Anthrop. Közl. *34;* 7–11. (1992)

BODY COMPOSITION OF SZÉKESFEHÉRVÁR CHILDREN AGED 7 TO 18

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Abstract: *In 1991 a cross-sectional growth study was carried out in 3633 children living in Székesfehérvár (1687 boys and 1946 girls). The purpose of the study was to analyze the changes in body composition with age, as reflected by absolute and relative body fat and total and lean body mass.*

In the boys lean body mass increased continuously with age, with a steep rise between 12 and 16 years. The increase in absolute body fat levelled off after age 16.

The changes in the girls' body components followed a different pattern: absolute body fat content rose in the whole age range studied while lean body mass did not change practically after 15 years of age.

The relationship betweem the respective body components was specific to the boys and girls though in prepuberty the growth rates of fat and lean body mass were found to be quite similar. During puberty the growing difference between the sexes was attributable only in part to a dissimilar composition of the body, the unequal growth rates of the body components were also important.

Key words: *Székesfehérvár growth study; Body composition; Maturation; Menarche; Oigarche (first emission).*

Introduction

Developmental grade in children has often been judged in medical practice by stature and body mass or by developmental indicies based on these two dimensions. There are two basic problems in estimating developmental status by body mass. First, the impact of environmental factors on body mass is greater in comparison with height. Second, the components of body mass, such as bones, muscles, fat and viscerae, differ in their time course of growth and development. Body mass is a resultant of the differential development of these organs and tissues, so it may show comparable values despite wholly dissimilar grades of development in the tissues. Accordingly, the growth curve of body mass is less informative and has a limited value in assessing body development in children.

To exactly describe the rules governing the age changes in the development of body components is a very intricate task demanding much work and considerable instrumental background (Pařízková 1977, Malina 1980). Simpler yet valid anthropometric methods have been devised on the basis of the former techniques so there are a number of practically easier procedures available (Sloan et al. 1962, Durnin and Rahaman 1967, Sloan 1967, Katch and Michael 1968, Katch et al. 1979).

The present paper summarizes our observations concerning the age changes of the body components and sex differences. Also the differences between the body composition of children of the same chronological age but differing sexual maturity are described.

Material and Methods

A detailed anthropometric study was carried out among the children of the Székesfehérvár primary and secondary schools in 1991. The 3633 children (aged 7 through 18) whose two-component study of body composition this report contains belonged to this sample. *Table 1* summarizes the age and sex distribution of the studied children.

Table 1. **Distribution of age and sex in the Székesfehérvár sample studied**

Boys N	Age (year)	Girls N
118	7	126
123	8	145
141	9	163
140	10	179
144	11	158
168	12	175
164	13	174
163	14	177
194	15	204
148	16	187
120	17	161
64	18	97

Body density was estimated by the regression equation of Durnin and Rahaman (1962). Total and fat-free mass was discriminated by using body fat per cent obtained by Siri's formula (1956). The differences between the respective subject groups were analyzed by *t*-tests for independent samples.

Results and Discussion

By analyzing the age changes in total body mass (TBM) it could be stated that the greatest difference between the successive age groups was in the age range between 11 and 15 in the boys and between 9 and 14 in the girls (*Table 2*). By comparing the age group means of the boys and girls body mass was found to be practically similar during child age and prepuberty. It was after age 13 that body mass began to differ by sex so that after 16 the boys were significantly heavier than the girls.

In boys the yearly growth of total and lean body mass (LBM) was almost the same except the age groups of 11 and 12, then 15 and 16, respectively. The relatively steady increase in fat mass (TBF) was superseded by a faster fat accumulation at the ages of 12 and 16. After 17 years of age an absolute fat loss was observed (*Table 2*).

In girls the steady increase of LBM until 10 years of age was followed by a phase of more intense gain while after 15 this was a stable fraction of body mass. Fat mass accumulation was fastest between 11 and 15 (*Table 2*).

The intergender comparison of body mass and its components showed that the prepubertally comparable body mass arose from differing sex-linked proportions between the components. The contribution to body mass of LBM was relatively larger in the boys and of body fat in the girls. The differences in LBM in the two sexes was smallest at the ages of 11 and 12. The reason for that is the earlier onset of adolescent growth spurt in the girls. The more intense and longer lasting increase of LBM in the boys leads to a very marked intergender difference by the end of puberty.

The sex-linked differences of fat mass in constituting total mass in the respective age ranges are more demonstrative when expressed relatively (*Table 3*). The significant differences that had been present also in prepuberty became even more marked after 14 years of age. While in the girls puberty brought about intense fat accumulation, in the boys relative body fat did not change practically after the age of 12.

Table 2. **Means and SDs of body mass and body components (kg) in Székesfehérvár boys and girls**

AGE (year)	TBM Mean SD	LBM Mean SD	TBF Mean SD
Boys			
7	24.6 ± 3.8	20.4 ± 2.3	4.2 ± 2.1
8	26.3 ± 6.2	21.6 ± 3.3	4.8 ± 3.2
9	29.7 ± 6.5	23.6 ± 3.3	6.1 ± 3.6
10	33.1 ± 6.7	26.2 ± 3.5	6.9 ± 3.8
11	35.8 ± 8.1	28.0 ± 4.1	7.8 ± 4.6
12	41.6 ± 10.8	31.7 ± 5.6	9.9 ± 5.9
13	46.4 ± 10.5	36.1 ± 6.5	10.2 ± 5.1
14	52.9 ± 10.8	41.3 ± 6.4	11.6 ± 5.9
15	58.1 ± 11.6	45.4 ± 6.7	12.7 ± 6.5
16	65.4 ± 10.0	50.2 ± 6.1	15.1 ± 7.2
17	66.4 ± 9.8	51.9 ± 5.8	14.5 ± 5.9
18	68.7 ± 9.4	54.6 ± 5.8	14.1 ± 5.3
Girls			
7	23.2 ± 4.2	17.6 ± 2.3	5.6 ± 2.2
8	25.9 ± 5.1	19.4 ± 2.6	6.5 ± 2.7
9	27.9 ± 5.2	20.8 ± 2.7	7.1 ± 2.8
10	32.0 ± 7.1	23.3 ± 3.6	8.7 ± 3.8
11	36.7 ± 8.3	26.6 ± 4.4	10.1 ± 4.4
12	42.0 ± 9.7	30.1 ± 4.9	11.9 ± 5.3
13	46.5 ± 9.5	33.2 ± 4.9	11.9 ± 5.3
14	50.9 ± 9.4	35.8 ± 4.7	15.1 ± 5.0
15	54.0 ± 8.7	37.2 ± 4.3	16.8 ± 5.0
16	55.7 ± 9.2	38.0 ± 4.6	17.7 ± 5.1
17	56.7 ± 8.2	38.7 ± 4.4	17.9 ± 4.5
18	57.5 ± 9.3	39.5 ± 4.9	18.0 ± 5.8

Table 3. **Means and SDs of relative body fat (%)**

Boys Mean SD	Age (year)	Girls Mean SD
16.58 ± 5.61	7	23.46 ± 5.00
16.91 ± 6.07	8	24.25 ± 5.25
19.18 ± 6.76	9	24.70 ± 5.46
19.73 ± 6.85	10	26.19 ± 5.50
20.37 ± 7.30	11	26.47 ± 5.76
22.20 ± 7.56	12	27.21 ± 6.05
21.16 ± 6.29	13	27.65 ± 5.46
21.06 ± 6.81	14	28.95 ± 4.63
20.89 ± 6.54	15	30.56 ± 4.64
22.15 ± 6.76	16	31.29 ± 4.10
21.36 ± 5.31	17	31.68 ± 4.19
19.89 ± 5.84	18	30.79 ± 4.07

In summary, it could be stated that body composition differs markedly by sex already in childhood and such differences become even larger during sexual maturation.

Other reports as well as our studies (Malina 1975, Forbes 1978, Holliday 1978, Chumlea et al. 1983, Bodzsár 1980, 1984, 1988, 1991, Bodzsár and Pápai 1989) have also shown that during puberty not only intergender differences become more marked, but also the differences between children of the same sex but belonging to a different type of development and maturation.

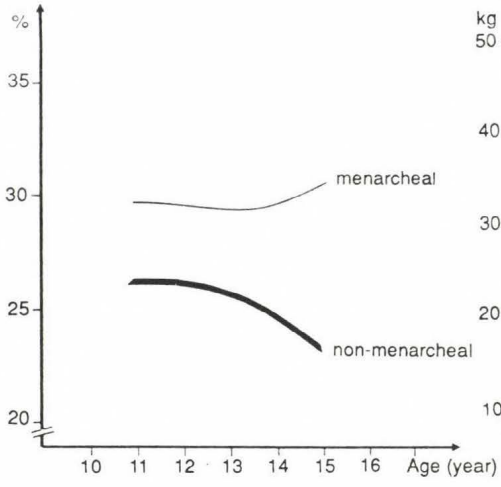

Fig. 1: Mean percent body fat of menarcheal and non-menarcheal girls

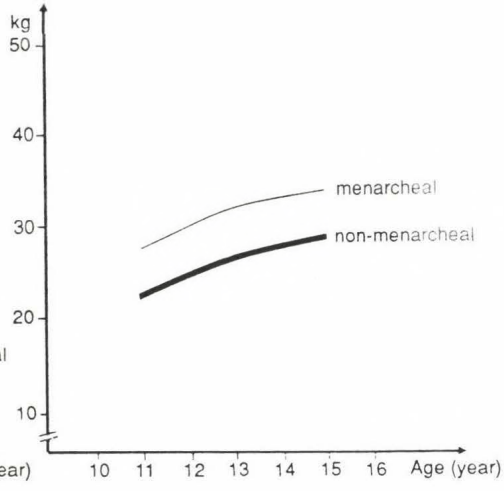

Fig. 2: Mean lean body mass of menarcheal and non-menarcheal girls (kg)

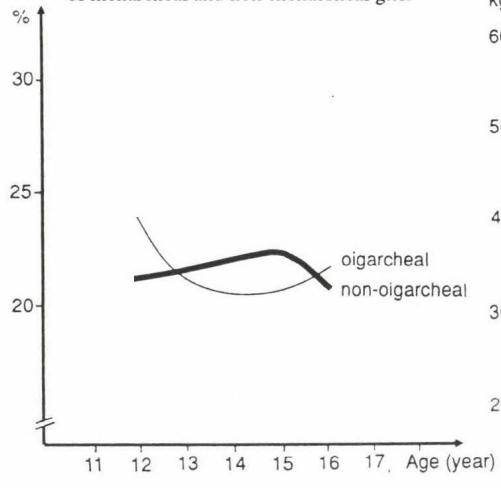

Fig. 3: Mean percent body fat of oigarcheal and non-oigarcheal boys

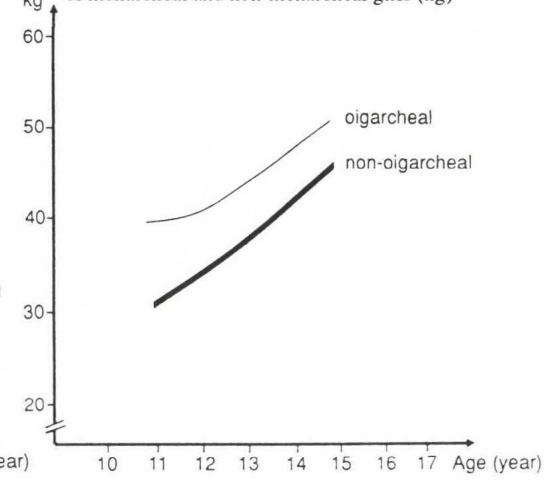

Fig. 4: Mean lean body mass of oigarcheal and non-oigarcheal boys (kg)

In what follows, a comparative analysis of body composition is given through the observations made in the children of the same age but grouped according to the occurrence or non-occurrence of menarche, respectively oigarche (first emission).

In girls, relative body fat – as shown by the fat percentage – was significantly greater in those reporting menarche in the whole observed age range. In them it was also of the same extent practically at all ages (*Fig. 1*). This gives rise to the inference that the smaller relative body fat the later menarche occurs.

Post-menarcheal girls had a significantly larger LBM, too (*Fig. 2*). On the other hand, the ratio of LBM over fat mass was greater in the pre-menarcheal girls than in the early maturers. Thus, excess body mass in the more mature ones was due to a relatively larger fat mass.

In boys the early maturers accumulated less fat and had a consistently larger absolute LBM (*Fig. 3* and *4*).

Summarizing these observations it can be stated that the child's maturation type is clearly reflected by body composition, nevertheless, early and late maturation is predestined by dissimilar ratios of body components in the two genders.

In this way, the standards produced for the age changes of body composition do not only inform on the developmental stage of bones, muscles and fat in the children but provide an opportunity to evolve an adequate technique for a short-time prediction of pubertal events.

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Acknowledgement: This study was funded by the Hungarian National Foundation for Scientific Research (OTKA grant No. 2225).

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Paper presented at the Conference of the Pediatric-Anthropological Subsection of the Anthropological Section, Hungarian Biological Society, Debrecen, Hungary, May 1992. — Received 30 September, 1992.

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