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Gender Differences in the Distribution of Subcutaneous Adipose Tissue in Bulgarian Patients with Type 2 Diabetes Mellitus

Atanas Baltadjiev

Department of Anatomy, Histology and Embryology
Medical University, Plovdiv, BG
balt@abv.bg

Abstract: *The aim of the present study is to determine the deposition and distribution of the subcutaneous fat tissue in patients with type 2 diabetes mellitus. Female (N=69) and male (N=56) patients with type 2 diabetes mellitus were examined. The mean age of the females was 65.2 years and of the males 65.5 years. All patients were of Bulgarian ancestry. Nine skinfolds in the upper and lower limbs, thorax and abdomen were measured with Harpenden Skinfold Caliper. The data obtained allow determining the tendency of distribution of the subcutaneous fat tissue. In the females the skinfolds were thicker in the abdomen than in the thorax and in the lower limbs thicker than in the upper limbs. Males have greater deposition of subcutaneous fat tissue in the thorax than in the abdomen and in the lower limbs than in the upper limbs.*

Keywords: *skinfolds, subcutaneous fat tissue, type 2 diabetes mellitus, female, male, anthropometry.*

1. INTRODUCTION

Diabetes mellitus attracts greatly the interest in the modern society [1], [2]. The relation between age, overweight, distribution of the subcutaneous fat tissue and risk of type 2 diabetes mellitus is widely discussed. The hypothesis of the relationship between type “pear” and type "apple" obesity in type 2 diabetes mellitus patients and severity of the associated cardiovascular syndromes has been recently proposed [1], [3], [4], [5]. Skinfolds thickness is an important anthropometrical parameter for defining the model of distribution of subcutaneous adipose tissue in norm and in a range of metabolic diseases such as obesity, metabolic syndrome, etc [2]. It is particularly very useful in defining the anthropological status of people with diabetes mellitus. This procedure is relatively non-invasive. It demands simple technology and shows good applicability giving results with acceptable accuracy [4], [6]. More sophisticated measures derived from skinfold thickness measurements [7]. The skinfold thicknesses appear to be at least accurate in identifying metabolic risk among adults [8], [9]. The aim of the present study is to establish the peculiarities in deposition and distribution of the subcutaneous fat tissue by means of skinfolds in Bulgarian patients of both sexes with type 2 diabetes mellitus.

2. SUBJECTS AND METHODS

Female (69) and male (56) patients with type 2 diabetes mellitus were examined. They were diagnosed by a endocrinologist and recruited from the Clinic of endocrinology of St. George University Hospital at the Medical University of Plovdiv, Bulgaria. The inclusion criteria were: Bulgarian ethnicity, duration of the disease of no less than five years, compensated diabetes at the time the study, age range from 40 to 80 old. The mean age of the females was 65.2 years and of the males 65.5 years. The exclusion criteria were: previous or existing metabolic, oncologic or other disorders that could compromise the anthropological study. Skin folds were measured, using Harpenden Skinfold Caliper (British Indicators Ltd) in nine body areas: over the triceps and biceps brachii, the forearm, subscapular region, over the 10^{th} rib, abdomen, iliac crest, in the thigh and crus. **Statistical analysis.** Data were analyzed using statistical software SPSS version 15 (SPSS Inc., Chicago, IL). Parametric statistical methods were relevant. Independent Samples t Test was used to compare the means of two independent anthropologic parameters in order to determine whether there was statistical evidence that the means were significantly different. The one-way analysis of variance (ANOVA) was used to determine whether there were any significant differences between the means of three or more independent groups. $P<0.05$ (two tailed) was considered statistically significant.

3. RESULTS AND DISCUSSION

3.1. Females

The results of the skinfold thickness are shown in Table 1.

Table1. *Thickness of skinfolds (sf) in the female patients (mm)*

Variable	N	Mean	SEM	SD	max	min
sf Triceps	69	18.29	0.93	7.69	40.2	5.2
sf Biceps	69	11.15	0.55	4.55	24.4	3.0
sf Forearm	69	10.34	0.45	3.75	21.2	3.8
sf Subscapular	69	23.75	1.03	8.51	50.0	9.0
sf 10^{lh} rib	69	24.40	0.91	7.59	47.4	11.4
sf Abdomen	69	27.78	1.03	8.57	42.0	7.8
sf Iliac crest	69	18.23	0.75	6.22	34.0	5.6
sf Thigh	69	17.37	1.32	10.99	41.0	4.2
sf Crus	69	17.18	1.03	8.52	39.2	3.3

Skinfolds of the thorax and upper limb

The skinfolds over the 10^{lh} rib and in the subscapular region are thickest and the difference between them does not reach statistical significance ($p>0.05$). The thickness of both skinfolds is significantly greater than that over the triceps brachii, biceps brachii and in the forearm ($p<0.001$). The skinfold over the triceps is significantly greater than the skinfolds over the biceps brachii and in the crus. There is no statistically significant difference between the skinfolds over the biceps brachii and in the forearm ($p>0.05$).

Skinfolds of the abdomen and lower limb

The skinfold of the abdomen is the thickest and significantly greater than the skinfolds over the iliac crest, in the thigh and crus ($p<0.001$). The second in thickness is the skinfold over the iliac crest, which however does not differ significantly from the skinfolds in the thigh and the crus ($p>0.05$). The last two skinfolds are of almost equal thickness.

Comparison between the skinfolds of the upper and lower half of the body

The skinfold of the abdomen is the thickest and statistically greater than the skinfolds in the upper part of the body and upper limbs ($p<0.001$). The difference between the skinfold of the abdomen and over the 10^{th} rib is of moderate statistical significance ($p<0.01$). The skin folds over the 10^{th} rib and subscapular region are significantly greater than those of the lower limb ($p<0.001$). The skinfold in the thigh is significantly greater than that over the biceps brachii ($p<0.001$) and almost equal with that over the triceps brachii ($p>0.05$). The skinfold in the crus is almost equal with that over the triceps brachii ($p>0.05$) and significantly thicker that the skinfolds over the biceps brachii and in the forearm ($p<0.001$).

The skinfold in the forearm is of lowest thickness followed by that over the biceps. The subcutaneous fat tissue deposition in the upper part of the body is greater in the thoracic region and more expressed in the chest than in the back. The subcutaneous fat deposition is less expressed in the upper limbs and especially on the back of the arm.

The amount of subcutaneous fat tissue is significantly greater in the region of the abdomen than in the lower limbs.

The subcutaneous fat tissue deposition shows a tendency to a downward decrease on the body and is more expressed in the lower than in the upper limbs.

Our findings show an indistinct tendency of deposition of subcutaneous fat tissue in the region of the abdomen and lower limbs. Some authors report that the subcutaneous fat in females with type 2 diabetes mellitus is laid down exclusively in the upper part of the body with tendency to "super apple" [1], [10].

3.2. Males

The results of the skinfold thickness are shown in Table 2.

Table2. *Thickness of skinfolds (sf) in the male patients (mm)*

Variable	N	Mean	SEM	SD	max	min
sf Triceps	56	9.25	0.56	3.35	18.6	3.2
sf Biceps	56	6.32	0.43	2.57	12.4	2.6
sf Forearm	56	6.16	0.49	2.93	14.0	2.6
sf Subscapular	56	19.08	1.19	7.16	35.8	7.8
sf 10^{th} rib	56	21.33	1.23	7.39	40.2	9.8
sf Abdomen	56	19.66	1.53	9.18	42.4	6.2
sf Iliac crest	56	11.16	0.96	5.74	31.0	4.0
sf Thigh	56	11.54	1.14	6.85	27.8	4.0
sf Crus	56	7.27	0.56	3.39	19.6	3.2

Skinfolds of the thorax and upper limb

The thickest is the skinfold over the 10^{th} rib followed by that in the subscapular region and the difference between them does not reach statistical significance ($p>0.05$). The difference between both skinfolds and the other skin folds (triceps, biceps and forearm) is statistically significant ($p<0.001$). The upper limb skinfolds are of lower thickness and the difference between them and those of the thorax reaches statistical significance. The thickest is the skinfold over the triceps, which is statistically greater than the skinfolds over the biceps and in the forearm ($p>0.001$).

Skinfolds of the abdomen and lower limb

The skinfold of the abdomen is the thickest and significantly greater than the skin folds over the iliac crest, in the thigh and the crus ($p<0.001$). The skinfold in the crus is of lowest thickness and the difference with the other skin folds is statistically significant ($p<0.001$). The skinfolds over the iliac crest and in the crus are of almost equal thickness and significantly thinner than the skinfold of the abdomen ($p<0.001$).

Comparison between the skinfolds of the upper and lower half of the body

The skinfold over the 10^{th} rib is the thickest followed by those of the abdomen, subscapular region, thigh, iliac crest, triceps, crus, biceps and forearm.

The skinfold over the 10^{th} rib is insignificantly greater than that of the abdomen ($p>0.05$) and significantly greater than the skinfolds in the lower limb ($p<0.001$).

The subscapular skinfold is almost equal in thickness to the skinfold of the abdomen ($p>0.05$) and significantly thicker than the skinfolds in the lower limb ($p<0.001$).

The skinfold in the thigh is slightly thicker than that over the triceps brachii ($p>0.05$), significantly thicker than the skinfolds over the biceps brachii and in the forearm but significantly thinner than the skinfolds over the 10^{th} rib and in the subscapular region ($p<0.001$).

The skinfold in the crus is significantly thinner than that over the triceps brachii, 10^{th} rib and subscapular region ($p<0.001$), slightly thicker that the skinfold in the forearm ($p>0.05$) and almost equal to the skinfold over the biceps brachii.

Our findings show an indistinct tendency to a greater deposition of subcutaneous fat tissue in the upper parts of the body. Horejsi et al. [2] have reported that the subscapular and midaxillar skinfolds are significantly thicker in male patients with type 2 diabetes mellitus. Hence, there is a tendency to an "apple" type deposition of the subcutaneous fat tissue.

The subcutaneous fat tissue deposition in the upper part of the body is greater in the thoracic region and almost equal in the chest and in the back. The subcutaneous fat deposition in the upper limbs is more expressed on the back of the arm.

The amount of subcutaneous fat tissue is significantly greater in the region of the abdomen and proximal part of the lower limbs.

The subcutaneous fat tissue is greater in the region of the thorax than in the abdomen. The skinfolds are thicker in the lower than in the upper limbs. The subcutaneous fat tissue shows a tendency to an "apple" type deposition.

Intersexual differences in the skin folds

The examined skinfolds are significantly greater in the female than in the male patients with type 2 diabetes mellitus ($p<0.001$). The only exception is the skinfold over the 10^{lh} rib with intergender difference failing to reach statistical significance ($p>0.05$).

4. CONCLUSION

It could be concluded that the deposition of the subcutaneous fat tissue is greater in the female than in the male type 2 diabetes mellitus patients.

Our findings show that in Bulgarian diabetic patients there is a tendency to an "apple" type deposition of the subcutaneous fat tissue in males and as ”super apple” in females.

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