

CHANGES IN LATENT MORPHOLOGIC STRUCTURE OF CHILDREN BETWEEN 7 AND 14 YEARS OF AGE

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SPREMEMBE V LATENTNI MORFOLOŠKI STRUKTURI OTROK MED 7. in 14. LETOM STAROSTI

ABSTRACT

On a 1% sample of girls and boys of 7–14 years of age (in all 3163), representative for the Republic of Slovenia, changes in relations between morphologic dimensions – measured with 15 anthropometric measures – and their latent structure were analysed. Differences in latent structure were obtained through comparison of factor analyses, computed for all the age groups and both sexes.

This comparison shows a great instability of morphologic structure. The biggest changes occur because of the distribution of circumference of extremities and trunk on different dimensions, partly on skeletal dimensionality and partly on subcutaneous fat – with girls in the tenth and eleventh year and with boys from the twelfth to the fourteenth year. From the analysis of changes in the structure of the inter-correlation matrices, it is possible to conclude that individual phases of changes of morphologic structure occur at a higher rate with boys, thus ensuring a more harmonious development, while with girls we find greater structural changes, specially between the seventh and eighth year and between the eleventh and twelfth year.

Key words: morphology, structure, change, children, 7 to 14 years, males, females

IZVLEČEK

Na, za RS reprezentativnem, 1% vzorcu deklic in dečkov starosti od 7 do 14 let (skupno 3163 enot), so bile ugotovljane spremembe, ki nastopajo v tem obdobju v medsebojni povezanosti morfoloških značilnosti, izmerjenih s 15 antropometričnimi merami, in njihovi latentni strukturi. Spremembe v latentni strukturi so bile ugotovljane s primerjanjem rezultatov faktorskih analiz, izvedenih za skupine merjenecv, dobljenih po spolu in starosti.

Ta primerjava dokazuje veliko nestabilnost morfološke strukture. Največje strukturne spremembe nastajajo zaradi porazdeljevanja projekcij mer obsegov ekstremitet in trupa na različne latentne dimenzije, deloma na dimenzionalnost okostja in deloma na podkožno maščevje - pri deklicah v desetem in enajstem letu in pri dečkih od dvanajstega do štirinajstega leta. Iz analize sprememb v strukturi matrik interkorelacij je mogoče sklepati, da se posamezne faze v spremembah antropometričnih mer hitreje menjajo pri dečkih in tako zagotavljajo bolj skladen razvoj, medtem ko pri deklicah prihaja do večjih strukturnih sprememb, zlasti med 7. in 8., ter 11. in 12. letom.

Ključne besede: morfologija, struktura, sprememba, šola, učenci, učenke

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INTRODUCTION

There cannot be any doubt that great changes have occurred in life and work, both abroad, as well as in the R of Slovenia. It is therefore logical to expect a concurrent adaptation of the development of man in accord with these changes (see: Hmjelovec, Krstonijević: 91; Kalošova, Riegerova: 88; Momirović, Mraković, Hošek, Metikoš: 87). This is specially true for the development of school youth (Bell: 93; Jensen: 88; Kurelić et al.: 75; Šturm, Strel: 83, 84, 85). On the basis of a comparative study of the years 1970 and 1983, drastic changes were found in the morphologic development of youth (Šturm, Strel, Ambrožič: 88).

Acceleration of body height in some age groups exceeds 3.8 cm, still greater changes are present when separately viewing individual regions of different socio-demographic characteristics, in rural areas we find even higher values. From the analyses it can be seen that the number of extremely short children has decreased by a factor of four and by the same factor we have an increase of extremely tall children. Changes in other parameters are also great and varied.

The above-mentioned changes in the morphological development mean also changed relations in the psychosomatic development of youth and consequently a different relation towards movement expression of youth (see also: Bischoff, Lewis: 87). Successfulness of youth in individual sports, specially in top competition sport, is also dependent on morphological development (Skrivasta: 90; Štihec, Kovač: 88, 90). Positive and also negative influences of individual anthropometric dimensions on movement efficacy are evident, therefore such information on the changes of morphologic development is a must for quality direction of youth into sport. Such knowledge is also needed in programming the transformation processes with which we develop movement abilities and facilitate the formation of motor programs.

Beside changes in central and dispersion parameters of anthropologic variables (Šturm: 79; Šturm, Strel: 83, 84, 85), structural changes are equally important (Popović, Dranković, Bubanj, Stanković, Popović: 91; Szivovica, Momirović, Hošek, Gredelj: 80). With this in mind we have attempted to find the factor structure of morphology of children between 7 and 14 years of age, as well as the changes in structure between these age levels.

METHODS

The subjects here presented represent a 1% stratified sample of the whole population of children between 7 and 14 years of age in Slovenia. In the year 1983, 3163 children were measured and divided into 16 sub-samples according to age and sex.

The variable sample consists of 15 measures, best representing the following four latent dimensions: longitudinal skeletal dimensionality, voluminosity, transversal skeletal dimensionality and subcutaneous fat. The measures used were: body height, length of leg, length of arm, body weight, circumference of lower arm, circumference of thigh, circumference of chest, breadth of pelvis, diameter of wrist, diameter of knee, diameter of ankle, upper arm skin fold, stomach skin fold, back skin fold and thigh skin fold. All were measured according to international standards.

The data was processed at the Institute for Kinesiology, Faculty of Sport, on the computer DEC 1091 of the University of Ljubljana computing centre. The computer processing was done in two phases. In the first phase the SPSS statistical package was used to compute the basic statistical parameters and find the factor structures. The Hotelling principal component method was used, the Kaiser-Guttman criterion to establish the number of salient factors and the oblimin rotation to obtain the final oblique solution.

In the second phase the TAMARIS program in the GENSTAT statistical package was used to compare the correlations between individual variables in the two age groups. These comparisons were made for all the pairs of adjacent ages (7-8, 8-9 etc.). The changes in structure were analysed by the congruence of latent vectors, Schoenneman method, Flury congruence of factors, simple difference in correlation coefficients and standardised operator norm of difference matrix, which was used to assess the level of change in structure.

All the processing was done separately for both sexes and all age groups (7 to 14 years).

RESULTS AND DISCUSSION

One of the possible strategies in finding changes in the morphologic structure in the process of growth and development between 7 and 14 years of age is the condensation of information emitted by the manifest anthropometric measures to latent dimensions with factor analysis (see also: Bosnar, Hošek, Prot: 87).

Table 1: Factor structures by age – MALES

	N	%KG	%1PC	Measures, that define the factor
7)	185	66,8	43,2	1= transversal + volume (trunk) 2= body fat + volume (thigh) 3= longitudinal
8)	190	69,4	44,1	1= body fat + mass + volume 2= longitudinal 3= transversal
9)	208	68,6	53,6	1= body fat + mass + volume 2= longitudinal + transversal
10)	185	75,2	51,4	1= body fat + mass + volume 2= longitudinal 3= transversal
11)	185	67,1	52,0	1= body fat + mass + volume 2= longitudinal + transversal
12)	190	65,0	49,4	1= longitudinal + transv. + mass + vol. 2= body fat + volume + mass
13)	209	64,0	46,1	1= longitudinal + transv. + mass + vol. 2= body fat + mass + volume
14)	210	66,3	43,5	1= longitudinal + transv. + mass + vol. 2= body fat + volume

Legend: N number of measured children
%KG percent of common variance of the system
%1PC % of explained variance by the 1st component

Table 2: Factor structures by age – FEMALES

	N	%KG	%1PC	Measures, that define the factor
7)	215	63,5	47,6	1= body fat + mass + volume 2= longitudinal + transversal
8)	207	73,9	51,2	1= body fat + mass + volume 2= longitudinal 3= transversal
9)	187	65,4	50,4	1= body fat + mass + volume 2= longitudinal + transversal
10)	200	67,0	52,2	1= longitudinal + transv. + mass + vol. 2= body fat + mass + volume
11)	191	71,5	51,3	1= body fat + mass + volume 2= transversal + volume 3= longitudinal
12)	190	70,6	44,1	1= body fat + mass + volume 2= longitudinal 3= transversal
13)	180	60,4	45,2	1= body fat + mass + volume 2= longitudinal + transversal
14)	194	65,3	38,9	1= body fat + mass + volume 2= longitudinal 3= transversal

A comparison of the factor solutions in the individual age groups (tables 1 and 2) shows a great instability of the morphologic structure. Both the number and the nature of the latent dimensions of the morphologic characteristics as a rule differ in the consecutive age groups.

On the basis of parallel and orthogonal projections of the manifest anthropometric measures on the individual isolated latent dimensions, it is possible to state that four basic categories exist, which have been extracted also in previous studies on different samples. These are: longitudinal skeletal dimensionality, voluminosity, transversal skeletal dimensionality and subcutaneous fat. In our case these categories coexist in different combinations and therefore produce different latent dimensions. Both

skeletal dimensions are usually independent and separate – 8 and 10 year old boys, 8, 12 and 14 year old girls – or in unison – 9, 11 and 12 year old boys; 7, 9, 10 and 13 year old girls.

Volume, body mass and subcutaneous fat usually appear together, with fat dominant – boys from age 8 to 11 and girls all ages, except 10 and 11.

The greatest changes occur because of the oscillation of the measures of voluminosity between different latent dimensions, on one side skeletal dimensionality and on the other subcutaneous fat – boys from 12 to 14 and girls aged 10 and 11.

All this causes that the factor structure at the different age groups and both sexes can be “cleaner” (the four categories separate), or less clean (categories mixed on factors). This is due to the variations of the correlations between individual variables. If correlations between variables of the same category are significantly greater than correlations between variables of different categories, then we obtain a “clean” factor solution. A less clean solution is obtained if the correlations between variables of different categories are on par with those of the same category. Examples of less clean structure are specially evident with boys at the 7th and 14th year and with girls at the 10th and 11th year.

A second possible strategy that enables us to gather information on the changes in morphologic structure is that which is based on the comparison of the correlation matrices of all the variables. This information was given by the Tamaris program. One of the generated parameters of this program are the standardised operator norms of the correlation difference matrix (table 3).

Table 3: Standardised operator norms of difference matrix

Age	Male	Female
7-8	0.0421	0.0524
8-9	0.0690	0.0199
9-10	0.0245	0.0297
10-11	0.0312	0.0174
11-12	0.0269	0.0426
12-13	0.0307	0.0276
13-14	0.0347	0.0289
Sum:	0.2591	0.2185

An inspection of table 3 leads us to believe that the greatest changes in morphologic structure occur at the age of 7 and 8, that is, at the start of primary schooling. A similar situation – if somewhat less prominent – is to be found at the end of primary schooling (age 14).

It seems to be possible to formulate the hypothesis that changes in morphologic structure are greater

with boys, are continually present and as a rule significant.

With girls we find quite different changes of morphologic structure. Only at the 7–8 and 11–12 age levels do we find significant changes, otherwise we can see a quite stable evolution, specially between 8 and 9 and 10 and 11 years of age.

All the above-said enables us to formulate a hypothesis that individual phases of change of anthropometric measures pass quicker with boys and so enable a more stable development, while with girls, because of a somewhat slower pace of change, we find greater differences in morphologic structures, specially between 7–8 and 11–12 years of age. From this we can conclude that changes with boys are more frequent than with girls.

This attempt at an analysis of the standardised operator norms of the difference matrix leads us to believe that an identical comparison of all age groups with all other age groups is meaningful, as this would show us the age group that is responsible for the greatest change in morphologic structure.

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