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Body mass in diabetes type 2 patients at the time of diagnosis – Relation to visceral fat distribution

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RESEARCH

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ABSTRACT

Background

In todays world, there is a growing trend of adiposity and its complications including type 2 diabetes, cardiovascular disease and metabolis syndrome.

Aims

This study aimed to investigate adiposity levels and type 2 diabetes regulations at the time of diagnosis in 161 patients.

Methods

Data were collected from medical history, physical examination, body mass index measuring and laboratory test results including HbA1c for every patient OMRON BF 511 diagnostic scale was used in order to measure body fat percentage in a percentage of body weight using the bioelectrical impedance method and for visceral fat measuring also.

Results

Study was conducted on 161 participants including 82 (50.9per cent) of men and 79 (49.1per cent) of women. Median age was 60 years (IR 53-59) from 26 to 81 years. Women were significantly older with higher values of BMI i fat tissue percentage while men were significantly higher, with higher body mass, basal metabolism, muscle mass percentage and visceral fat tissue percentage.

Conclusion

Diabetes type 2 is global epidemic problem which is often found in obese people. High body fat levels lead to visceral fat tissue higher levels, which also leads to higher risk for diabetes type 2 developments. Also these factors are leading to lower glycaemic regulation.

Key Words

Diabetes, adiposity, regulation, visceral

What this study adds:

1. What is known about this subject?

Diabetes type 2 has growing incidence in today's world. Obesity is strongly related to diabetes type 2 and development of its complications.

2. What new information is offered in this study?

This study showed that adiposity, but also visceral fat tissue amount in total fat is related to lower glycaemic regulation in type 2 diabetes.

3. What are the implications for research, policy, or practice?

Diet regulation can lead to lower visceral fat tissue and all of this together can prevent diabetes type 2 and its complications.

Background

Adiposity is a global epidemic problem with many consequences on human's health including diabetes mellitus type 2, high blood pressure, cardiovascular disease, and often these conditions are found in same patients. Main cause for adiposity is todays way of life which is consisted of overeating and lack of physical activity. Being overweight is one of the main risk factors for developing diabetes mellitus type 2 and most of patients with diabetes mellitus type 2 are overweight[1].

Comparing people with normal BMI and those who are overweight or with 1st, 2nd and 3rd degree of adiposity, people who are overweight or obese have higher risk for developing diabetes type 2 and its complications[2].

Body fat distribution is better predictor of adiposity effects on humans health that absolute visceral fat amount(2,3).

Relation between central adiposity and metabolic disorders is well known, but recent studies suggest that visceral fat is related to risk of developing diabetes type 2. There are few theories about visceral body fat and risk for diabetes type 2 relation[2].

Fat tissue is a dynamic endocrine organ which products inflammatory and immune mediators which are known as adipokines. Disregulation in adipokines production, lower levels of adiponectin can cause insulin resistance making a risk for diabetes type 2 higher, but also for cardiovascular disease and metabolic syndrome[4,5,11].

Losing body weight is important preventive strategy for overweight people who have prediabetes because it can slow development of diabetes type 2. For preventing diabetes type 2 complications it is important to balance normal body weight.BMI which is even slightly over 25 means higher risk for development of complications. Many programs for weight reduction including diets, physical activity and behavioural methods are permanently effective and lead to significant decrease in diabetes type 2 prevalention[2].

Lifestyle modification with diet and body mass reduction is related to significant decrease of visceral fat tissue which is than related to lover risk for diabetes type 2 development[6].

The aim of this study was to investigate adiposity degree and body fat in patients with type 2 diabetes at the time of diagnosis. Also, we wanted to investigate is there a relation between glycaemic regulation with body fat distribution.

Method

Study subjects

The study enrolled adult patients (n=161) newly diagnosed with type 2 diabetes who were referred to the Department of Endocrinology and Diabetology, General hospital "Dr. Josip Bencevic" Slavonski Brod, Croatia by a nearby primary health care centre or general practitioners from January 2017 to December 2017. Exclusion criteria were: age under 18 or over 80 years, type 1 diabetes, pregnancy, previous high glucose levels measured in medical history, sever heart, renal or hepatic disease, malignant disease, sepsis and severe infectious disease. This study was approved by the General hospital "Dr. Josip Bencevic" Slavonski Brod Ethics Committee (2017-01-xxx-xxx) and all the subjects provided written informed consent.

Clinical and laboratory measurements

Data were collected from detailed medical history taking, physical examination, body mass index measuring and laboratory test results including HbA1c for every patient. These data included gender, age, duration of diabetes, weight, height and body mass index. Height and weight were measured after overnight fasting and subjects were wearing light clothes without shoes during the examination. Blood samples were drawn from the antecubital vein into vacuum tubes also after overnight fasting and analyzed at a General hospital "Dr. Josip Bencevic" Medical laboratory. Body mass index was calculated as weight in kilograms divided by the square of height in meters. Glycosylated haemoglobin (HbA1c) was measured using an immunoturbidimetric assay with a Cobas Integra 800 automatic analyzer (Roche Diagnostics) with a reference value range of 4.4% to 6.4per cent. OMRON BF 511 diagnostic scale was used in order to measure body fat percentage in a percentage of body weight using the bioelectrical impedance method and for visceral fat measuring also.

Statistical analysis

Normally distributed data were presented as mean±standard deviation, and non-normally distributed date were presented as median (interquartile range [IQR]). Shapiro-Wilk test was used to measure the distribution. The Mann-Whitney U test was used for comparison of quantitative variables. Data were analysed using Friedman analysis of variance. All statistical tests were two-tailed, and the significance level was set at $P<0.05$. Analyses were carried out using IBM SPSS Statistics for Windows, Version 22.0 (IBM Corp, Armonk, NY, USA).

Results

Study was conducted on 161 participants including 82 (50.9per cent) of men and 79 (49.1per cent) of women. Median age was 60 years (IR 53-59) from 26 to 81 years. Women were significantly older with higher values of BMI and fat tissue percentage while men were significantly higher, with higher body mass, basal metabolism, muscle mass percentage and visceral fat tissue percentage (Table 1 and 2). In BMI there were not found significantly different values between man and women. Women have significantly higher fat tissue percentage, significantly higher than men. Visceral fat tissue coefficient is significantly high in men and normal in women. HbA1c values were not significantly different between man and women (Table 3, 4 and 5).

Discussion

Adiposity is important public health problem which is accepted as important risk factor for many chronic diseases on global level. In Croatia, 20.37per cent of adult people are obese, 20.14per cent of men and 20.60per cent of women. In adult Croatian population according to 2010. Study in patients with type 2 diabetes, 79per cent of men and 84per cent of women are obese[8]. Higher abdominal fat tissue, especially visceral fat, can cause arterial hypertension, higher lipid levels, type 2 diabetes and metabolic syndrome. Recent studies have shown that with higher visceral fat percentage there is significantly higher risk of developing type 2 diabetes[9].

The aim of this study was to investigate adiposity levels, total body fat and visceral fat tissue in participants with type 2 diabetes at the time of diagnosis and to find is there a relation between glycaemic regulation with body fat distribution.

In this study we analayzed 161 patient at the diabetest type 2 onset time who were adminitstred to our hospital at daily ambulance programme. Our results are showing, as we expected, that patients with type 2 diabetes at the time of diagnosis are mostly overweight or obese. Also, women were significantly more adipose, with higher BMI and

visceral fat index. The higher body fat was, there was more visceral adiposse tissue present (Table 1 and 2)[12].

Also, our results are showing that in this sample the amount of visceral body fat was higher in older people and in those with higher body fat amount, but with less muscle amount in total body weight also.

This is also comparsble to other similar studies, showing that visceral fat in total body fat might be important predictor or risk factor for diabetes type 2 development, but also for cardiovascular disease and diabetes complications [2].

Adiposity as a growing problem might be related to western lifestyle which mostly leads to insuline resistance making free fat acid, glicerol and proinflammatory cytokines levels higher[13].

HbA1c levels are often used for average glucose plasma concentration levels calculation through few weeks/months period. Recent studies have shown that HbA1c levels are in positive correlation for diabetes type 2 complications development (retinopathy, neuropathy, cardiovascular disease)[14]. Until now it has been shown that HbA1c is in positive correlation to visceral fat tissue amount in patients with type 2 diabetes[15]. This study also aimed to investigate if there is a possible relation between Hba1c and visceral body fat amount. Our results are showing that patients who have very low diabetes type 2 regulation with Hba1c value more than 8 have significantly higher percentage of visceral fat tissue than those who have normal regulation (Table 3,4 and 5).

Recent studies have shown that programs for body fat reduction are including modification of lifestyle, more physical activity and behavioral methods and all of these factors can improve glycaemic regulation[16]. It is still unknown which type of diet is the best for treating obesity in type 2 diabetes. Main strategy should be total energy intake reduction which leads to body weight reduction. Also, it is still undefined which is ideal amount of carbohydrates, protein and fat intake. Mediranean, vegan and diet with low glycaemic index have promising results for now[17].

Conclusion

In conclusion, diabetes type 2 treatment should be multidisciplinary through body mass reduction, dietary plans, lifestyle modification and increase of physical activity, all of these factors should be combined with continuous education of patients. At the diabetes onset time it is important to improve basic patients knowledge about disease and the treatment, make anthropologic measures, investigate possible complications, and make diet and physical activity plans combined to medicamentose therapy. Daily ambulance is good treatment because it provides individual treatment, education and permanent follow up for treatment success.

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Table 1: General characteristics of patient

	Men (n=82)	Women (n=79)	Total (n=161)	P
Age (years) [Median (25per cent-75per cent*)]	58 (52 – 64)	63 (55 – 66)	60 (53 – 65)	0,04§
Antropological characteristics Mean(SD†)				
Mass (kg)	96,3 (19,2)	88,3 (17,9)	92,4 (18,9)	0,007‖
Height (cm)	176 (7,4)	162,6 (6,2)	169,5 (9,6)	<0,001‖
BMI (kg/m^2)	31,1 (5,8)	33,4 (6,6)	32,2 (6,4)	0,02‖
Basal metabolism	1871,8 (272,1)	1632,7 (217)	1754,5 (273)	<0,001‖
per cent fat	28,8 (8,8)	44,5 (8,5)	36,5 (11,7)	<0,001‖
per cent muscle mass	30,9 (5,9)	24,2 (3,9)	27,7 (6,1)	<0,001‖
Visceral fat tissue	16,3 (6,5)	11,6 (3,03)	14,0 (5,6)	<0,001‖
Hba1c	8,6 (1,7)	8,2 (1,9)	8,4 (1,8)	0,29‖
Body mass [n(per cent)]				
Normal	13 (16)	8 (10)	21 (13)	0,28¶
Overweight	25 (30)	16 (20)	41 (25)	
Adiposity 1^0	23 (28)	24 (30)	47 (29)	
Adiposity 2^0	14 (17,1)	21 (26,6)	35 (21,7)	
Adiposity3^0	7 (8,5)	10 (12,7)	17 (10,6)	
Fat tissue percentage [n(per cent)]				
low	1 (1)	0	1 (1)	0,02‡
normal	21 (26)	8 (10)	29 (18)	
high	19 (23)	16 (20)	35 (22)	
very high	41 (50)	55 (69,6)	96 (59,6)	
Visceral fat tissue coefficient [n(per cent)]				
normal	14 (17)	20 (25)	34 (21)	<0,001¶
high	18 (22)	46 (58)	64 (40)	
very high	50 (61)	13 (16)	63 (39)	
Hba1c values [n(per cent)]				
normal	12 (16,4)	17 (23,9)	29 (20,1)	0,26¶
high	61 (83,6)	54 (76,1)	115 (79,9)	

* interquartile range;†standard deviation; ‡Fisher egzact test;§Mann Whitney U test; ‖Student t-test; ¶χ^2 test;

Table 2: Relation of anthropological characteristics to HbA1c levels

	Hba1c normal (n=29)	Hba1c high (n=115)	Total (n=161)	P
Age (years) [Median (25per cent-75per cent*)]	58 (53 – 63)	62 (53 – 66)	60 (53 – 65)	0,56§
Antropological characteristic Mean(SD†)				
Mass (kg)	94,32 (21,92)	92,17 (18,05)	92,4 (18,9)	0,58‖
Height (cm)	168,62 (9,01)	169,66 (9,47)	169,5 (9,6)	0,59‖

BMI (kg/m^2)	33,13 (7,2)	32,1 (6,11)	32,2 (6,4)	0,44[II]
Basal metabolism	1773,45 (286,54)	1754,06 (268,11)	1754,5 (273)	0,73[II]
per cent fat	37,46 (10,63)	36,95 (11,62)	36,5 (11,7)	0,83[II]
per cent muscle mass	27,82 (5,07)	27,3 (6,07)	27,7 (6,1)	0,67[II]
Visceral fat tissue coefficient	13,41 (5,19)	14,4 (5,71)	14,0 (5,6)	0,40[II]
Body mass [n(per cent)]				
Normal	4 (14)	15 (13)	19 (13)	
Overweight	6 (21)	30 (26)	36 (25)	
Adiposity 1^0	8 (28)	33 (29)	41 (28)	0,97[¶]
Adiposity 2^0	7 (24,1)	25 (21,7)	32 (22,2)	
Adiposity 3^0	4 (13,8)	12 (10,4)	16 (11,1)	
Fat tissue percentage [n(per cent)]				
normal	4 (14)	19 (17)	23 (16)	
high	7 (24)	25 (22)	32 (22)	0,92[¶]
Very high	18 (62)	71 (62)	89 (62)	
Visceral fat tissue percentage [n(per cent)]				
normal	8 (28)	22 (19)	30 (21)	
high	10 (34)	44 (38)	54 (38)	0,61[¶]
Very high	11 (38)	49 (43)	60 (42)	
Total	29 (100)	115 (100)	144 (100)	

*interquartile range;†standard deviation; [‡]Fisher egzact test;[§]Mann Whitney U test; [II]Student t-test; [¶]χ^2 test

Table 3: Correlation between HbA1c, BMI, basal and visceral fat tissue coefficient to anthropological characteristics of patients using Pearson correlation coefficient

	Pearson correlation coefficient (P value)			
	Hba1c	BMI	Basal	Visceral fat tissue coefficient
Age (years)	-0,031 (0,71)	0,002 (0,98)	-0,268(0,001)	0,191 (0,01)
BMI (kg/m^2)	-0,113(0,18)	-	-	-
Basal metabolism	-0,034 (0,69)	0,659(<0,001)	-	-
per cent fat	-0,053 (0,53)	0,589(<0,001)	0,042(0,59)	0,202 (0,01)
per cent muscle mass	0,027(0,75)	-0,485(<0,001)	0,056(0,48)	-0,292(<0,001)
Visceral fat tissue coefficient	0,005 (0,95)	0,644(<0,001)	0,686(<0,001)	-
Hba1c	-	-0,113 (0,18)	-0,034 (0,69)	0,005 (0,95)

Table 4: Relation of fat tissue percentage to HbA1c levels using Fisher egzact test

	per cent fat tissue				P*
	normal	high	very high	total	
Hba1c [n(per cent)]					
normal (do 6,5)	1 (4)	3 (9)	11 (12)	15 (10,4)	
Good regulation (6,6 – 7,0)	3 (13)	5 (16)	8 (9)	16 (11,1)	
Middle regulation (7,1 – 7,5)	2 (9)	2 (6)	13 (15)	17 (11,8)	0,36
Low regulation (7,6 – 8)	7 (30,4)	4 (12,5)	9 (10,1)	20 (13,9)	
Very low regulation (> 8)	10 (43,5)	18 (56,3)	48 (53,9)	76 (52,8)	
Total	23 (100)	32 (100)	89 (100)	144 (100)	

Table 5: Relation of visceral fat tissue coefficient to HbA1c using Fisher egzact test

	Visceral fat tissue coefficient				P*
	normal	high	very high	Total	
Hba1c [n(per cent)]					
normal (do 6,5)	3 (10)	6 (11)	6 (10)	15 (10,4)	
good regulation (6,6 – 7,0)	6 (20)	5 (9)	5 (8)	16 (11,1)	
middle regulation (7,1 – 7,5)	0	6 (11)	11 (18)	17 (11,8)	0,01
low regulation (7,6 – 8)	9 (30)	8 (14,8)	3 (5)	20 (13,9)	
very low regulation (> 8)	12 (40)	29 (53,7)	35 (58,3)	76 (52,8)	

Total	30 (100)	54 (100)	60 (100)	144 (100)	

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