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ON THE CORRELATION STRUCTURE OF BODY MEASUREMENTS IN SUBADULTS

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Abstract: *The authors carried out principal component analyses on ten body measurements of an adult and four subadult age groups to describe the tendency of changes in their correlation structure during growth. The sample consisted of altogether 151 males and 216 females examined in a village situated in NE Hungary (Beszterec). The representation of boys and girls below the age of twenty-three was thirty-nine per cent and fifty-nine per cent, respectively, as compared with the total number of inhabitants.*

According to the analysis of the correlation structure of body measurements the constitution of children between three and seven years of age were indistinct in both sexes. The correlation pattern characteristic of adults could already be pointed out between eight and ten years of age. This pattern broke up between fifteen and twenty-three years of age for males and between eleven and fourteen years of age for females.

Keywords: *Body measurements; Correlation system; Growth.*

Introduction

The present paper is about the constitution of children and its changes during growth. In the course of our examinations a multidimensional approach was applied similarly to a study on the interrelationship of various anthropometric traits of Lithuanian children (Tutkuviene 1994). The constitution is interpreted as the correlation system of body measurements and we make an attempt at describing the changes of this correlation system which manifest during maturation.

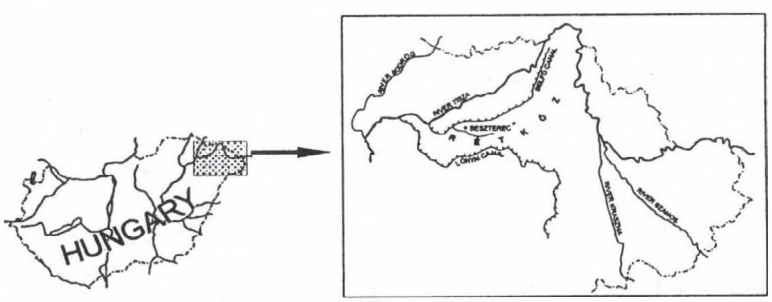

Fig. 1: Map of the region

For this purpose, the population of the village called Beszterec and situated in the area of Rétköz, NE Hungary, was investigated (Figure 1). The isolation of the villages in this swampy region was maintained until the end of the last century but has broken up recently because of the drainage of the area of Rétköz (Borsy 1961, Marosi 1990, Pók 1992). Therefore, the populations in this area of which an inbreeding was typical in the Middle Ages have become more exogamous ones, however, they still seem to have some endogamous characteristics (Hajdú and Szelci 1980).

Material and Method

In 1992-93 a cross-sectional sampling was carried out in the population of Beszterec. The body measurements of altogether 151 males and 216 females were recorded. The representation of the individuals below 14 years of age was about 50 per cent while that of the total sample was about 35 per cent as compared with the total number of inhabitants (Table 1).

Table 1: Sample examined

Years	Total number of inhabitants (Census 1990)			Sample					
				Males		Females		Together	
	Males	Females	Together	N	%	N	%	N	%
0-14	128	141	269	64	50	72	51	136	51
15-13	69	71	140	13	19	23	32	36	28
24-x	297	353	650	74	25	121	34	195	30
Together	**494**	**565**	**1059**	**151**	**31**	**216**	**38**	**367**	**35**

Table 2 shows the age-composition of the sample examined according to the division used in this investigation (Szilvássy 1986, Szilágyi 1992).

Table 2: Age groups examined

Age groups	Males	Females	Together
Infans I. (3-7 years)	19	16	35
Infans II/a. (8-10 years)	18	23	41
Infans II/b. (11-14 years)	27	33	60
Juvenis (15-23 years)	13	23	36
Ad.-Sen. (24-x years)	74	121	195
Together	**151**	**216**	**367**

The body measurements analysed include height measurements (go from 1 to 5), and measurements which are mainly related to width (go from 6 to 10) (Table 3).

In each age group a principal component analysis on the body dimensions, using varimax rotation method, was carried out in order to describe the correlation structure which was characteristic for that group. Furthermore, the rotated factor matrices were clustered on the basis of average linkage between groups using squared Euclidean measure.

Table 3: Body measurements examined (Martin 1928)

1. Body height	6. Shoulder width
2. Sitting height	7. Chest breadth
3. Shoulder height	8. Chest depth
4. Finger height	9. Chest circumference
5. Iliac spine height	10. Hip width

Results

Seeing the dendograms it is striking that, as it was to be expected, the variables are usually grouped into two main clusters. One of the clusters is definitely related to the height measurements, which are printed in italics, the other to the rest of the measurements. It is the age group of boys aged 3 to 7 years that does not show the separation of height and other measurements, which means that the constitution of boys belonging to this age group is indistinct (Figure 2). The separation of the height dimensions from other ones can be pointed out in the second age group, just as in the third one (Figures 3 and 4). This harmonic pattern of the correlation breaks up between 15 and 23 years of age. While the sitting height obviously correlates with width measurements, the hip width is connected with the height dimensions. It is striking, that the chest depth has a definite outstanding position (Figure 5). In adults the separation of height measurements from the rest of the dimensions can be observed again (Figure 6). It is the 1st, 2nd, 6th, 7th and 8th variables, that show stable structure during growth. The pattern of correlation of body measurements breaks up between 15 and 23 years of age most of all.

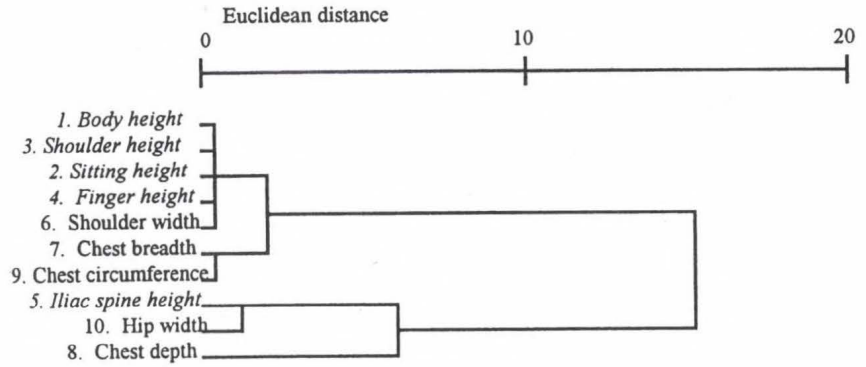

Fig. 2: Dendogram based on the cluster analysis of the factor matrix of boys between 3 and 7 years

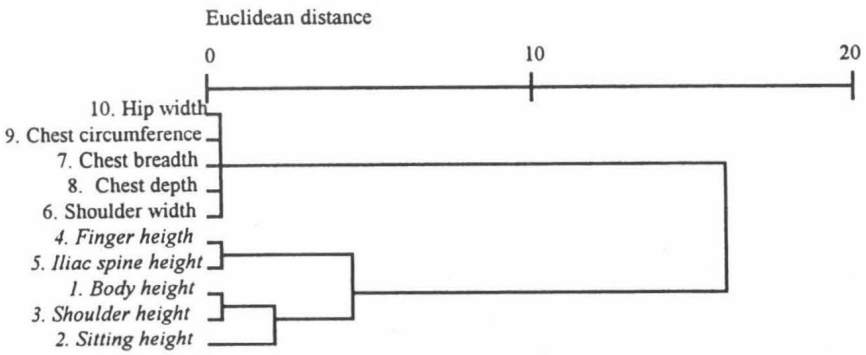

Fig. 3: Dendogram based on the cluster analysis of the factor matrix of boys between 8 and 10 years

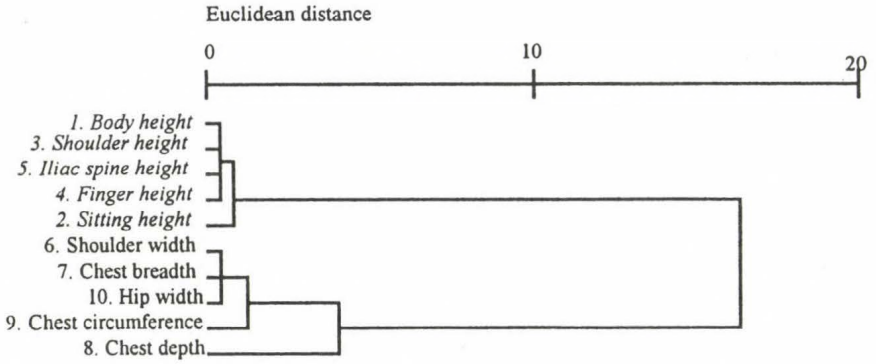

Fig. 4: Dendogram based on the cluster analysis of the factor matrix of boys between 11 and 14 years

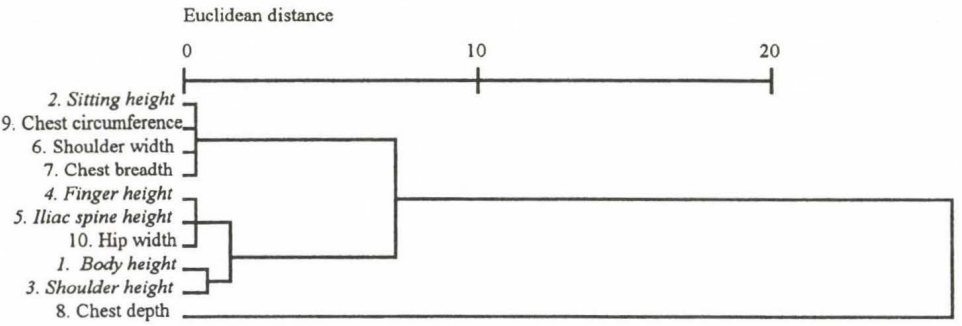

Fig. 5: Dendogram based on the cluster analysis of the factor matrix of boys between 15 and 23 years

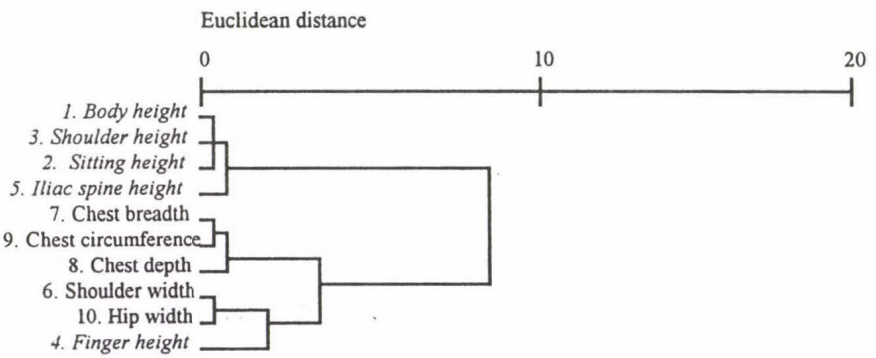

Fig. 6: Dendogram based on the cluster analysis of the factor matrix of males over 24 years

In the case of females the body dimensions are highly correlated with each other in the first age group. Consequently, in this sample the constitution of girls below 8 years of age are even less definable and indefinite than that of the boys at the same age (Figure 7). The height dimensions seem to separate from the others in the second group (Figure 8). This separation does not characterise the third age group, mainly because of the change of the

correlative position of finger height (Figure 9). The separation of the dimensions can be observed between 15 and 23 years of age and also in adults, although the correlation of shoulder width differs from that of other width dimensions (Figures 10 and 11). The most significant change of the correlation pattern can be shown between 11 and 14 years of age during growth.

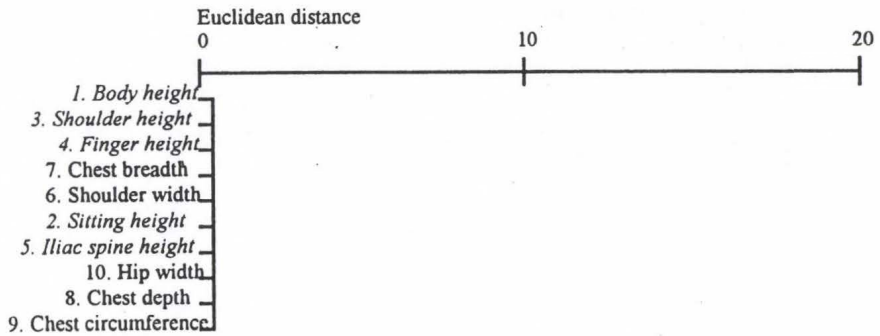

Fig. 7: Dendogram based on the cluster analysis of the factor matrix of girls between 3 and 7 years

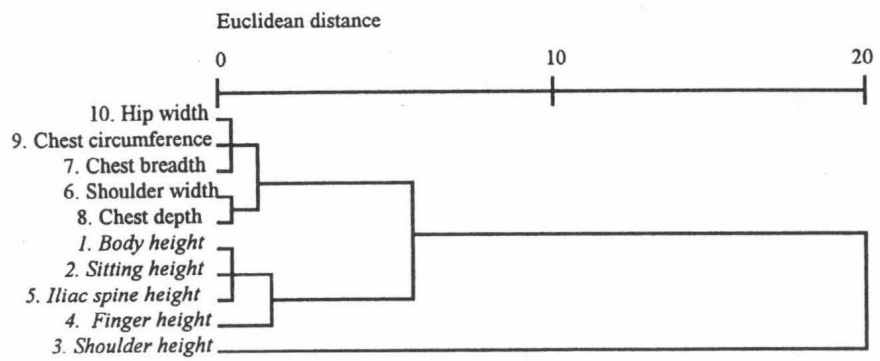

Fig. 8: Dendogram based on the cluster analysis of the factor matrix of girls between 8 and 10 years

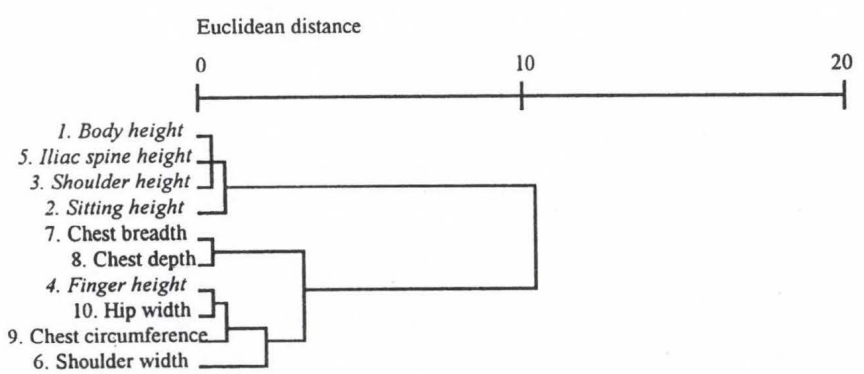

Fig. 9: Dendogram based on the cluster analysis of the factor matrix of girls between 11 and 14 years

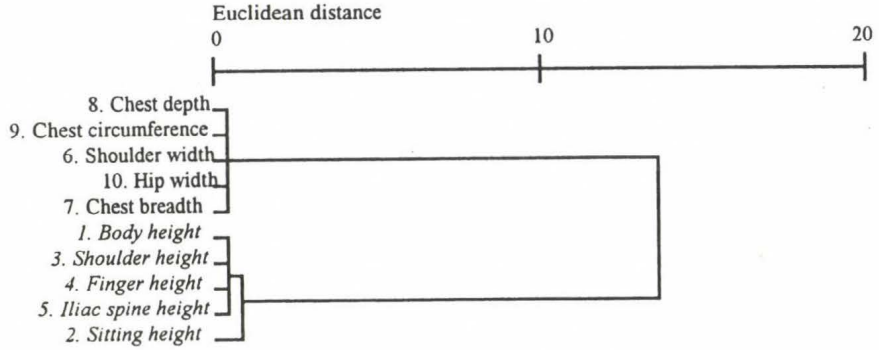

Fig. 10: Dendogram based on the cluster analysis of the factor matrix of girls between 15 and 23 years

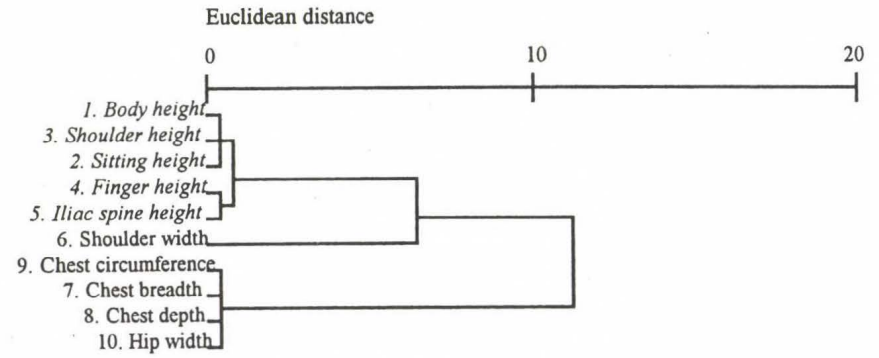

Fig. 11: Dendogram based on the cluster analysis of the factor matrix of females over 24 years

Comparing the results of the sexes, we will not take the first age groups into consideration, because they have, especially in the case of girls, rather an indefinite structure. Most of the dimensions show the same pattern in males and females. There are two dimensions in both the second and the third age group which differ in the sexes: the shoulder height and the finger height. The greatest sexual difference can be found between 15 and 23 years of age. In adults it is the shoulder width and finger height, that have different correlative positions (Table 4).

If we pick out the height measurements from the whole correlation structure, three phases of the individual development can be outlined: developmental phase; transformational phase; re-arrangement phase. The dynamics of these phases is different in the sexes.

The development of the close correlation of the five height dimensions proceeds earlier and remains stable longer in males (between 3 and 7 years of age : 1st, 3rd, 2nd, 4th+5th measurements; between 8 and 14 years of age : all five measurements). An intensive transformational phase follows that between 15 and 23 years of age (2nd+4th, 5th+1st, 3rd measurements). The tendency of re-arrangement is definite over the 24 years of age (1st, 3rd, 2nd, 5th+4th measurements).

The correlation of the five height dimensions cannot be observed below 7 years of age in females, but it is developed between 8 and 10 years of age completely. The transformational phase following that between 11 and 14 years of age is moderate (1st, 5th, 3rd, 2nd+4th measurements). The re-arrangement phase starts at as early as 15 years of age. From that time on the correlation of the five height measurements concerned are the same as between 8 and 10 years of age.

The arguments mentioned above call our attention to the fact, that it is the height measurements that likely have a discriminative importance in the course of the development of constitution.

Table 4: Comparison of correlation pattern of sexes
(Similarities mean the measurements have similar position in the correlation pattern in both sexes. Dissimilarities refer to the different correlation of measurements.)

Age groups	Similarities		Dissimilarities
	Height measurements	Other measurements	
8-10 years	1. Body height 2. Sitting height 4. Finger height 5. Iliac spine height	6. Shoulder width 7. Chest breadth 8. Chest depth 9. Chest circ. 10. Hip width	3. Shoulder height
11-14 years	1. Body height 2. Sitting height 3. Shoulder height 5. Iliac spine height	6. Shoulder width 7. Chest breadth 8. Chest depth 9. Chest circ. 10. Hip width	4. Finger height
15-23 years	1. Body height 3. Shoulder height 4. Finger height 5. Iliac spine height	6. Shoulder width 7. Chest breadth 9. Chest circ.	2. Sitting height 8. Chest depth 10. Hip width
24-x years	1. Body height 2. Sitting height 3. Shoulder height 5. Iliac spine height	7. Chest breadth 8. Chest depth 9. Chest circ. 10. Hip width	4. Finger height 6. Shoulder width

Conclusions

According to the analysis of the correlation structure of body measurements the constitution of children between 3 and 7 years of age are indistinct in this sample. The correlation pattern characteristic of adults, that is, the separation of height measurements from the ones related to width can already be pointed out between 8 and 10 years of age. This pattern breaks up between 15 and 23 years of age for males and between 11 and 14 years of age for females.

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