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Subcutaneous Fat Tissue in Children Aged from 3 till 6 Years (preliminary report)

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The development of Subcutaneous Fat Tissue (SFT) is morphological characterization with high ecological sensitivity and specificities connected with age and sex. The aim of the present work is to characterize the age and sexual differences of subcutaneous fat tissue thickness and its distribution in children aged from 3 to 6 years. The data presented are part of a detailed anthropological investigation started in June 2004 in Sofia kindergartens. Data about 440 children (210 boys and 230 girls) at 3, 4, 5 and 6 years are included. The thickness of 9 standard skinfolds and the total quantity of SFT are analyzed. The total quantity of SFT in all the examined ages is larger in girls. The age differences show that SFT accumulation happens basically during the periods 3-4 and 5-6 years. Sexual differences of total quantity SFT are biggest in 5 years old children and smallest at the age of 3.

Key words: subcutaneous fat tissue, skinfolds, sexual differences, age differences, children.

Introduction

From birth till adulthood in the anthropometrical characterization occur great changes, which accompany the morphological maturation of human body [3]. The changes themselves are connected with individual's sex and his physiological status. The Subcutaneous Fat Tissue (SFT) thickness is an important morphological characterization for the assessment of physical development in children. It possesses great eco-sensitivity and age-sexual specificity, and gives valuable medico-anthropological information about physical and health status of the growing up organism [2, 4].

The aim of the present work is to characterize the age and sexual differences of subcutaneous fat tissue thickness and its distribution in children aged from 3 to 6 years.

Material and Methods

The data presented are part from a detailed anthropological investigation started in June 2004 and carried out till now in kindergartens in Sofia City. The report includes data about 440 children (210 boys and 230 girls) at the age of 3, 4, 5 and 6 years.

The thickness of 9 standard skinfolds (in mm) and the total quantity SFT presented by the 9 skinfolds' sum are analyzed.

The skinfolds are measured with Holtain skinfold caliper, by the WHO standardized method approved in 1987 and published in 1989 [1].

The sexual differences are evaluated quantitatively by the Index of Sexual Differences (ISD), expressed in Index Units (IU) and computed by the formula:

$$ISD = 2 \times [(\bar{x}\ \text{boys} - \bar{x}\ \text{girls}) \times 100] / (\bar{x}\ \text{boys} + \bar{x}\ \text{girls}).$$

The zero ISD value shows absence of sexual differences. The positive values point out priority for boys and the negative — priority for girls.

The metrical data are statistically computed and the established differences are assessed by the t-test of Student at $P<0.05$.

Results

The statistical data about each skinfold on body and extremities and the sexual differences and their reliability are presented in Tables 1, 2, 3 and Figs. 1, 2, 3; while about the sum of 9 skinfolds in Tables 1, 2, 3 and Fig. 4.

Subscapular skinfold. The subscapular skinfold thickness concerning the 3 years old children is 5.29 mm for boys and 5.23 mm for girls. It increases up to 5.61 mm in the 6-year-old boys and up to 6.43 mm in the 6-year-old girls. The inter-age comparison shows that the changes of SFT thickness on back during 3-6 years are similar for both sexes. Throughout the periods 3-4 years and 5-6 years the subscapular skinfold increases for both sexes more tangible in girls, throughout the period 4-5 years it remains nearly the same for boys and girls and even a slightly decrement have been observed for both sexes. The sexual comparisons indicate almost equal SFT thickness on back for both sexes at 3 years of age but girls have always thicker subscapular skinfold from 4 till 6 years of age. The ISD data pointed out that the sexual differences increase in the ages, being 1.14 IU at 3 years (little priority of boys over girls) and it rises already to 13.62 IU at 6 years — priority of girls over boys. The sexual differences are not statistically significant in any of the studied age groups.

X-th rib skinfold. The X-th rib skinfold thickness is nearly equal for both sexes at 3 years of age, being insignificantly thicker in boys (boys — 4.12 mm, girls — 3.93 mm). There are small changes of the X-th rib skinfold in the ages for both sexes that are more strongly expressed in girls. The skinfold thickness increases in boys, although slightly, during the entire studied period. The accumulation of SFT on chest is more clearly displayed in girls throughout the periods 3-4 and 5-6-years, compared to boys for the same periods. In girls the SFT thickness decreases between the 4th and 5th year, at the age of 5 boys and girls have equal skinfolds, and girls at 6 have already thicker X-th rib skinfold than boys (boys — 4.45 mm, girls — 5.12 mm). Most intensive is the accumulation of SFT on this area in boys between 4 and 5 years, and in girls — between 5 and 6 years.

The sexual differences assessed by ISD data are smallest, practically missing, at 5 years of age (0.69 IU) and biggest with priority for girls at 6 years of age (–14.22 IU). The differences are not statistically significant.

Abdomen skinfold and suprailiac skinfold. The SFT quantity on abdomen area is determined by the abdomen and suprailiac skinfolds. At 3 years of age they are practically equal for both sexes: in boys respectively 6.81 mm and 3.77 mm, and in girls respectively

Table 1. Data about skinfolds' thickness in boys

Age	*n*	Subscapular		X-th Rib		Suprailiac		Abdominal		Triceps		Biceps		F
		$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$
3	44	5.29	1.16	4.12	0.86	3.77	0.89	6.81	2.20	10.03	2.36	4.87	1.10	5.9
4	62	5.39	1.92	4.16	1.31	4.07	2.00	7.31	3.32	9.91	2.84	4.76	1.50	5.6
5	59	5.20	2.72	4.35	2.97	3.75	1.34	6.78	2.84	9.68	2.52	4.41	1.04	5.0
6	45	5.61	2.85	4.44	2.23	4.41	2.32	8.17	4.74	9.90	3.14	4.67	1.84	5.0

Table 2. Data about skinfolds' thickness in girls

Age	*n*	Subscapular		X-th Rib		Suprailiac		Abdominal		Triceps		Biceps		F
		$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$
3	48	5.23	1.16	3.93	0.91	3.89	1.01	6.82	2.16	10.35	1.96	4.74	1.15	6.1
4	69	5.90	1.70	4.42	1.23	4.78	1.82	8.13	3.00	11.42	2.80	5.14	1.27	5.8
5	70	5.70	2.02	4.32	1.12	4.71	1.64	8.44	3.34	10.94	2.58	5.02	1.32	5.4
6	43	6.43	3.66	5.12	3.13	5.34	3.12	9.10	4.49	11.12	3.38	5.46	2.06	5.2

Table 3. Sexual differences according to the ISD data and the statistical significance by Student's t-test

Age	Subscapular skin fold		X-th Rib skin fold		Suprailiac skin fold		Abdominal skin fold		Triceps skin fold		Biceps skin fold		
	ISD	t-test	ISD	t-test	ISD	t-test	ISD	t-test	ISD	t-test	ISD	t-test	IS
3	1.14	0.24	4.72	1.04	-3.13	-0.62	-0.15	-0.03	-3.14	-0.71	2.70	0.56	-3
4	-9.03	-1.62	-6.06	-1.17	16.04	-2.12*	10.62	-1.50	-14.16	-3.08*	-7.68	-1.61	-4
5	-9.17	-1.19	0.69	0.09	-22.70	-3.58*	-21.81	-3.01*	-12.22	-2.79*	-12.94	-2.88*	-7
6	-13.62	-1.17	-14.22	-1.19	-19.08	-1.58	-10.77	-0.95	-11.61	-1.76	-15.60	-1.92	-3

* Statistically significant differences ($P< 0.05$)

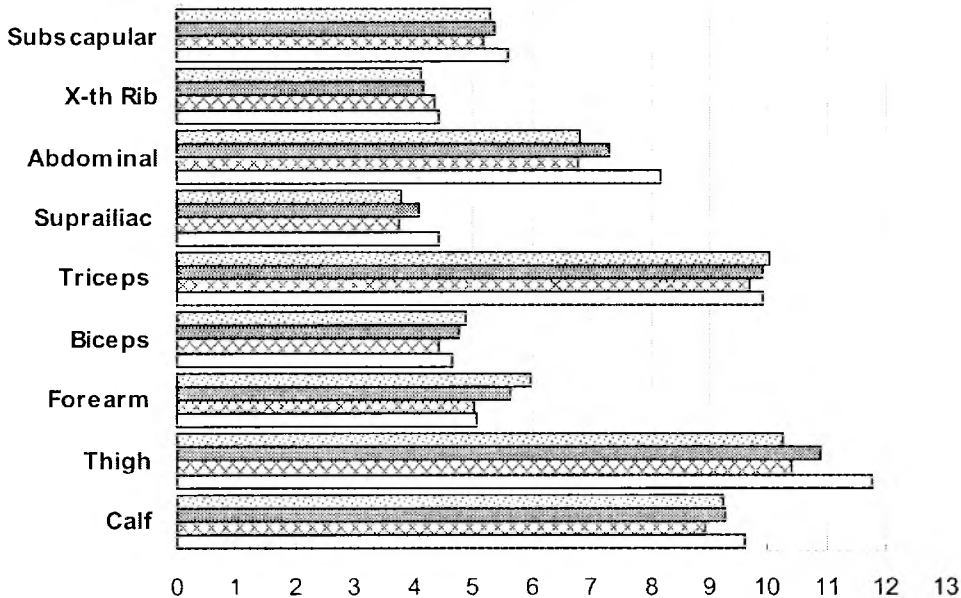

Fig. 1. Data about skinfolds thickness in boys

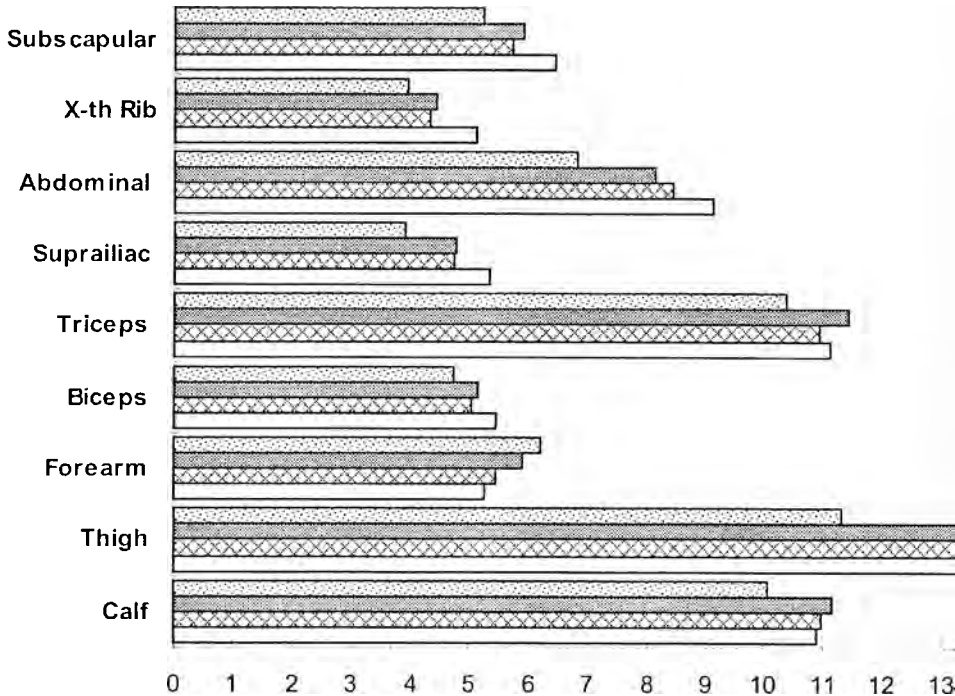

Fig. 2. Data about skinfolds thickness in girls

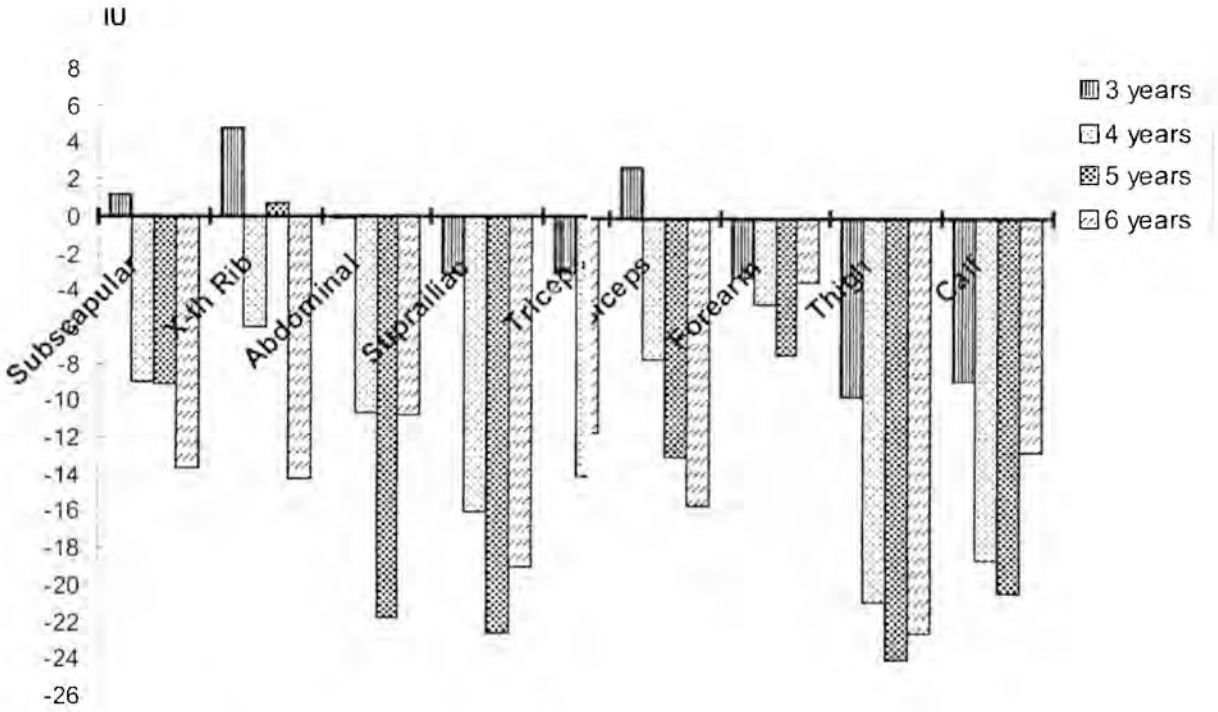

Fig. 3. Intersexual differences according to the ISD data

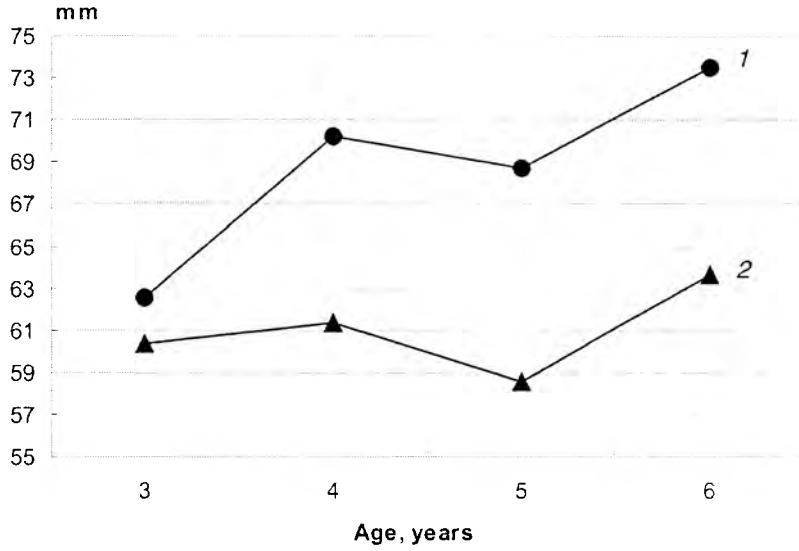

Fig. 4. Sum of the measured 9 skinfolds thickness
1 — girls; *2* — boys

6.82 mm and 3.89 mm. For boys at 6 the abdomen skinfold thickness is 8.17 mm and the suprailiac skinfold — 4.41 mm. Girls at the same age have thicker skinfolds (abdomen skinfold — 9.10 mm, supailiac skinfold — 5.34 mm). The inter-age comparisons show that more intensive is the accumulation of SFT on abdomen area between 5th and 6th year in boys, and between 3rd and 4th year in girls. Throughout the period 4-5 years, the thickness of both skinfolds decreases in boys, in girls the abdomen skinfold increases insignificantly and the suprailiac skinfold remains nearly the same.

The sexual comparison displays nearly equal thickness of both skinfolds for the 3 years old boys and girls. Further till 6 years their mean values are bigger in girls. The ISD data display an increment of sexual differences till 5 years of age when the ISD values are highest (-21.81 IU for abdomen skinfold and —22.70 IU for suprailiac skinfold). Statistically significant are the differences of abdomen skinfold at 5 years and of suprailiac one — at 4 and 5 years. At 6 years of age, the sexual differences are smaller and this decrement is better expressed for the abdomen skinfold.

Triceps skinfold. The SFT thickness on back-arm area (triceps skinfold) in the 3-year-old children have similar values for both sexes — in boys it is 10.03 mm and in girls it is 10.35 mm. The age changes of triceps skinfold are of a different nature for both sexes. For boys in the period 3-5 years it decreases, between 5 and 6 years it slightly increases being 9.90 mm for the 6 years old boys, but it reaches not the value for the 3-year-old boys. For girls the triceps skinfold thickness increases reliably between 3rd and 4th year and achieves its maximum for the entire period under study at the 4-year-old ones (11.42 mm). A decrement of the triceps skinfold is observed during the period 4-5 years. Between the 5th and 6th year the triceps skinfold thickness increases again, at 6 it is 11,12 mm but it is not so high as for the 4-year-old girls.

The sexual differences of triceps skinfold are smallest at 3 and biggest at 4 years, after which they gradually decrease remaining considerably high. Statistically significant are the differences for the 4 and 5-years-old boys and girls. For all studied age groups the SFT thickness on triceps area is higher for girls.

Biceps skinfold. The mean value of SFT on frontal-arm area (biceps skinfold) is 4.87 mm for 3-year-old boys and 4,74 mm for 3-year-old girls. At 6 years of age the biceps skinfold decreases up to 4.67 mm for boys, and vice versa it increases for girls up to 5.46 mm. The age changes of biceps skinfold for boys are similar to the ones of triceps skinfold, and more clearly expressed are: the biceps skinfold decrement between 3rd and 5th year and its increment after the 5th year. The age changes of biceps skinfold for girls are similar to those of triceps skinfold, but it reaches its maximal mean value at 6 years of age.

The ISD data display that sexual differences of biceps skinfold increase in the ages. They are smallest, not statistically significant at the age of 3 (2.70 IU) in favor for boys. After this age till 6, girls have permanently thicker biceps skinfold but statistically significant are only the differences at 5 years of age (—12.94 IU).

The age changes of SFT thickness on arm (biceps skinfold and triceps skinfold) tended to a SFT distribution that is characteristic for adults, i.e. for boys the tendency is commonly toward a decrease of the SFT thickness on arm, while for girls — it is toward an increase.

Forearm skinfold. The SFT quantity on forearm site during the period 3-5 years gradually decreases for both sexes. Throughout the 5th and 6th year forearm skinfold thickness remains the same in boys and it continue to decrease in girls. The forearm skinfold decreases in boys from 5.99 mm to 5.06 mm and in girls — from 6.19 mm to 5.24 mm during the period 3-6 years.

Thicker is the SFT thickness on forearm site in girls about all age groups. ISD data show that sexual differences are smallest at 3 years of age (—3.28 IU) but they are biggest and statistical significant at 5 years of age (—7.45 IU). After this age the sexual differences become smaller and at the age of 6, being —3.50 IU, they are near to the differences for the 3-year-old children.

Thigh skinfold. Highest is the SFT thickness on thigh site (thigh skinfold) for both sexes in all age groups. For the 3-year-old children it is 10.25 mm in boys, and 11.30 mm in girls. At 6 years the thigh skinfold is already 11.77 mm in boys and 14.76 mm in girls. The age changes are nearly the same for both sexes. Throughout the 4th and 5th year the thigh skinfold becomes slightly lower in both sexes and in girls — even unnoticeably. After 5 years of age, the SFT thickness on thigh site increases again for both sexes, more intensively in girls.

The sexual comparison displays that for all investigated ages, girls have larger quantity of SFT on thigh. The sexual differences are smallest at 3 years and only at this age they are not statistically significant (—9.74 IU). Biggest are they in the 5-year-old children (—23.91 IU) and at the age of 6 the sexual differences slightly diminish.

Calf skinfold. The thickness of calf skinfold is 9.22 mm in 3-year-old boys and 10.08 mm in 3-year-old girls. At 6 years of age it is 9.60 mm for boys and 10.91 mm for girls. In the age, the changes of this skinfold thickness are different for both sexes. In boys between 3rd and 4th year the calf skinfold practically didn't modify, between 4th and 5th year it decreases, and between 5th and 6th year it increases noticeably. Girls accumulate larger quantity of subcutaneous fat tissue on calf site in the period 3-4 years and after this age till 6 the calf skinfold thickness slightly decreases.

The intersexual differences assessed quantitatively are smallest for the 3-year-old children (—8.91 IU), as it is for the rest skinfolds, and they increase till the 5th year when the differences are most clearly expressed (—20.39 IU). At 6 years of age the sexual differences become smaller, in view of the fact that the calf skinfold thickness decreases in girls and it increases in boys.

Sum of 9 skinfolds thickness. The total quantity of measured SFT thickness is presented by the sum of 9 skinfolds. The tendency and intensity of age differences are comparatively equal for both sexes. The accumulation of SFT happens basically during the periods 3-4 and 5-6 years, as the total quantity of SFT increases throughout the 3rd and 4th year more noticeably in girls than in boys. Between 4th and 5th year a tangible change in the total quantity of SFT is not observed. The sum of 9 skinfolds for boys aged 6 years is about 5.43% higher compared to this for the boys aged 3 years, and for girls the percentage is three times higher — 17.51%.

The results described could be explained by the first physiological extension, mainly of the extremities, that could be observed during the period 4-6 years (in girls it happens one year earlier) [3].

The results about sexual comparison of the 9 skinfolds thickness sum display that girls have larger quantity of SFT than boys in all studied age groups. The intersexual differences assessed by the ISD data are smallest in the 3-year-old children (—3.55 IU) and biggest — in the 5-year-old ones (—16.03 IU).

Conclusions

1. The total quantity of SFT thickness in the period 3-6 years of age is greater in girls compared to boys.
2. The inter-age differences display that the accumulation of SFT happens mainly in the periods 3-4 and 5-6 years of age in both sexes.
3. The sexual differences of total quantity SFT are biggest at the 5 years old children and smallest at 3 years old ones.

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