

BASIC COMPARATION ANALYSIS OF FACTOR STRUCTURE IN CERTAIN ANTHROPOMETRIC VARIABLES WITH 17 OLD MALES AND FEMALES

Original scientific paper

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Abstract

Two sub-samples (185 males and 166 females) aged 17 were examined with application of 8 anthropometric manifest variables for the latent anthropometric dimensions assessment. Variable data were processed by the basic statistical descriptive parameters and factor analysis that is the principal components method. They were transformed into the oblimin position with calculation of the parallel projections and inter-correlations of the isolated anthropometric factors. In both sub-samples (males and females) two factors were isolated and defined with a similar structure. The first factor, both in males and females, was defined as a longitudinal body dimensionality, and the second, also both in males and females, as subcutaneous fat and voluminous body weight factor. Based on the inter-correlation coefficient of the isolated factors, each of them is an independent factor structure, but in females a more pronounced independence is noted. The statistically significant inter-correlation coefficient indicates that their further factorization would allow isolation of a general anthropometric factor in both sexes of the treated respondents.

Keywords: factor analysis, anthropometric, male, female, correlations

INTRODUCTION

The anthropometric structure study is a very important requirement for realization of the function and tasks of physical education and sports activities, as well as some other practical and scientific requirements. The starting point in those requirements is measurement and verification of the basic indicators of the dimensions.

However, in so far practice of physical education and sports activities, programming tasks still have been realized without taking into account facts about the anthropometric structure of same age but different sex entities. Here, it is primarily related with the latent structure situation, and not only with the situation of the manifest anthropometric variables.

Facts on the situation is of a particular importance when it is about students, that is athletes both males and females aged 17.

These facts are a very important basis for more efficient programming of activities in physical education, for definition of the students' physical development and for their sport results achievement. In this context, facts about the factor structure in males and females aged 17 may be helpful in selection of their future successful sports activities. Provided that the facts have comparative relations, their values and significance will be expressed by a higher degree in realization of students and young athletes' practical and environmental needs.

In so far practice, studies have been conducted connected with analysis of the situation of anthropometric latent dimensions. Among them, only some more important studies can be mentioned.

In a study of 45 anthropometric variables applied with 4040 male and female respondents aged 12 to 22, Momirovic and associates (1969) used an interactive multi-group method of the factor analysis to determine existence of four anthropometric factors: Longitudinal skeleton dimensionality, Body volume and weight, Transversal skeleton dimensionality and subcutaneous fat. The factors were defined in the study according to the age and sex.

Kurelic and associates (1975) conducted a comprehensive study not only in respect of the number of respondents, but also in respect of the number of applied anthropometric and motor manifest and latent variables. The study included more sub-samples of respondents from both sexes aged 11 to 17. Among the 56 applied manifest variables, 18 were aimed for anthropometric latent dimensions assessment with respondents aged 17. One of the sub-samples con-

sisted of 423 female and 435 male respondents. The study results were processed by a number of univariate and multi-variate methods with factor analysis application. The results of the factor analysis showed that three latent anthropometric dimensions had been isolated: Longitudinal skeleton dimensionality; Circular body weight dimensionality; subcutaneous fat.

A study including a sample of 1340 males and females aged 11 to 18, with application of corresponding multi-variate methods as well as factor analysis treating 11 anthropometric manifest variables, was conducted by Naumovski and associates (2003). The study examined a sub-sample of 330 female respondents and a sub-sample of 321 male respondents, where certain anthropometric factors were isolated. Two factors were isolated in the male sub-sample: 1. Body volume and adipose tissue; 2. Longitudinal body. In the female sub-sample were isolated three factors: 1. Adipose tissue with voluminous legs; 2. Longitudinal body dimensionality with voluminous body weight; 3. Voluminous arms. The study also proved that isolated factors in males are less differentiated and less independent.

The aforementioned studies applied factor methods with similar, and also different factor procedures that have corresponding meaning from the methodological aspect. Regardless of the sex and age, the respondents involved in the study can be treated with sufficient methodological adequacy and similarity with the subject of our study. Therefore, these studies make a considerable contribution for more complete consideration of the conclusions arrived at in our study.

The subject of this study was defined with the factor structure situation of the anthropometric space in a part of the final adolescent population of both sexes.

With regard to the subject of the study and corresponding social requirements, the goal of the study was to determine and compare the basic situation of the factor structure of certain anthropometric measures with males and females aged 17.

Based on the so far studies, as well as on the defined subject of this study, the following hypothesis can be set:

The situation and anthropometric factor structure with male and female populations aged 17 differs according to the number of isolated factors.

METHODS

The study was conducted with a sample of 185 males and 166 females aged 17 (city high school students). In the respondent selection psycho-physical health was taken into consideration and their normal participation in physical education and sports activities.

The anthropometric measures selection was determined by the study goal. The following anthropometric measures were applied in the factor anthropometric structure assessment:

- Body height (AVT)
- Arm length (ADR)
- Biacromial width (ABS)
- Wrist diameter (ADRZ)
- Forearm circumference (AOBPOD)
- Body weight (ATT)
- Upper arm skin fold (AKNNA)
- Stomach skin fold (AKNST)

The study was conducted in a sports hall equipped with necessary technical and hygienic conditions (light, noise, ventilation, favorable temperature at the required level, etc.).

The anthropometric measurements were carried out in the morning 8-14 hours.

Before measurement with inspection and palpation, each respondent was located on one of the determined anthropometric points marked with a dermatographic pencil. Position of all anthropometric points was determined in so-called "standard body position" that is a normal upright position.

Variable measurement was taken by the same person according to the methodology of the International Biological Program (IBP).

The team performing anthropological measurements consisted of associates (high school and primary school teachers of physical and health education).

The obtained data were processed by the following statistical methods:

- Basic descriptive statistical parameters.
- Inter-correlation Pearson correlation coefficients (r)
- Principle component method
- Communalities (h²)
- Oblique transformation of the principle components with the

direct oblimin criterion (oblimin factors) in parallel and orthogonal projections.

- Inter-correlation of the isolated oblimin factors

RESULTS AND DISCUSSION

Results referring to the inter-correlations of the applied anthropometric variables (tables 1 and 2), both with males and females, are largely positive and statistically significant at the level of 0.05 (5%).

Given the size of the samples with both sex respondents, all correlations higher than 0.16 are statistically significant for that level.

This correlation ratio with both sex respondents indicates that isolation of real number of factors is possible within each sex.

Application of the principle component method leads to the conclusion that statistically significant principle components have been isolated in both respondent groups (tables 3 and 4).

Sizes of their characteristic roots that is the total valid variance have similar values, but they are larger with the males. The valid variance for the first principle component with males is larger for about 7%, and the percent for the second principle component between males and females is slightly different.

Communalities (Table 5) follow the relations of the valid variance both with males and females.

All communalities, except for the test – biacromial width (ABS), have higher values with males than with females. It is particularly evident in the tests for adipose tissue assessment and in the tests for body volume and weight assessment. This, among the other, indicates that the applied tests have completely higher values. In parallel, the communalities values indicate that test application defines isolated factors more clearly, and analogically they can provide better assessment of the anthropometric factor structure with males as compared to females.

The structure of corresponding principle components and varimax transformations of the principle components have not be presented in this study. This is due to the fact that these transformations can rarely give a complete meaningful interpretation of the real structure of analyzed anthropological space of the manifest variables.

The data review referring to the oblimin rotations (tables 6 and 7) shows the simplest structure of isolated anthropometric factors both with males and females.

Table 1. Inter-correlations of applied anthropometric measures with males

Variables	AVT	ADR	ABSI	ADIRZ	AOBPOD	ATT	AKNNA	AKNST
AVT	1,000	,811	,446	,420	,333	,526	,014	,082
ADR	,811	1,000	,394	,401	,304	,449	-,020	,066
ABS	,446	,394	1,000	,369	,443	,541	,113	,238
ADRZ	,420	,401	,369	1,000	,514	,437	,093	,113
AOBPOD	,333	,304	,443	,514	1,000	,835	,403	,539
ATT	,526	,449	,541	,437	,835	1,000	,523	,683
AKNNA	,014	-,020	,113	,093	,403	,523	1,000	,742
AKNST	,082	,066	,238	,113	,539	,683	,742	1,000

Table 2. Inter-correlations of applied anthropometric measures with females

Variables	AVT	ADR	ABSI	ADIRZ	AOBPOD	ATT	AKNNA	AKNST
AVT	1,000	,686	,421	,380	,242	,455	,054	-,035
ADR	,686	1,000	,355	,329	,189	,364	,051	,062
ABS	,421	,355	1,000	,348	,330	,505	,149	,112
ADRZ	,380	,329	,348	1,000	,182	,217	,032	-,055
AOBPOD	,242	,189	,330	,182	1,000	,669	,396	,337
ATT	,455	,364	,505	,217	,669	1,000	,552	,497
AKNNA	,054	,051	,149	,032	,396	,552	1,000	,565
AKNST	-,035	,062	,112	-,055	,337	,497	,565	1,000

Table 3. Characteristic roots (Lambda - λ), percent (%) and cumulative percent (%) of the valid variance with males

Components	Characteristic roots		
	Lambda (λ)	Percent (%)	Cumulative percent (%)
1	3,820	47,747	47,747
2	1,857	23,216	70,963
3	,772	9,656	80,619
4	,635	7,938	88,557
5	,418	5,222	93,778
6	,225	2,814	96,592
7	,190	2,381	98,973
8	,082	1,027	100,000

Table 4. Characteristic roots (Lambda - λ) percent (%) and cumulative percent (%) of the valid variance with females

Components	Characteristic roots		
	Lambda (λ)	Percent (%)	Cumulative percent (%)
1	3,210	40,130	40,130
2	1,815	22,686	62,816
3	,786	9,824	72,640
4	,669	8,364	81,004
5	,584	7,296	88,300
6	,438	5,475	93,774
7	,303	3,792	97,566
8	,195	2,434	100,000

Table 5. Communalities (h^2) of the applied anthropometric variables

Variables	Communalities (h^2)	
	Males	Females
AVT	,780	,737
ADR	,746	,629
ABS	478	,497
ADRZ	,461	,421
AOBPOD	,718	,560
ATT	,899	,831
AKNNA	,757	,682
AKNST	,838	,668

Table 6. Parallel projections of the oblimin factors with males

Variables	Factors	
	F1	F2
AVT	,930	-,174
ADR	,918	-,219
ABS	,624	,149
ADRZ	,657	,056
AOBPOD	,394	,622
ATT	,473	,670
AKNNA	-,264	,929
AKNST	-,141	,957

Table 7. Parallel projections of the oblimin factors with females

Variables	Factors	
	F1	F2
AVT	,879	-,078
ADR	,811	-,069
ABS	,627	,185
ADRZ	,677	-,131
AOBPOD	,208	,659
ATT	,363	,734
AKNNA	-,174	,862
AKNST	-,260	,857

The first factor both with males and females is defined by the anthropometric measures: body height (AVT), arm length (ADR), biacromial width (ABS), wrist diameter (ADRZ). Accordingly, this factor can be defined as a longitudinal body dimensionality. It is more clearly defined in both groups by the anthropometric measures: body height (AVT) and arm length (ADR). To a lesser extent, it is defined by the two applied manifest transversal anthropometric measures: biacromial width (ABS), wrist diameter (ADRZ) which in some more important studies (Stojanovic and associates, 1975), are constituent part of the longitudinal latent dimensions definition.

The second factor, also in both respondent groups, is defined by the same anthropometric measures: forearm circumference (AOBPOD), body weight (ATT), upper arm skin fold (AKNNA) and stomach skin fold (AKNST). Anthropometric measures: forearm circumference (AOBPOD) and body weight (ATT) with males have lower saturations, and the upper arm skin fold (AKNNA) and stomach skin fold (AKNST) have higher saturations. In that way, the second factor can be meaningfully defined as a subcutaneous fat and body volume and weight.

The inter-correlation coefficient of isolated factors has similar values both with males and females (tables 8 and 9). The coefficient with males is more pronounced, so that it is .36, and it is slightly lower (.30) with females.

Table 8. Inter-correlation of isolated oblimin factors with males

Factors	1	2
1	1,000	,358
2	,358	1,000

Table 9. Inter-correlation of isolated oblimin factors with females

Factors	1	2
1	1,000	,302
2	,302	1,000

Higher correlation of the isolated factors indicates their less independence and less differentiation in respect of the factor structure with females. Some of the possible reasons for that situation can be faster biological final stabilization of the physical development of females, as compared to the male development.

CONCLUSIONS

Based on the results obtained in the study, a number of concluding observations can be made, such as the following:

1. Identical number of factors has been isolated in both groups of male and female respondents, and also two anthropometric factors can be identically defined in each sex. The first factor can be defined as a longitudinal body dimensionality, and the second as a subcutaneous fat and body volume and weight.

2. Isolated factors in each sex of the respondents are defined with the same number of factors of anthropometric measures.

3. Independence between the two isolated factors is greater with females, than with males.

REFERENCES

- Bala, G. (1986). Logičke osnove metoda za analizu podataka iz istraživanje u fizičkoj kulturi [Logical method basics for data analysis in physical culture studies. In Serbian.] Novi Sad Самостојно авторско издание.
- Bala, G. (2003). Metodološki aspekti kinezioloških merenja (sa posebnim osvrom na merenja motorickih sposobnosti) [Methodological aspects of Kinesiology measurements (with a special review of the motor skill measurements). In Slovenian.] Ljubljana: Institut za Kineziologiju Fakulteta za sport.

- Barou, M.H., & Mec Gi, R. (1975). Merenje u fizickom vaspitanju [Measurement in physical education. In Serbian.] Beograd: Vuk Karadzić.
- Брогли, Я. (1969). Факторният анализ в научноизследователската работа [Factor analysis in the scientific research. In Bulgarian.] Въпроси на физическата култура, (12), 733 -739.
- Fulgosi, A. (1988). Faktorska analiza [Factor analysis. In Croatian.] Zagreb: Školska knjiga.
- Kurelić, N., Momirović, K., Stojanović, M., Šturm, J., Radojević, Đ., & Viski-Štalec, N. (1975). Struktura i razvoj morfoloskih i motorckih dimenzija omladine [Structure and development of morphological and motor dimensions of youth. In Serbian.] Beograd: Institut za naučna istraživanja Fakulteta za fizičko vaspitanje Univrziteta u Beogradu.
- Momirović, K. (1970). Komparativna analia latentnih antropometrijskih dimenzija muškaraca i žena [Comparative analysis of latent anthropometric dimensions in male and females. In Croatian. Glasnik antropološkog društva Jugoslavije, (7), 193 - 207.
- Momirović, K., со соработниците. (1969). Faktorska struktura antropometrijskih varijabli [Factor structure of anthropometric variables. In Croatian.] Zagreb: Institut za kineziologiju.
- Наумовски, А., Спасов, Ѓ., Шуков, Ј. & Керамичиев, Д. (1995). Манифестниот и латентниот статус на некои антрополошки карактеристики на децата и младината во Република Македонија [Manifest and latent status of some anthropological characteristics in children and youth in the Republic of Macedonia. In Macedonian.] (Извештај од научно истражување). Скопје: Сојуз на спортските педагози на Македонија.
- Наумовски, А., & соработниците. (2003). Статусот и компарација на антропометриската и биомоторната латентна структура на испитаници со возраст од 11 и 18 години [Status and comparison of anthropological-metric and bio-motor latent structure in respondents aged 11 and 18. In Macedonian.] (Извештај - елаборат од научен проект). Скопје: Универзитет „Св. Кирил и Методиј“, Факултет за физичка култура.
- Stojanović, M., Momirović, K., Vukosavljević, R., & Solarić, S. (1975). Struktura antropometrijskih dimenzija [Anthropometric dimension structure. In Croatia. In Croatian.] Kineziologija, 5(5), 193-205.
- Stojanović, M., Momirović, Vukosavljević, R., Hošek, A., & Momirović, K. (1975). Image analiza strukture antropometrijskih dimenzija [Image analysis of anthropometric dimension structure. In Croatian.] Kineziologija, 5(1-2), 207-228.
- Stojanović, M., Momirović, K., Zakrajsek, E & Hosek, A. (1977). Kretanje relativnog varijabiliteta nekih antropometrijskih dimenzija dečaka i devojčica uzrasta od 11 do 17 godina [Movement of relative variability of some anthropometric dimensions in boys and girls aged 11 to 17. In Serbian.] Fizicka kultura, (4), 270 - 275.

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