Institute of Experimental Morphology and Anthropology

Acta morphologica et anthropologica, 9
Sofia • 2004

Development of Subcutaneous Fat Tissue in 7-17 years old schoolchildren from Sofia

A. Nacheva, E. Lazarova, L. Yordanova

Institute of Experimental Morphology and Anthropology, Bulgarian Academy of Sciences, Sofia

The *aim* of the present work is to characterize the age and sexual differences of subcutaneous fat tissue amount and its relative share, i.e. its topical distribution on different trunk and extremity parts in 7-17 years old schoolchildren. Data about thickness of 9 standard skinfolds are analyzed and by the computing of the relative share of every skinfold thickness regarding the sum of the 9 skinfold thickness, the topical distribution of SFT on different trunk and extremities parts is analyzed and assessed, as well. It is established that between 7 and 17 years of age the girls constantly have thicker skinfolds than boys, but the specific for the adults' sexual differences in SFT deposition on trunk and extremities display itself after 12 years of age when boys accumulate more SFT on trunk, and girls – on extremities.

Key words: Subcutaneous Fat Tissue, skinfold, childhood, adolescence, adults.

Introduction

One of the most interesting periods during the postnatal human ontogenesis is the one in which the childish organism, and especially the relatively identical children's body composition is changing manifestly in forms and structure in order to be formed the adult male and female body build [2]. Important morphological and functional characteristics, that possess a big ecological sensitivity and significant specificities connected with the sexes are the quantity of their body fat, and especially the thickness of their subcutaneous fat tissue on different trunk and extremities parts. Throughout the transitional periods from childhood to adolescence and than to adults, the Subcutaneous Fat Tissue (SFT) thickness and its topical distribution are the most quickly changeable morphological features, which contribute to the formation of the male and female body type composition [1, 3, 4]. They go along with the sexual and physiological maturation and together with them reflect the way of life and sport's physical activities, the nutritive habits, the treatment of self physics and so on [1, 5].

The *aim* of the present work is to characterize the age and sexual differences of subcutaneous fat tissue amount and its relative share, i.e. its topical distribution on different trunk and extremity parts in 7-17 years old schoolchildren.

Material and Methods

Data about thickness of 9 standard skinfolds are analyzed and by the computing of the relative share of every skinfold thickness regarding the sum of the 9 skinfold thickness, the topical distribution of SFT on different trunk and extremities parts is analyzed and assessed, as well. The sexual differences are assessed quantitatively by the relative index for sexual differences – ISD by the formula:

(X girls × 100):(X boys)

The data in the present study are a part of detailed anthropological investigation of 7-17 years old schoolchildren from the capital carried out in the period 1993-2000. From 7 to 14 year of age the study is longitudinal and after that mixed – longitudinal and transversal. The number of annual investigated boys varies between 118 and 189, and those of the girls between 136 and 205 depending on the presence of the children in the school when the investigation was taken through. The annual studies are carried out from one and the same anthropomertical staff by the standard methods and one and the same specialist has taken the measured skinfolds during the years by a Holtain caliper.

Results and Discussion

The comparative analyzes of the data for the 9 skinfolds thickness sum gives a most general idea of the age and sexual differences about development of SFT during 7-17 years of age. (Table 1, Fig. 1) In the investigated schoolchildren throughout all years under study the girls have bigger quantity of SFT than boys. The age differences have relatively the same character in both sexes up to 12 years of age. The girls from 12 to 14 years of age, i.e. during the active puberty and the early post puberty keep on an active accumulation of SFT, and after 14 till 17 years of age the amount of SFT thickness remains nearly the same. For boys, the amount of SFT thickness is thicker in 12 and 13 years old ones after which it lightly decrease up to 16 years of age. The data about ISD for the sum of 9 skinfold thickness show that the sexual differences are higher at 16- and 17-year-old children, and lowest at the 10, 11 and 12 years old ones.

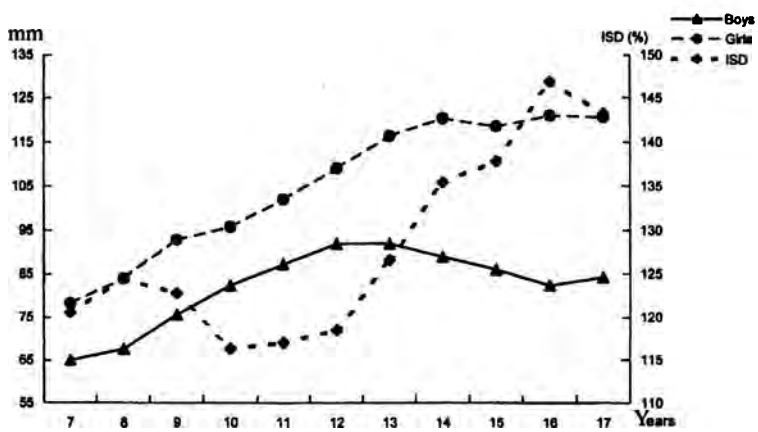

Fig. 1. Sum of 9 Skinfolds and Sexual differences acording to ISD data

Table 1. Thickness of the investigated Skinfolds (mm)

Age	n	*Subscapular*		*X-th Rib*		*Suprailiac*		*Abdomen*		*Triceps*		*Biceps*		*Forearm*		*Thigh*		*Calf*		Sum of 9 SF
		X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	
								Males												
7	181	5.8	3.0	4.4	2.2	4.3	2.4	8.6	5.0	9.3	3.4	4.5	1.7	5.4	1.4	13.0	5.3	9.5	3.7	64.8
8	189	6.2	3.5	4.7	2.8	4.8	3.2	8.4	5.6	9.5	3.8	4.7	2.0	5.3	1.5	14.1	6.0	9.8	4.3	67.5
9	189	6.9	4.0	5.1	2.8	5.6	4.0	10.0	7.2	10.5	4.5	5.1	2.2	5.4	1.6	16.0	7.5	10.9	5.1	75.5
10	189	7.8	5.1	5.9	3.9	6.5	5.0	11.3	8.1	11.0	5.1	5.3	2.7	5.3	1.7	17.5	7.9	11.8	5.6	82.4
11	181	8.5	5.4	6.2	3.9	7.2	5.6	12.7	8.8	11.7	4.9	5.4	2.7	5.4	1.6	17.6	7.9	12.5	5.5	87.2
12	170	9.1	5.9	6.8	4.4	7.6	5.7	14.3	8.7	12.0	5.3	5.5	2.9	5.3	1.6	18.2	7.6	13.0	5.7	91.8
13	164	9.2	6.1	7.1	4.6	7.8	5.9	14.7	8.8	11.7	5.6	5.1	3.0	5.0	1.7	17.9	8.4	13.3	6.3	91.8
14	139	9.6	5.8	7.8	4.6	8.3	5.6	13.3	7.6	10.8	5.2	4.8	2.6	5.1	1.5	16.5	7.7	12.6	5.7	88.8
15	124	9.4	4.9	8.0	4.1	8.5	5.5	13.3	6.9	10.3	4.9	4.3	2.1	5.0	1.3	15.6	7.6	11.6	5.6	86.0
16	131	9.5	4.8	8.1	4.8	7.9	5.4	12.8	7.4	9.6	4.9	4.1	2.0	4.9	1.4	14.6	7.6	11.0	5.2	82.5
17	118	9.9	4.3	8.7	4.2	7.7	4.8	14.3	8.1	9.6	4.6	4.1	1.7	4.8	1.1	15.0	7.4	10.2	4.8	84.3
30-40	**2415**	**17.9**	**8.4**	**13.4**	**6.6**	**11.7**	**6.0**	**27.6**	**11.5**	**11.7**	**5.1**	**6.2**	**3.2**	**5.8**	**2.3**	**17.8**	**7.3**	**10.9**	**5.1**	**123.0**
Age	n	*Subscapular*		*X-th Rib*		*Suprailiac*		*Abdomen*		*Triceps*		*Biceps*		*Forearm*		*Thigh*		*Calf*		Sum of 9 SF
		X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	X	SD	
								Females												
7	178	6.7	3.4	5.3	2.7	5.6	3.1	11.2	5.9	10.5	3.5	5.3	2.2	5.9	1.6	16.3	5.6	11.5	3.9	78.2
8	182	7.2	3.8	5.8	3.0	6.3	3.5	11.5	6.6	11.2	3.9	5.6	2.0	6.0	1.7	18.0	5.9	12.4	4.1	83.9
9	183	8.3	4.6	6.6	3.7	7.0	4.3	13.4	8.0	12.3	4.6	6.0	2.4	6.1	1.8	19.8	6.7	13.3	5.0	92.8
10	188	9.4	5.9	7.0	4.4	7.5	4.6	13.8	8.1	12.5	5.0	5.9	2.6	5.9	1.9	20.1	6.8	13.8	4.9	95.9
11	205	9.9	5.6	7.9	4.8	8.4	5.0	14.7	7.7	12.7	4.8	6.1	2.6	5.9	2.0	21.2	6.7	15.1	5.4	101.9
12	190	10.8	6.1	8.8	5.1	9.2	5.1	17.0	7.1	13.4	5.0	6.3	2.8	5.8	1.7	21.9	6.5	15.7	5.3	108.9
13	182	12.0	6.5	9.9	5.4	9.7	5.2	18.3	7.6	14.5	5.5	6.3	2.9	5.9	2.0	23.3	6.3	16.5	5.4	116.4
14	138	13.0	6.4	10.6	5.4	10.1	5.3	18.7	7.1	14.8	5.2	6.3	2.5	6.4	2.7	23.7	6.5	16.9	5.2	120.5
15	136	12.2	4.9	10.0	4.1	10.2	4.2	18.7	6.5	14.8	4.3	6.1	2.1	6.3	1.7	24.0	5.8	16.3	4.2	118.6
16	128	13.3	5.5	11.1	5.2	9.6	4.9	18.1	7.0	15.2	4.7	6.3	2.4	6.3	1.9	24.4	6.1	16.7	5.3	121.0
17	136	13.1	5.3	11.2	4.4	9.2	3.6	17.9	6.7	15.4	4.6	6.3	2.2	6.1	1.6	24.8	6.2	16.8	4.9	120.8
30-40	**2840**	**22.4**	**10.4**	**16.5**	**7.9**	**16.6**	**8.3**	**32.3**	**11.7**	**22.2**	**7.9**	**10.3**	**5.5**	**8.7**	**4.5**	**33.1**	**9.8**	**20.1**	**6.8**	**182.2**

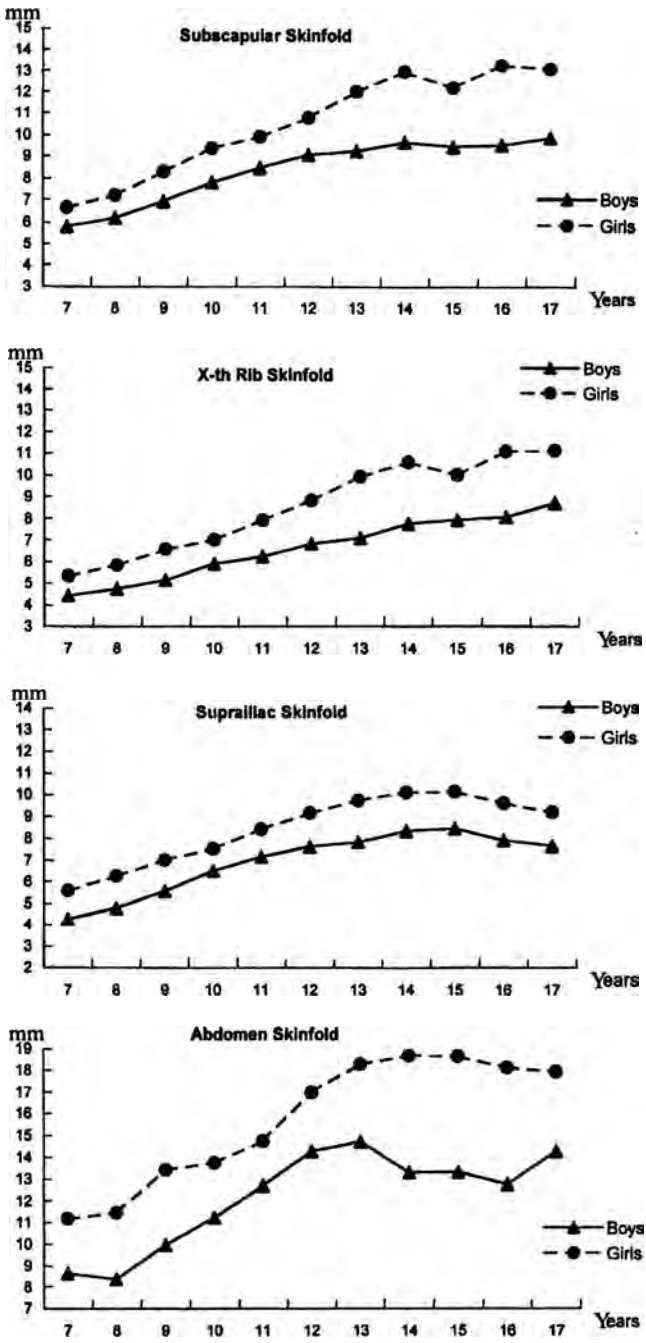

Fig. 2. Trunk SFT thickness

Analyzing the thickness about every skinfold separately are established sexual differences with character specific for both sexes. These data show that after 11 or 12 years of age, the male and female accumulating type is demonstratively marked, i.e. the type of distribution of SFT on trunk and extremities.

In boys during the period 7-17 years of age a slight deposition of a thicker SFT on the chest is available, i.e. under the scapula and over the Xth rib at the expense of the significant decrease of SFT thickness on the abdomen area after the 13 and 15 years of age (Fig. 2).

In girls the accumulation of SFT on trunk continues more strongly after 11-12 years of age on abdomen and less on the chest till 14 years of age. After this age, however, till 17 years the accumulation of SFT on trunk in girls either stops or decreases.

From the three skinfolds that characterize the SFT thickness on the upper extremity with more expressed sexual and age differences is the triceps skinfold thickness. After 12 years of age the male and female type of SFT distribution on upper arm is clearly manifested which is characteristic with comparatively thicker SFT in girls compared with boys. Lowest are the age and sexual differences of SFT on forearm (Fig. 3).

The male and female type of SFT distribution on lower extremity again is more strongly manifested after 12 years of age. During this age the SFT increase considerably on thigh and more slightly on calf in girls, as in the boys the SFT thickness on the lower extremity considerably decrease (Fig. 4).

To establish when and how much the SFT thickness during childhood and youth get near to its characteristics for adults [6], a comparison between the present data about 7, 13 and 17 years old schoolchildren and representative data about adult Bulgarian population – 30-40 years old man and women (from the National anthropological program) is made. (Table 2, Fig. 5 and 6) The comparative analysis of data about the sum of 9 skinfold thickness shows that even at 7 years of age the male and female type of SFT thickness is already marked. The amount of the measured SFT is with 20.5 % more in the 7 years old girls than it is in the 7 years old boys. At 13 years of age the sexual differences grew strong as the priority for the girls increases up to 26.7 %. For the 17 years old girls, the nine skinfolds thickness sum is higher with 43.3 % compared to boys. This is a type of sexual differences, which are significantly near to those in the adults (30-40 years old ones) when the sum of the nine skinfolds in women is with 48.1 % higher than those in men. These data show that at 17 years of age the formation of sexual differences' type in the SFT thickness is nearly finished. Nevertheless however, for both sexes a parallel accumulation of more significant quantity of SFT is forthcoming as the youth body nutritional status at 17 years of age to transform as a nutritional status of the adult men and women. At 17 years of age the 9 skinfolds thickness sum for boys is 84.2 mm and for the adult men it is 123.0 mm, i.e. an increase with 38.8 mm for this sum is forthcoming. In the 17 years old girls the sum of the 9 skinfolds thickness is

Table 2. Sexual differences according to the sum of 9 Skinfold Thicknesses

Feature	7 years		13 years		17 years		30-40 years	
	♂	♀	♂	♀	♂	♀	♂	♀
Sum of 9 SF Thickness	64.8	78.2	91.8	116.4	84.3	120.8	123.0	182.2
ISD data	120.5%		126.8%		143.3%		148.1%	

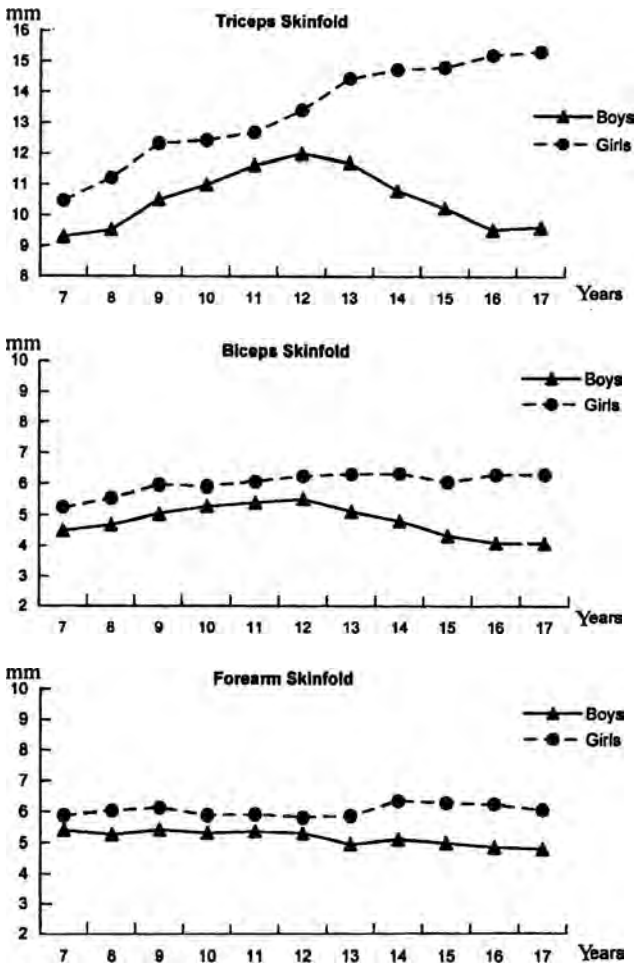

Fig. 3. Upper extremity SFT thickness

Table 3. Age Differences in the Topical distribution of Subcutaneous Fat Tissue

Sex	Age	Relative share of every Skinfold Thickness to the sum of 9 Skinfold Thicknesses (%)								
		Subsca pular	X-th Rib	Supra iliac	Abdo men	Triceps	Biceps	Forearm	Tight	Calf
♂	7	8.9	6.8	6.6	13.3	14.4	6.9	8.3	20.1	14.7
	`13	10.0	7.7	8.5	16.0	12.7	5.7	5.4	19.5	14.5
	17	11.7	10.2	9.1	16.8	11.3	4.8	5.7	17.7	12.7
	30-40	**14.5**	**10.9**	**9.5**	**22.4**	**9.5**	**5.0**	**4.8**	**14.5**	**8.9**
♀	7	8.6	6.8	7.1	14.3	13.4	6.8	7.5	20.8	14.7
	13	10.3	8.5	8.3	15.7	12.5	5.4	5.1	20.0	14.2
	17	10.9	9.3	7.6	14.8	12.7	5.2	5.1	20.5	13.9
	30-40	**12.3**	**9.1**	**9.1**	**17.6**	**12.2**	**5.7**	**4.8**	**18.2**	**11.0**

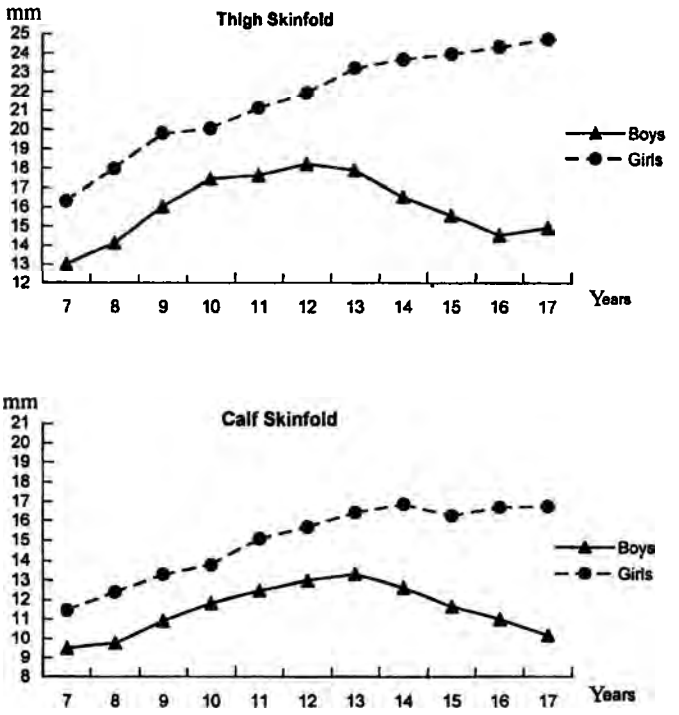

Fig. 4. Lower extremity SFT thickness

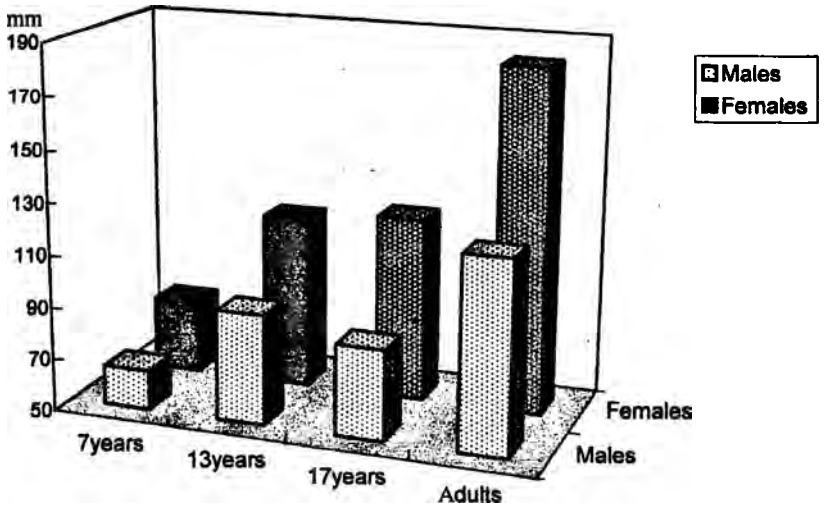

Fig. 5. Age Differences in the sum of 9 Skinfolds Thickness

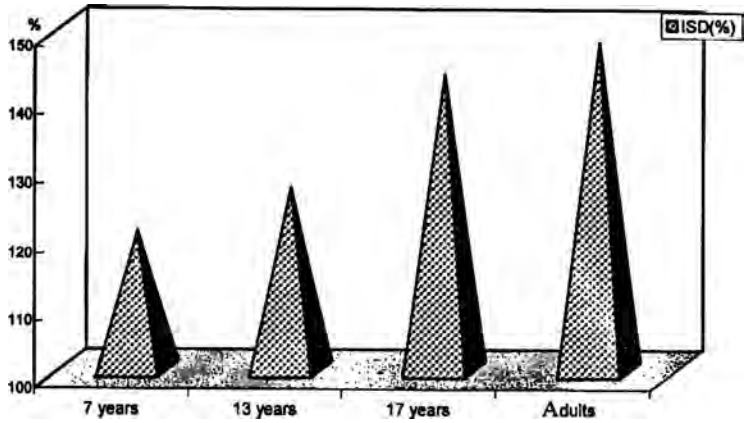

Fig. 6. Sexual Differences in the sum of 9 Skinfolds Thickness

120.7 mm and for the adult women it is – 182.2 mm, and the forthcoming increase is respectively 61.5 mm.

For the characterization of the differences in the topical distribution of SFT during the childhood and youth, as well as for the adult men and women we analyze the data about the relative share of every skinfold thickness regarding the sum of nine skinfolds for 7, 13, 17 years old schoolchildren and for adults (Table 3, Fig. 7). In the male individuals, relatively lowest share of SFT on the chest and abdomen have the 7 years old boys, between 13 and 17 years of age this SFT gradually increase and the adult men have highest share of SFT on trunk most markedly on abdomen. Opposite is the arrangement for the relative share of SFT thickness on the extremities. Highest is the relative share of SFT thickness in 7 years old boys and lowest it is in the adult men.

For the female individuals, the differences in the topical distribution of SFT throughout the investigated age periods are similar to this for the male individuals but in the females the age differences are more slightly expressed.

Conclusion

It is established that between 7 and 17 years of age the girls constantly have thicker skinfolds than boys.

In both sexes the sum of nine skinfolds thickness increase in parallel with the ages till 11-12 years. After this age the SFT thickness continue to increase palpably till 14 years of age in girls, than the accumulation stops and its thickness remain commonly the same till 17 years of age. In boys after 13 years of age begins an evidently decrease of SFT thickness and the 17 years old boys have significantly less quantity of SFT than girls, i.e. the sexual differences are largest in this age.

At 17 years of age the formation of sexual differences type of the SFT thickness is nearly finished, as it is in adults. Notwithstanding, however for both sexes the accumulation of significant quantity of SFT is forthcoming for the youth nutritional status type to become a nutritional status type of the adult men and women.

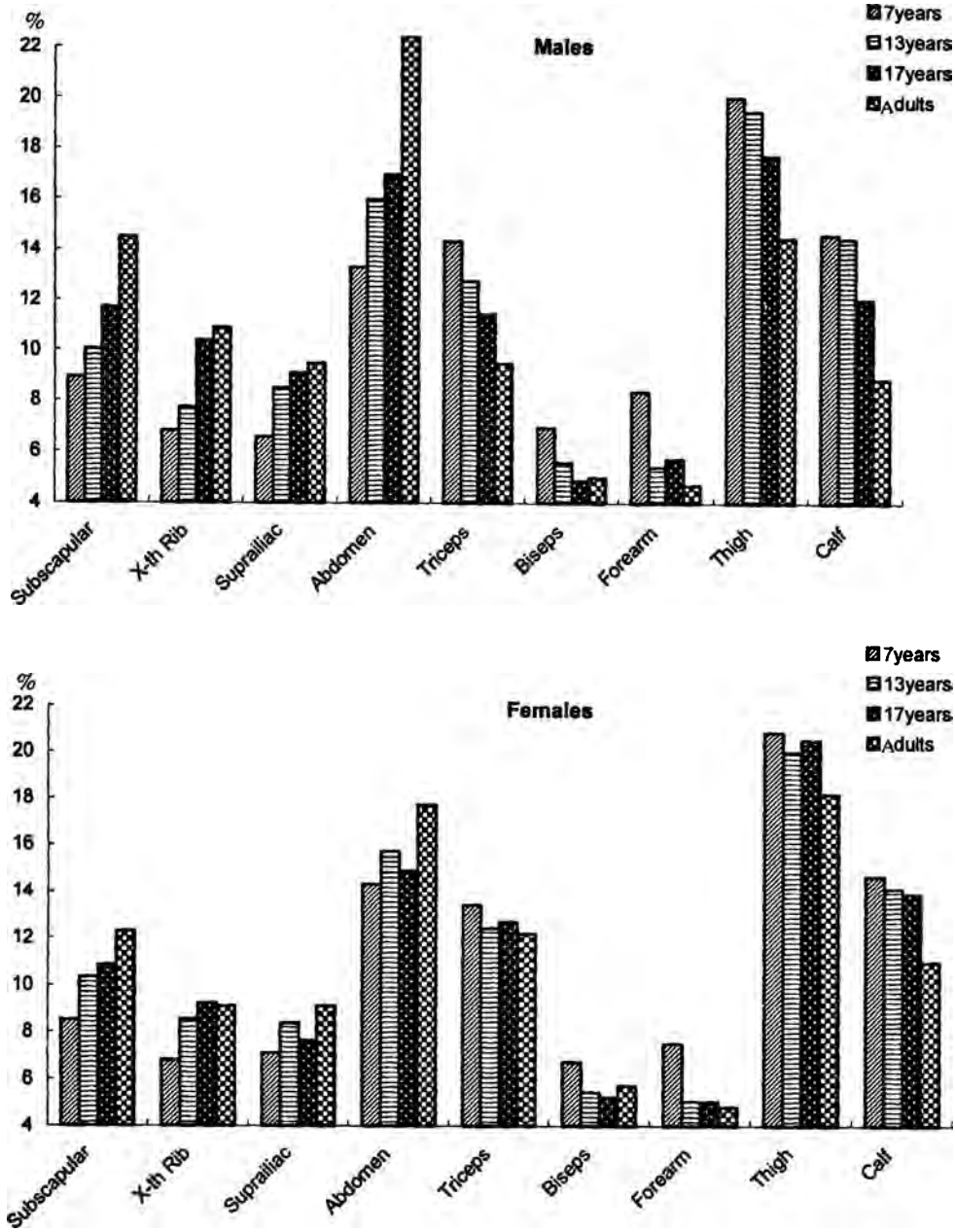

Fig. 7. Age Differences of the Topical Distribution of Subcutaneous Fat Tissue (According to the Relative Share of Investigated Skinfolds)

References

1. Asienkiewiz, R. Ontogenetic variation of adiposus layer in 5-14 year old children. – Przeglad medyczny – scripta periodica, Rok III, 2000, No 4, 42-55.
2. Falkner, F., J. Tanner. Human Growth. A comprehensive treatise. 3, 1987, 227-228; 298.
3. Malina, R., C. Bouchard C. Subcutaneous fat distribution during growth. – In: Fat distribution during growth and latter outcomes. (Bouchard, C., Johnston, F., eds.) New York, Liss, 1988, 63-84.
4. Nacheva, A., E. Lazarova, L. Yordanova. Body nutritional status of 7-17 years old schoolchildren from Sofia (longitudinal study, 1993-2001). – Journal of Anthropology, 4, 2003, 21-23.
5. Stefancic, M., U. Arko, V. Broder, F. Dovecar, M. Juricic, M. Macarol-Hiti, P. Leben-Seljak, T. Tomazo-Ravnic. An Assessment of physical growth and development in children and youths in Lubljana, Supl. 1. Lubljana, Zdrav Var, 1996, 1-159.
6. Начева, А., М. Колева. Особености в количеството и разпределението на подкожната мастна тъкан при израснали. – Journal of Anthropology, 2, 1999, 58–67.