World Applied Sciences Journal 14 (9): 1389-1396, 2011
ISSN 1818-4952

Prevalence of Obesity Among Type 2 Diabetes Mellitus In Gorgan (South East of Caspian Sea), Iran

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Abstract: The present study aimed to assess the prevalence of obesity in patients diagnosed with type 2 diabetes mellitus in Gorgan (South East of Caspian Sea), Iran. The subjects consist of 122 females and 78 males type 2 diabetic patients. Anthropometric and laboratory parameters in both sexes were determined (2011).Waist circumference was higher in males than females subjects ($p<0.05$), but the females had higher body fat percent ($p<0.05$) than males subjects. Using BMI, 86.88% females and 83.33% males were obese and 13.11% and 16.66% of them were none-obese ($p=0.739$, $p=0.505$). Using waist circumference, 86.06% females and 74.35% males were obese and 13.92% and 25.63% of them were none-obese ($p<0.001$, $p=0.008$). Waist circumference is correlated positively with BMI and body fat percent in diabetic female ($r=0.233$ and $r=0.892$, $p<0.05$) and male ($r=0.280$ and $r=0.931$, $p<0.05$). Waist circumference is very highly correlated with body fat percent likely to behave similarly in diabetes prediction. Body mass index, despite lower correlation with waist circumference, appears to have the same ability to predict diabetes as do body fat percent. Waist circumference appears to be a better predictor for diabetes risk than other parameters.

Key words: Waist Circumference · Body Mass Index · Type 2 diabetes · Gorgan

INTRODUCTION

Diabetes, as a metabolic disease, is one of the most common endocrine disorders affecting an almost 6% of the world's population [1] The prevalence of type 2 diabetes mellitus ranges from 1.2% to 14.6% in Asia, 4.6% to 40% in the Middle East and 1.3% to 14.5 % in Iran [2-3]. Obesity as health problems is becoming more widely identified. The enormous economical health cost of obesity, locates it among the most health care problems. Overweight and obesity are often determined by calculating the body mass index (BMI). Higher BMI is associated with a higher risk of death by cardiovascular disease [4]. This risk enhances with additional abdominal adiposity, which is measured by the waist circumference (WC) [5]. A study found that a WC of 80 cm was a simpler valid alternative to BMI for health promotion [6]. However, other researchers showed that the effects of anthropometric variables on obesity co-morbidities are also different in Whites and Blacks and depend on the studied risk factors [7-8]. They have highlighted the need to evaluate these effects in different population groups [9]. Although the dramatic worldwide increase in the incidence of obesity and consequently in the incidence of type 2 diabetes, has been recognized, the exact etiologic link between these remains unclear. The prevalence of obesity has increased dramatically in industrialized and developing countries [10-11]. Some studies show that the prevalence of obesity and overweight is increasing developing countries, including Iran [12-13].Prevalence of type 2 diabetes increases with age, obesity and a family history of diabetes in Western countries [14].Body mass index (BMI) is the most widely used and simple measure of body size and is often used to estimate the prevalence of obesity within a population [15-16]. BMI does not reflect body fat distribution, whereas the intra abdominal deposition of adipose tissue is a major contributor to the development of hypertension, insulin resistance, DM and dyslipidemia [17]. Thus, other anthropometric indices such as waist circumference (WC) have been used as

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alternatives to BMI. Waist circumference is being accepted as an anthropometric indicator of abdominal adiposity and metabolic risk [18-19].The identification of WC to discriminate persons at significantly raised high risk for obesity-associated risk factors is a valuable tool in clinical care and public health research. There are racial and ethnic effects on the relationship of visceral adipose tissue to metabolic risk factors [20-21]. The present study aimed to assess the prevalence of obesity in patients diagnosed with type 2 diabetes mellitus in Gorgan, Iran.

MATERIALS AND METHODS

This study was performed in the Biochemistry and Metabolic Disorder Research Center of Gorgan (South East of Caspian Sea), Iran in 2011 (from January to May). We had a study group included 200 patients of type-2 diabetes mellitus whom referred to the Department of Diabetes Center (The only Diabetes Center in Gorgan) in 5th Azar Hospital (the only general teaching hospital in Gorgan), in Golestan University of Medical Sciences. The mean age of the patients was 53.51±9.49 and 53.74±9.54 years in male and female subjects, respectively. (Range: 30-69 years), consisting of 78 (39%) males and 122 (61%) females. At the point of study entry, all diabetic patients were underwent a clinical and biochemical investigation. Data were collected by trained interviewers. The exclusion criterion was the coexistence of any other serious illness. Type-2 diabetes mellitus was defined as non-ketosis diabetes by medical history and current treatment with oral agent. None of the patients had micro vascular complications (diabetic nephropathy or retinopathy). Administration of insulin for glycaemic control was considered an exclusion criterion. A venous blood sample was collected from all the subjects who came after a 12-h overnight fast. Fasting blood sugar level was measured by biochemical kit using spectrophotometer techniques (Model JENWAY 6105 UV / VIS) in the Biochemistry and Metabolic Disorder Research Center. BMI was calculated as weight in kilograms divided by height in meters squared. Those with a BMI of 25.0-29.9 Kg/m^2 were classified as overweight (none-obese), whilst those with a BMI =30 Kg/m^2 were defined as obese[35]. Waist circumference was measured at the point halfway between the lower border of ribs and the iliac crest in a horizontal plane. Males with a waist circumference (WC) 94-101.9 cm and females with a waist circumference 80-87.9 cm were classified as overweight (none-obese), whilst males with a waist circumference = 102 cm and females with a waist circumference =88 cm were classified as obese [22].Body fat content was calculated according to the method of Lean *et al.* [23] using the following formula:

Body fat % for men = [(0.567 × waist circumference in cm) + (0.101 × age in years)] - 31.8

Body fat % for women = [(0.438 × waist circumference in cm) + (0.221 × age in years)] - 9.4

The results are reported as mean± SD and percentage. The statistical analysis was done with SPSS-11.5 version software. The results were evaluated by using Independent sample't' test, ÷ square and Pearson's correlation coefficient test. Statistical significance was considered at $P < 0.05$.

The Measurement of Serum Insulin: Serum insulin level was measured using a human insulin ELISA test kit (DiaPlus, Immunoenzymometric assay, USA).

RESULTS

The mean duration of disease was 3.95±1.21 and 6.02±2.16 years in male and female subjects. The mean body mass index was 32.22±2.62 cm and 32.90±3.27 cm in male and female subjects. The mean waist circumference was 102.39±10.70 cm and 93.20±10.60 cm in male and female subjects (Table 1). Indices of waist circumference, fasting insulin were higher in males than females subjects ($p<0.05$), but the females had higher body fat percent ($p<0.05$) than males subjects. The males and females were of the same age and BMI ($p>0.05$).The prevalence of type 2 diabetes in both genders is almost the same at ages 30-49 (females: 33.60% and males: 30.76%) and 50-69 (females: 66.39% and males: 69.23%) years. The prevalence of disease in both genders began at 30 years old and increased after 49 years old. Prevalence of type 2 diabetes is the highest at 50-69 years (males: 69.23% and females: 66.39%). In total, the prevalence of type 2 diabetes in female subjects is almost higher than male subjects (males: 32.50 % and females: 67.50 %., table 2). Using BMI, 86.88% females and 83.33% males were considered to be obese and 13.11% and 16.66% of them falling into the none-obese category, respectively ($p=0.739$, $p=0.505$, table 3). Using waist circumference, 86.06% females and 74.35% males were considered to be obese and 13.92% and 25.63% of them falling into

Table 1: Anthropometric and laboratory parameters of male and female type 2 diabetes mellitus subjects

	Females (n=122)	Males (n=78)
Age (years)	53.74±9.54	53.51±9.49
Duration of diabetes (years)	6.02±2.16	3.95±1.21
BMI (kg/m²)	32.90±3.27	32.22±2.62
Waist Circumference (cm)	93.20±10.60	102.39±10.70*
Fasting glucose (mmol/l)	10.51±6.54	9.82±2.09
Fasting insulin (μU/ml)	15.33±6.89	17.07±6.66*
Body fat (%)	43.21± 5.31	31.55±6.00*
All	122	78

*P<0.05, statistically significant

Table 2: Prevalence of type 2 diabetes mellitus by age and gender

Age groups	Females n (%)	Males n (%)	Total n (%)
30-49	41(33.60)	24(30.76)	65 (32.5)
50-69	81(66.39)	54 (69.23)	135 (67.5)
Total	122 (100)	78(100)	200(100)

Table 3: prevalence of obesity by body mass index and waist circumference among males and females type 2 diabetes mellitus patients

	Obesity category		Body Mass Index Sex		Waist Circumference Sex	
	Males n (%)	Females n (%)	P-value	Males n (%)	Females n (%)	P-value
Obese	65(83.33)	106(86.88)	0.739	58(74.35)	105(86.06)	0.001>
None obese	13(16.66)	16(13.11)	0.505	20(25.63)	17(13.92)	0.008*
Total	78(100%)	122(100%)	-	78(100%)	122(100%)	-

*P<0.05, statistically significant

Table 4: prevalence of obesity by body mass index and waist circumference among type 2 diabetes mellitus patients by age and gender

	Obesity category		Body Mass Index Sex		Waist Circumference Sex	
	Males n (%)	Females n (%)	P-value	Males n (%)	Females n (%)	P-value
30-49 (years) 50-69	19 (24.35)	34 (27.86)	0.487	17(21.79)	35(28.68)	0.130
(Obese)	46 (58.97)	72 (59.01)	0.705	41(52.56)	70(57.37)	0.001>
30-49 (years)	5(6.41)	7(5.73)	0.364	7(8.97)	6(4.91)	0.224
50-69 (None obese)	8(10.25)	9(7.37)	0.613	13(16.66)	11(9.01)	0.065
Total	78(100%)	122(100%)	-	78 (100%)	122(100%)	-

*P<0.05, statistically significant

Table 5: Correlations of waist circumference with age, BMI,, Fasting glucose, Fasting insulin and body fat percent, in male and female type 2 diabetes mellitus patients

Parameters	Male	Female
Age (years)	0.179	0.124
BMI (kg/m²)	0.280*	0.233*
Fasting glucose (mmol/l)	-0.039	-0.068
Fasting insulin (μU/ml)	-0.081	-0.035
Body fat (%)	0.931*	0.892*

*P<0.05, statistically significant

the none-obese category, respectively ($p<0.001$, $p=0.008$, table 3). The prevalence of obese and none-obese diabetic patients is higher in both sexes at ages 50-69 years when compared to 30-49 years. Using BMI, there were no significant differences in type 2 diabetic obese ($p=0.487$and $p=0.705$) and none-obese ($p=0.364$ and $p=0.613$) male and female at ages 30-49 and 50-69 years respectively (Table 4), while using waist circumference, there were no significant differences in type 2 diabetic none-obese ($p=0.224$ and $p=0.065$) male and female at ages 30-49 and 50-69 years respectively. There were no significant differences in obese male and female diabetic subjects at ages 30-49 years ($p=0.130$). There was significant differences in obese diabetic subjects at ages 50-69 years ($p<0.001$). Waist circumference is correlated positively with BMI and body fat percent in diabetic female ($r=0.233$ and $r=0.892$, $p<0.05$) and male ($r=0.280$ and $r=0.931$, $p<0.05$) (Table 5).There was no correlation between waist circumference and other parameters in diabetic subjects (fasting insulin and fasting glucose, table 5).

DISCUSSION

Obesity is associated with many metabolic risks; however, fewer studies of obesity-related disorders have been performed in Asia compared with western countries [24]. Studies in Iran have shown an increasing prevalence of obesity, which is expected to rise in the future due to increasing urbanization [25]. Most studies examining the risk of adverse health conditions associated with fat location have been based on data from Europe or United States and few information on less developed countries are available. A consultation by a World Health Organization (WHO) expert group suggested that Asians have different associations between body mass indexes, percentage of body fat, health risk of type 2 diabetes compared to European populations [26]. On the other hand, studies among other populations showed waist circumference alone [27] or together with body mass index (28) to be good predictors for type 2 diabetes mellitus. The World Health Organization [29] has explained that waist circumference is the easiest and most efficient anthropometric index to be used in many studies because it measures fatness and fat location. In the present study, we determined waist circumference, body mass index, body fat percent, fasting glucose and fasting insulin in males and females type 2 diabetic patients. The main findings in this study are: (1) Type 2 diabetic patients were significantly increased in waist circumference, body mass index and fasting insulin in males when compared to diabetic females; but body fat percent was significantly increased only in diabetic females. The data of diabetic subjects showed that the body fat percent was higher in females than males suggesting increased adiposity of females which override the effect of metabolism alterations. (2) In present study we investigated the relationships between waist circumference and some anthropometric indices in males and females type 2 diabetic patients in Gorgan. Our result showed that there is a significant difference between males and females (obese and none-obese) diabetic patients when using waist circumference indices. Our result also showed that there is a correlation between waist circumference and some of these indices. Among the anthropometric indices, waist circumference had a correlation with body mass index and body fat percent in both sex. The correlation between waist circumference and body mass index and body fat percent almost were similar in both sex. None of the other indices showed any relation to waist circumference. Our data showed that waist circumference is good predictors of diabetes in the future. The reasons for the waist circumference correlation with body mass index and body fat percent in our diabetic males and females patients are of interests. Patients with type 2 diabetes in Gorgan, who were also obese, waist circumference, were not correlated with age, fasting glucose, fasting insulin. Several publications on the relation between anthropometric markers and type 2 diabetes mellitus, but the best anthropometric index of fat location remain controversial. Controversies may be explained in part by differences in body composition and fat distribution in different racial groups [11, 30 and sexes 31-35]; such as Japanese women have a higher abnormal waist circumference than men [36]. Many studies found that waist circumference is strongly correlated with BMI [33, 34, 37 and 38] and percentage of body fat [38-39]. This was in agreement with our results when compared to the diabetic subjects. Some researchers have suggested that the abdominal fat localization is more important than the total amount of body fat or subcutaneous adipose tissue in the prediction of type 2 diabetes. They also reported that the predictive effect of WC was equal to the combined effect of waist circumference and body mass index [40]. Ford *et al.* [41] showed the use of waist circumference as a measure of obesity to predict health risk. Their arguments are that waist circumference has been shown to be a good or better predictor than body

mass index of the metabolic syndrome, diabetes, cardiovascular disease and all-cause mortality; it provides information about health risk. However, others have noted that substitution of body mass index by waist circumference as an indicator of risk for diabetes may be an oversimplification [42-43]. Many counterarguments are that waist circumference is strongly correlated to body mass index [40-41, 44-45]; waist circumference does not differentiate between subcutaneous fat and visceral fat; it has not been shown that a consistent association exists between waist circumference with visceral fat after adjustment for body mass index; and body fat distribution is different across racial and sex [42, 38, 46-48]. In present study, waist circumference has a weaker correlation with body mass index than does body fat percent in males and females diabetic patients. Stevens *et al.* [49] showed that waist circumference had better discriminatory performance for diabetes than did body mass index. However, waist circumference alone has been suggested as being a more practical measure of intra-abdominal fat mass and total body fat. The Framingham study suggested that the waist predicted mortality better than other anthropometric measures [50]. Waist circumference was also found to be associated with diabetes, stroke and coronary heart disease [51]. A study showed that the change in waist was a better predictor of the change in visceral adipose tissue [52]. Waist circumference captures information on general as well as abdominal obesities including both abdominal subcutaneous fat and visceral adipose [53]. Measure of obesity that takes into account the increased risk of obesity related illnesses because of the accumulation of abdominal fat is desirable. An increased waist circumference is most likely associated with elevated risk factors because of its relation with visceral fat accumulation and the mechanism may involve excess exposure of the liver to fatty acids [54]. The abdominal visceral adipose tissue deposition is associated with an increase of the portal free fatty acid concentration, which leads to plasma disturbances as hyperinsulinemia [47, 55]. Thus, waist circumference reflects total body fat (BMI) and abdominal fat distribution [56]. In conclusion, the present study showed consistently strong associations of waist circumference and body mass index in both sex with type 2 diabetes. Waist circumference is very highly correlated with body fat percent likely to behave similarly in diabetes prediction. Body mass index, despite lower correlation with waist circumference, appears to have the same ability to predict diabetes as do both body fat percent. Waist circumference appears to be a better predictor for diabetes risk than other parameters.

ACKNOWLEDGEMENT

The authors would like to thank the personnel at the Biochemistry and Metabolic Research Center and diabetes center of Golestan University of Medical Sciences for providing for their cooperation and assistance in the handling of experiments.

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