.-. six months. The main goal of this research is to evaluate possibilities of adequate individual planning, programming, and dosage physical exercising on base of extracted structure of used anthropometric variables.

METHODS

Participants

The examination was conducted among 286 7-9 year old boys, which have been healthy, without any major anatomic deformations or locomotors apparatus damage and involved in regular physical training. The age have been defined as a chronological age oscillating +.-, six months from the exemplar age.

Instruments

The longitudinal dimensionality evaluation has been based on ten longitudinal measures of the different body parts (skeleton):

1. ATJVIS – Body height
2. AVISSJ – Sitting height
3. AVISGL – Head height from the atlas
4. AVISSZ – Angle joint height
5. ADUŽND – Upper arm length
6. ADUŽPD – Forearm length
7. ADUŽSA – Hand length
8. ADUŽNA – Upper leg length
9. ADUŽPO – Lower leg length
10. ADUŽST – Foot length

For the evaluation of skeleton transversal dimensionality we used six tests of width measurement for the certain skeleton parts:

1. AŠIRRA – Shoulder width – biachromic range
2. AŠIRLZ – Elbow width – elbow joint diameter
3. AŠIRRZ– Wrist width
4. AŠIRKA – Pelvis width – bitrochanterial range
5. AŠIRKO – Knee width – knee diameter
6. AŠIRSZ – Ankle joint width

Six measures have been used for the assessment of the body mass and volume i.e. circular dimensionality of the body:

1. ATJMAS - Body mass
2. AOGRKO- Bust measurement
3. AONADL- Upper arm circumference
4. AOPODL- Forearm circumference
5. AONATK- Upper leg circumference
6. AOPOTK- Lower leg circumference

Six measures have been used for the evaluation of subcutaneous connective tissue:

1. AKNTAR– skin crease triceps
2. AKNABI – skin crease biceps
3. AKNAPD – skin crease forearm
4. AKNATK– skin crease upper leg
5. AKNPOT – skin crease lower leg
6. AKNABO– skin crease on axel-hip

Methods of data processing

Result processing of the anthropometric measures of 7-9 year old boys was conducted in accordance to the planned complex methodology. The characteristic and the size of the selected exemplar of examinees, particularly the established research hypothesis, determined the basic methods for the processing of the research results. Data gathered during this research have been processed using the program systems for multi variable and mono variable data analysis. Data analysis was performed at Physical Training Institute in Sarajevo.

In order to establish the basic structure of anthropometric variables set, the Hotelling method of major constituents has been applied (Hotelling, 1936). The collective participation of applied variables measure has been established as the first major constituent in the defining of common measurement subject. In the remaining major constituents, the structural correlation between polar variables magnitudes, as a characteristic of the given population of boys, has been applied.

RESULTS AND DISCUSSION

Constituent analysis of anthropometric variables of 7-9 year-old boys according to age groups
The separation of significant major constituents started on the basis of the criteria of distinctive derivations in the anthropometrical scope.

Table 1. Age group of 7-9 years-old boys boys

Final Statistics:			
Gk	Eigenvalue	Pct of Var	Cum Pct
1	11.6025	41.4	41.4
2	6.23572	22.3	63.7
3	2.02587	7.2	70.9
4	1.78012	6.4	77.3
5	1.57488	5.6	82.9
6	1.24057	4.4	87.4

Correlations	MCI	MC2	MC3	MC4	MC5	MC6
AKNABO	.94213					
AKNABI	.93296					
AOPDL	.93206					
AKNAPT	.92773					
AKNANK	.92693					
AONADL	.92630					
AONADK	.91590					
AKNAPD	.90671					
AKNATR	.81217					
AOGRKO	.76901					
AOPODK	.69501					
ATJMAS	.68846					
ASIRKA	.66598					
ADUZNA		.89900				
ADUZPO		.88859				
ADUZPD		.81635				
ADUZND		.77812				
AV1STJ		.64394				
ASIRLZ			.85903			
AS1RSZ			.79580			
ASIRRZ			.76578			
ASIRKO			.62202			
ADUZST			.54946			
ADUZSA				.91850		
AVISS.T				.70415		
ASIRRA				.61977		
AVISGL					.88123	
AVISSZ						.96769

In the anthropometrical scope, six significant statistic constituents have been derived. These six major constituents cover 87.4% of the applied mutual systematic variables.Table No. l represents the structure of isolated major constituents, i.e. correlation between variable manifestations and major constituents.

Table 2Age group of 7 years and six months old

Final Statistics:			
Gk	Eigenvalue	Pct of Var	Cum Pct
1	13.00882	46.5	46.5
2	3.73353	13.3	59.8
3	1.94498	6.9	66.7
4	1.38243	4.9	71.7
5	1.24207	4.4	76.1

Correlations	MCI	MC2	MC3	MC4	MC5
AONADL	**.90977**				
AKNANK	**.87783**				
AKNAPD	**.86250**				
AKNAVO	**.92795**				
ATJMAS	**.91623**				
AKNABI	**.91479**				
AOGRKO	**.90581**				
AKNAPT	**.90334**				
AKNATR	**.90186**				
AOPODL	**.89979**				
AKNAPD	**.85169**				
ASIRKA	**.84634**				
AOPODK	**.65331**				
ASIRKO	**.62366**				
ASIRRA	**.61342**				
ADUZPO		**.87704**			
AVISTJ		**.83067**			
ADUZND		**.82291**			
ADUZPD		**.81674**			
ADUZNA		**.79768**			
ADUST		**.71787**			
AVISSJ		**.65959**			
ADUZSA		**.56495**			
ASIRSZ			**.79797**		
ASIRRZ			**.72210**		
AVISSZ			**.66120**		
ASIRSZ				**.68829**	
AVISGL					**.87361**

The first major constituent is completely defined by high correlations in all variables for subcutaneous connective tissue evaluation and body circumference, and its variable share is 41.4%,

The second major constituent is defined by variables for evaluating the body parts length and body height, and its variable share is respectively 22.3% and 7.2%, The third major constituent has the most significant transversal dimensionalities of the body, and its variable share is 7.2%,

The fourth major constituent is of mean structure and it is defined by the following variables: hand length, sitting height and shoulder width, and its variable share is 6.4%, The fifth major constituent is defined by the head height variable and its variable share is 6.4%, and the sixth variable is defined by the ankle join height, and its variable share is 4.4%.

Based on characteristic root magnitudes criteria **five major constituents** have been isolated with the variability of total 76.1%. Table No.2.

The first major constituent takes the major share of the total variability-46.5%, (the second takes 13.3%, the third takes 6.9%, the fourth 4.9% and the fifth 4.4%) and in its structure are mostly variables that define skin creases, body circumference and body mass (46.5%), **The second major constituent** is defined by variables for body parts evaluation: body height, sitting height and ankle joint height (13.3%), **The third major constituent** is presented by transversal dimensionality of skeleton variables (6.9%), **The fourth major constituent** is presented by head height variable (4.9%) **and the fifth** is presented by the skin crease biceps variable (6.4%).

Table 3 Age group of 8 years and six months old boys

Final Statistics:			
Gk	Eigenvalue	Pct of Var	Cum Pct
1	14.57180	52.0	52.0
2	3.30198	11.8	63.8
3	1.79881	6.4	70.3
4	1.59068	5.7	75.9
5	1.20098	4.3	80.2

Correlations	MCl	MC2	MC3	MC4	MC5
AKNATR	.92578				
AKNABI	.91452				
AKNAPT	.85984				
AKNABO	.85129				
AONADK	.84805				
AOPODL	.81768				
ATJMAS	.78871				
AOGRKO	.75528				
AOPODK	.70711				
AKNATR	.67216				
ASIRKO	.66232				
ASIRKA	.51312				
ASIRRA	.40654				
ADUZNA		.90977			
ADUZPO		.89361			
ADUZPD		.78361			
ADUZST		.74266			
ADUZSA		.73779			
ADUZND		.70583			
AVISTJ		.68613			
AVISSJ		.60324			
AVISSZ		.58085			
ASIRLZ			.76902		
ASIRRZ			.72126		
ASIRSZ			.67597		
AVISGL				.78109	
AKNABI					.87441

Table 4 Age group of 8 year-old boys

Final Statistics:			
Gk	Eigenvalue	Pct of Var	Cum Pct
1	12.98650	46.4	46.4
2	5.14220	18.4	64.7
3	1.54425	5.5	70.3
4	1.20394	4.3	74.6
5	1.07689	3.8	78.4

Correlations	Gk1	Gk2	Gk3	Gk4	Gk5
AONADK	.94915				
AKNANK	.93235				
AONADL	.93019				
AKNAVO	.92795				
ATJMAS	.91623				
AKNABI	.91479				
AOGRKO	.90581				
AKNAPT	.90334				
AKNATR	.90186				
AOPODL	.89979				
AKNAPD	.85169				
ASIRKA	.84634				
AOPODK	.65331				
ASIRKO	.62366				
ASIRRA	.61342				
ADUZPO		.87704			
AVISTJ		.83067			
ADUZND		.82291			
ADUZPD		.81674			
ADUZNA		.79768			
ADUST		.71787			
AVISSJ		.65959			
ADUZSA		.56495			
ASIRSZ			.79797		
ASIRRZ			.72210		
AVISSZ			.66120		
ASIRSZ				.68829	
AVISGL					.87361

Based on characteristic root magnitudes criteria, five major constituents have been isolated and their variable share is 78.4%. Table No.3

In the first major constituent structure there are mostly variables that define skin creases, body circumference, body mass and transversal dimensionality variables: pelvis width, knee height and knee width and its variable share is 46.4%,
The second major constituent is defined by body parts length and body height variables, and its variable share is 18.4%,
The third major constituents is presented by ankle joint and wrist joint width and ankle joint height variables, and its variable share is 5.5%, The fourth constituents is presented by ankle joint width variables, and its variable share is 4.3%,
The fifth major constituents is defined by head height variable, and its variable share is 3. Based on characteristic root magnitudes criteria **five major constituents** have been isolated with the variability of total 80.2%. Table No.4.
The first major constituent is defined mostly by variables for subcutaneous connective tissue, body circumference and body mass, and its variable share is 52.0%,
The structure of **the second major constituents** is defined mostly by variables for body parts length evaluation and body height, and its variable share is 11.8%,
The third and fourth major constituent are defined mostly by variables for skeletal transversal dimensionality, and its variable share is 6.4%,
The fifth major constituent is defined by head height variable, and its variable share is 4.3%.

Table 5 Age group of 9 years-old boys

Final Statistics:			
Gk	**Eigenvalue**	**Pct of Var**	**Cum Pct**
1	15.04698	53.7	53.7
2	3.59119	12.8	66.6
3	2.28581	8.2	74.7
4	1.50726	5.4	80.1
5	1.06547	3.8	83.9

Correlations	M C I	MC2	MC3	MC4	MC5
AKNAPT	.95238				
AKNAPD	.94901				
AKNAB1	.93299				
AKNATR	.93038				
AKNABO	.93018				
AOGRKO	.90669				
ATJMAS	.90051				
AKNANK	.87890				
AONADL	.86211				
AOPODL	.80935				
AONADK	.79637				
AOPODK	.73521				
ASIRKO	.69437				
A S IRK A	.59712				
ASIRRA	.53978				
ADUZPO		.85499			
ADUZPD		.84447			
ADUZSA		.78316			
ADUZNA		.75754			
ADUZST		.74699			
AVISSJ		.56550			
AVISSZ		.4813 1			

Based on characteristic root magnitudes criteria **five major constituents** have been isolated with the variability of total 83.9%. Table No.5.

As with the previous groups, **the first major constituent** is defined by variables for subcutaneous connective tissue, body circumference and body mass, and its variable share is 53.7%,

The second major constituent is defined by variables for body parts length evaluation and the third is defined by variables for transversal dimensionality, and its variable share is 12.8%,

The third major constituent is defined by variables for transversal dimensionality evaluation, and its variable share is 8.2%,

The fourth major constituent is defined by variables for body parts height evaluation, and its variable share is 5.4%; **the fifth major constituent** takes 3.8% of variability.

CONCLUSION

The characteristic of all five detached groups is: The first major constituent takes the biggest share of the total variability and, among all groups; the first major constituent is best defined by variables for subcutaneous connective tissue, body circumference and body mass. The second major constituent, among all groups, takes significantly less variable percentage and it is defined, among all groups, by variables for body parts length evaluation and body height. The third major constituent is, among all groups, defined by variables for skeleton transversal dimensionality evaluation. The fourth, the fifth and the sixth major constituent take the least amount of variable percentage and they are defined mostly by some sorts of individual parameters. The monitoring of the growth of student's functional and psychomotor capabilities enables the better observation of certain life condition effects, as well as the level of success of the teaching process and the measurements that should be taken to ensure the appropriate terms of development. During the analysis of motional and functional capabilities of 7-9 years-old student, it should be taken into account the series of circumstances which, more or less, reflect on the course of their growth and development which gives them specific characteristics.

The results obtained by this analysis favours the assumption that, by establishing of structure anthropometric area, of used variables in this research, can help us in objective individual planning, programming, and dosage physical exercising of boys ages 7-9 which are classified by age groups.

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KOMPONENTNA ANALIZA ANTROPOMETRIJSKIH VARIJABLI DJEČAKA UZRASTA OD 7 – 9 GODINA KLASIFICIRANIH U GRUPE PO STAROSTI

Izvorni naučni rad

Sažetak
Praćenje rasta, funkcionalnih i psihomotoričkih sposobnosti učenika omogućava bolje sagledavanje uticaja određenih uslova života, kao i uspješnosti nastavnog procesa i mjera koje treba poduzeti da bi se razvoj odvijao na što bolji način.Osnovni cilj ovog rada proističe iz istraživačkog projekta pod nazivom „Statička i eksplozivna snaga dječaka uzrasta od 7 – 9 godina u odnosu na proporcionalnost tjelesne građe“. Cilj ovog istraživanja je utvrđivanje značajnih glavnih komponenti antropometrijskih varijabli dječaka uzrasta od 7 – 9 godina klasificiranih u grupe po starosti (+ - 6 mjeseci). Struktura u prostoru antropometrijskih varijabli dječaka uzrasta od 7 – 9 godina analizirana je na uzorku od 286 dječaka Hotellingovom komponentnom analizom.

Ključne riječi: dinamika tjelesnog razvoja, proporcionalnost, segmenti tijela, tipske grupe, statističke procedure.

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