THE ADIPOSE TISSUE DISTRIBUTION IN TYPE 2 DIABETES MELLITUS

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Abstract

Obesity, especially the abdominal obesity, is an important factor for insuline-resistance and represents the most powerful risk-factor for the appearance of type 2 diabetes mellitus in the presence or absence of dislipidemy. An adipose tissue over 25% for males and over 35% for females identifies the obese persons. Antropometric parameters used for quantifying the obesity are: body mass index (BMI), abdominal circumference (AC), waist-hip ratio. The type 2 diabetes mellitus prevalence increases directly with the corporal mass index (CMI). There have been found correlations between the corporal-mass index and the abdominal circumference; abdominal circumference values over 94 cm (males) and over 80 cm (females) are usually present at persons with corporal-mass index over 25 kg/m^2 or smaller than this, but with a greater waist-hip ratio. Abdominal circumference values over 102 cm (males) and over 88 cm (females) are present in persons with corporal-mass index over 30 kg/m^2.

The objective of this study is to establish if there are sex-differencies regarding the adipose tissue distribution at obese patients with type 2 diabetes mellitus and with dislipidemy.

Key words: insulin resistance, metabolic syndrome, dislipidemy, diabetes mellitus.

Obesity, especially the abdominal obesity, is an important factor for insulino- resistance and represents the most powerful risk-factor for the offspring of type 2 diabetes mellitus in the presence or absence of dislipidemy [4,5]. An over 25% adipose tissue for males and over 35% for females identifies the obese persons. Antropometric parameters used for define the obesity are: body mass index (BMI), abdominal circumference (AC), waist-hip ratio[3,7,9]. The type 2 diabetes mellitus prevalence increases directly with the body mass index (BMI). There have been found correlations between the body mass index and the abdominal circumference; abdominal circumference values over 94 cm (males) and over 80 cm (females) are usually present at persons with body mass index over 25 kg/m^2 or smaller than this, but with a greater waist-hip ratio. Abdominal circumference values over 102 cm (males) and over 88 cm (females) are present at persons with body mass index over 30 kg/m^2 [7,10].

Identifying the abdominal type obesity is important, because it is the key-element in metabolic disorders of the metabolic syndrom. The association with the modification of the lipidic profile, metabolic disorders (type 2 diabetes mellitus) and with the concomitent presence of arterial hyper-tension are often in connection with this distribution. [1,3,8]

The objective of this study is to establish if there are gender-differencies regarding the adipose tissue distribution at obese patients with type 2 diabetes mellitus and with dislipidemy and to analyse the correlation of the different antrophometric parameters with the total mass of the adiposity of the body resulted by two different methods [2,6,7].

Material and method

A number of 100 pacients type 2 diabetes mellitus were analysed (51 men and 49 women), with the following characteristics (mean± standard deviation, for men, respectively for women):

Characteristic/ variable	Mean ± standard deviation	
	Men	**Women**
Age	(60.4 ± 8.24) years	(61.4 ± 7.38) years
Type 2 diabetes mellitus evolution	(2 8.39 ± 7.94) years	(12.11 ± 10.74) years
Corporal mass index	27.67 ± 3.92 kg/m²	28.16 ± 6.38 kg/m²
HbA1c	(9.61 ± 2.36) %	(10.34 ± 2.56) %

There have been made cross-sectional analysis of some antropometric measurements; we are presume the total fat-mass and we observed the adipose tissue distribution for the two gender-groups. The total adipose tissue have been measured by bioimpedancy with Omron equipment (Matsusaka, Japan)- the unit value represents a percentage by total body mass and by the 4 skin-folds method (bicipital, tricipital, subscapular and suprailiac).

The fat-percent of the body using the skin-fold method was computed through the following formula:

SIRI Equation:

$$\%fat = \left(\frac{4,95}{BD} - 4,5\right)\cdot 100$$

where BD represents the *body density* – computed with the following relation :

$$BD = C - \left[M \cdot \lg\left(\text{sum of the four skin fold}\right)\right]$$

C and M are constants, with the following values:

- For men : 40-49 years C = 1.1620, M = 0.07000;

  over 50 years C = 1.1715, M = 0.0779

- For women : 40-49 years C = 1.1333, M = 0.0612

  over 50 years C = 1.1339, M = 0.0645.

The adipose tissue distribution was documented by the abdominal circumference and the waist/hip ratio, as well as by measurements of skin-fold with Harpender caliper at the biceps, triceps, subscapular and suprailiac. We used the ecuation of linear regression Durnin-Wormersley for the measurement of the four fold and Siri ecuation for the determination of density of the adipose tissue and total grass of the body.

For statistical analysis there had been used ***SPSS*** and ***STATISTICA for Windows*** software.

Results

There have been found significant correlations between the abdominal circumference and the body mass index (the body mass index was computed as actually weight/High^2). The correlation-coefficient between the two variables was 0,738, pointing to a rather strong positive relation (figure no. 1). The correlation between the abdominal circumference and the corporal mass index was different for men and women: it was stronger for women than for men (correlation coefficient was greater for women than for men: 0,819, respectively 0,724). Student test proved that both coefficients (for men and women) were statistically significant (for women, the computed value of the Student's test was 7,347, while for men it was 9,785), for very high probability level, almost 100% (p-value was near zero).

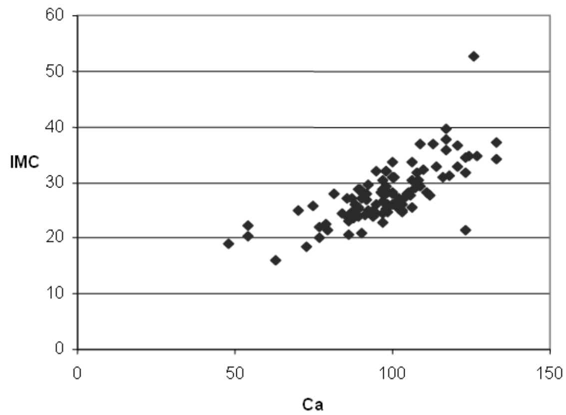

Figure no 1. Correlation between the abdominal circumference and the body-mass index

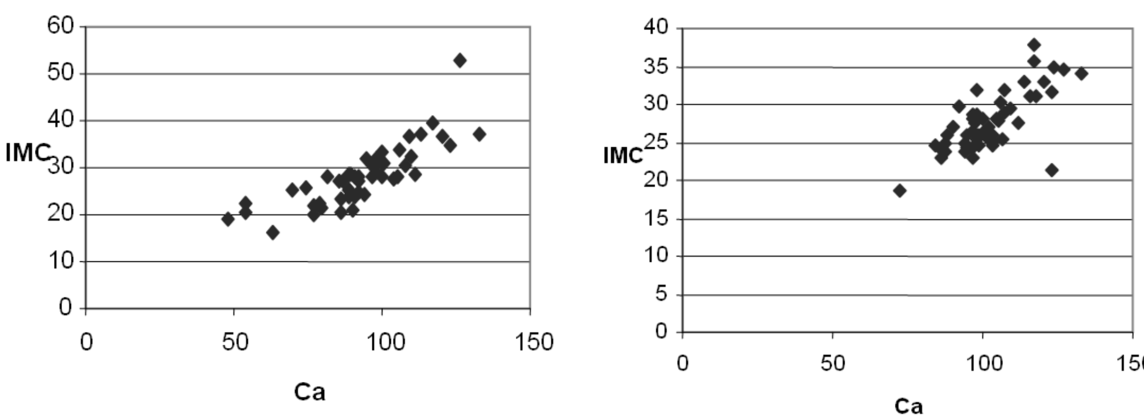

Figure no 2. Correlation between the abdominal circumference and the body-mass index (a) female; (b) male

The abdominal circumference correlates better with the body mass index (correlation coefficient 0,738, showing a rather strong positive correlation) than with the fat-percent determined by skin-fold measurements (correlation coefficient 0,393 pointing to a weak correlation).

The analyse of the data collected from 100 patients (51 men and 49 women) we found out a strong correlation between the abdominal circumference and weight (correlation coefficient 0,86, - statistically significant for an almost 100% probability level; the computed value of t-test was t_{calc} = 16,76855).

Also, using z-test, we determined a significant difference between the abdominal circumference for women and for men. The results are shown in figure no 3:

A	B	C
z-Test: Two Sample for Means		
	Variable 1	*Variable 2*
Mean	93.04898	102.5373
Known Variance	318.5063	151.618
Observations	49	51
Hypothesized Mean Difference	0	
z	-3.08278	
P(Z<=z) one-tail	0.001025	
z Critical one-tail	1.644854	
P(Z<=z) two-tail	0.002051	
z Critical two-tail	1.959964	

Figure no 3. The results using z-test

The computed z-test value was z_{calc} = -3,08278, greater (in absolute expression) than critical values for both one-tail and two-tail tests (1,645, respectively 1,96), which means that we can conclude, with a 99,8975% probability level, that the indicator value is significant higher for men than for women and, with a 99,7949% probability level, that there is a significant difference between the average values of the statistical indicator for men and women. The observed tendency was that for the women the values of the abdominal circumference are significant higher than normal value, so there is an excess adiposity at the abdominal level.

Between the abdominal circumference and the cholesterol-level (LDL-low density lipoproteins) there is a strong positive dependence (correlation coefficient 0,8837 is statistically significant for a very high probability level, almost 100%, as the computed-value of the t-test was t_{calc} = 18,786), *p value* was very low: 0,00001.

The adipose tissue distribution measured at the level of subscapular skin-fold with Harpenden caliper correlated at a medium intensity with the abdominal circumference; the correlation coefficient was 0,662, statistically significant for a very high probability level (almost 100%); the computed value of t-test was t_{calc} = 8,78828.

We determined a significant difference between the total adiposity of the body using bioimpedance for men and women type 2 diabetes mellitus. The computed value of z-test was z_{calc} = 3,522657, higher than critical values for both one-tail and two-tail test (1,645, respectively 1,96); we can conclude, then, with a 99, 9786% probability level, that the variable-value is significantly higher for women than for men, and, with a 99,95728% probability level, that there are significant differencie between the average-values of the variable for the two genders (figure no. 4).

A	B	C
z-Test: Two Sample for Means		
	Variable 1	*Variable 2*
Mean	35.7826087	29.68823529
Known Variance	45.27525	102.4503
Observations	46	51
Hypothesized Mean Difference	0	
z	3.522656807	
P(Z<=z) one-tail	0.000213622	
z Critical one-tail	1.644853627	
P(Z<=z) two-tail	0.000427244	
z Critical two-tail	1.959963985	

Figure no 4. The results using z-test.

Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
% grasime fem.	46	1646	35.78261	45.27525		
% grasime masc.	51	1514.1	29.68824	102.4503		
ANOVA						
Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	898.2855	1	898.2855	11.91876	0.000831	3.941221
Within Groups	7159.899	95	75.36736			
Total	8058.185	96				

Figure no. 5. The results by ANOVA.

The same aspect was studied using the Analysis of Variance ANOVA-single factor (figure no. 5); the F-test computed value was 11,91876, higher than the critical value F_{crit} = 3,9412, which means that the fat-percent varies with gender; it was higher for women than for men, guaranteed with a 99,9169% probability level (significance level "p value" was 0,000831).

We tested the existence of a significant difference between the percentage of adiposity using bioimpedancy and that one resulted using skin – fold method, but it came out a rather weak positive connection between the two variables (the correlation coefficient 0,5), with significant differences on the two genders: the correlation-coefficient was higher for women-patients (0,689) than for men-patients (0,2454), pointing to a stronger correlation in women's case than in men's case. We could have an explanation referring to the correlation coefficient 0,5 because the skin-fold method is a subjective method for the measurements, although for this study one single person performed the measurements of the skin-folds in the purpose to reduce at minimum the errors factors.

Conclusions

These data identify the gender characteristics of the distribution of the adiposity (using the skin-fold and the abdominal circumference) at the type 2 diabetes and for the fat-mass of the body too; established the significant correlations between abdominal circumference and BMI and between all these parameters and the total adiposity of the body, with the gender-difference. The study sustained the necessity of the concomitant determination, like complementary parameters, such as the abdominal circumference and BMI to all the patients type 2 diabetes.

REFERENCES

1. **Boyko EJ, Fujimoto WZ, Leonetti DL, Newell-Morris L**: „Visceral adiposity and risk of type 2 diabetes: a prospective study among Japanese Americans." Diabetes Care 23:465-471, 2000.

2. **Gastaldelli A, Miyazaki Y, Pettiti M, Buzzigoli E, Mahankali S, Ferrannini E, DeFronzo RA**: „Separate contribution of diabetes, total fat mass, and fat topography to glucose production, gluconeogenesis, and glycogenolysis". Clin Endocrinol Metab.; 89(8):3914-21, 2004.

3. **Hayashi T, Boyko EJ, Leonetti DL, McNeely MJ, Newell-Morris L, Kahn SE, Fujimoto WY**: „Visceral adiposity is an independent predictor of incident hypertension in Japanese Americans." Ann Intern Med.;40(12):I17, 2004.

4. **Ionescu-Tîrgovişte C.**: „Tratat de diabet Paulescu", Ed. Academiei 2004.

5. **Kohrt WM, Kirwan JP, Staten MA, Bourey RE, King DS, Holloszy JO**: "Insulin resistance in aging is related to abdominal obesity." Diabetes, 42:273–281, 1993.

6. **Lai SW, Ng KC**: „Which anthropometric indices best predict metabolic disorders in Taiwan?" South Med J. 97(6):578-82, 2004.

7. **Moreira-Andres MN, del Canizo-Gomez FJ, Losa MA, Ferrando P, Gomez de la Camara A, Hawkins FG**: "Comparison of anthropometric parameters as predictors of serum lipids in premenopausal women." Endocrinol Invest.; 27(4):340-7, 2004.

8. **Pascot A, Després JP, Lemieux I, Bergeron J, Nadeau A, Prud'homme D, Tremblay A, Lemieux S**: "Contributions of visceral obesity to the deterioration of the metabolic risk profile in men with impaired glucose tolerance". Diabetologia, 43:1126-1135, 2000

9. **Snifder MB, Dekker JM, Visser M, Bouter LM, Stehouwer CDA, Yudkin JS, Heine RJ, Nijpels G, Seidell JC**: „Trunk Fat and Leg Fat Have Independent and Opposite Associations With Fasting and Postload Glucose Levels." Diabetes Care 27:372-377, 2004.

10. **Vega GL**: „Obesity and the metabolic syndrome". Minerva Endocrinol.; 29(2):47-54, 2004

11. **Ţiţan E.** – „Statistică. Teorie si aplicaţii în sectorul terţiar", Editura Meteor Press, Bucuresti, 2002.