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Original article

Association of obesity with hypertension and dyslipidemia in type 2 diabetes mellitus subjects

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ABSTRACT

Aim: Obesity and diabetes are contributed to cardiovascular disease risk. The current study was performed to evaluate the association of central and general obesity and cardio-metabolic risk factors, including dyslipidemia and hypertension in T2DM patients.
Methods: This was a cross-sectional study in T2DM adults. Body mass index (BMI) was used to identify general obesity and waist circumference (WC) was measured to define abdominal obesity (based on ATP III). Biochemical analyses, and anthropometric and blood pressure measurements were done for all participants.
Results: Participants with central obesity showed significantly higher systolic (132.5 mmHg vs. 125.4 mmHg, $p = 0.024$) and diastolic blood pressures (84.9 mmHg vs. 80 mmHg, $p = 0.007$) than participants without obesity. Dyslipidemia was more prevalent in all participants either by BMI (98.3% vs. 97%, 95% CI: 0.18–17.53) or by WC (97.2% vs. 98%, 95% CI: 0.07–7.19). Abdominal adiposity in diabetic subjects showed significant reverse association with high level of physical activity (OR = 0.22, 95% CI: 0.06–0.85). Hypertriglyceridemia rate was increased with both central (OR = 2.11; p = 0.040) and general obesity (OR = 2.68; p = 0.021). After adjustment for energy intake and age, females had higher risk of general (OR = 4.57, 95% CI = 1.88–11.11) and central obesity (OR = 7.93, 95% CI = 3.48–18.08).
Conclusions: Females were more susceptible to obesity. Hypertension was associated with both obesity measures. Dyslipidemia, except for hypertriglyceridemia, was correlated to neither abdominal nor general obesity.

1. Introduction

Obesity is correlated to some major metabolic abnormalities like hypertension [1]. It is supposed that obesity have some contributions in hypertension, dyslipidemia and hyperglycemia, and is independently associated with higher cardiovascular (CVD) risk [2–4]. Abdominal obesity is the second risk factor for myocardial infarction [5].

On the other hand, there is a mutual association between obesity and diabetes. Type 2 diabetes mellitus (T2DM), the most prevalent form of diabetes, accompanies with obesity [6]. Obesity could also result in some degrees of insulin resistance which worsen the diabetes outcomes [6]. Patients with diabetes who have obesity are at increased risk for long-term vascular outcomes [7,8]. In 1999–2002, the prevalence of obesity (BMI ≥30 kg/m2) was 54.8% in the US T2DM patients [9]. There is a great discrepancy in the rate of obesity in diabetic population around the world. Various investigations have reported the general obesity prevalence from 7.14% [10] to 85.5% [11]. A systematic review on observational studies demonstrated that more than 70% of Asian and more than 80% of European T2DM adults with obesity had hypertension [12].

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Both general adiposity and abdominal obesity are important situations that influence the health. Up to now, several criteria have been established to measure the obesity status. Some indices are frequently utilized for obesity determination, however, there is no consensus on their application. Body mass index (BMI), the highly used index for obesity estimation, could not properly reflect body fat distribution, whereas the visceral deposition of fat is a major contributor to development of hypertension, insulin resistance, DM and dyslipidemia [13,14]. Other anthropometric indices such as waist circumference (WC) have been applied as alternatives for BMI. Waist circumference could indicate obesity and some major metabolic risks [15,16].

With regards to a recent high prediction of CVD in Ahvaz T2DM patients [17], this study was carried out to examine any possible link between the two obesity indices and two major metabolic abnormalities, i.e. hypertension and dyslipidemia, in these patients.

1.1. Subjects

This cross-sectional study was carried out on T2DM adults 28–75 years old (mean age: 54.5 years, N = 222). Study population was collected from outpatients attending Diabetes Clinic of Golestan Hospital, Ahvaz, Khuzestan province, Iran (from January to April 2015).

2. Materials and methods

2.1. Ethics

All participants were informed about the study procedure through a written consent form before participation. The study was complied with the Declaration of Helsinki and the research protocol was approved by the Ahvaz Jundishapur University of Medical Sciences Research Ethics Committee.

2.2. Inclusion & exclusion criteria

Diabetic adults with no insulin treatment were entered the study. Diabetes had previously been diagnosed by a general practitioner [6]. Patients who had cancer or any serious disease, or being pregnant were excluded from the study.

2.3. Biochemical assays

Fasting blood samples were drawn to measure serum cholesterol (Chop), high density lipoprotein cholesterol (HDL-C), low density lipoprotein cholesterol (LDL-C) and triglycerides (TG) levels. Standardized enzymatic colorimetric methods were performed to determine lipid profile (Pars Azmun kits, Pars Azmun Co., Karaj, Iran). LDL-C levels were derived using Friedewald equation [18].

2.4. Anthropometric data

Anthropometric measures were evaluated by a trained dietitian. Weight was measured using a digital scale to the nearest 100 g (Omron 212, Omron Corp., range 0.1–150 kg, Germany). Participants' height was assessed using a standard tape measure without shoes and recorded to the nearest millimeter. To calculate BMI, weight in kilogram was divided by squared height in meter (kg/m^2). WC was measured using a flexible tape measure at the midpoint of belly between the lowest ribs and the iliac crest over light clothes without any pressure and was recorded to the nearest 0.1 centimeter. After 10 min resting in sitting position, systolic and diastolic blood pressure levels were measured using a digital blood pressure monitor (OMRON, model M3, Kyoto, Japan).

2.5. Categories definition

BMI equal to or more than 30 kg/m^2 was identified as general obesity [19]. Having WC ≥ 102 cm in men and ≥ 88 cm in women has been recognized as abdominal obesity according to ATP III criterion [20]. Systolic blood pressure (SBP) ≥ 130 mmHg or diastolic blood pressure (DBP) ≥ 85 mmHg or treatment with antihypertensive medications were considered as hypertension [21]. Serum HDL-C concentrations below 50 mg/dL in women and below 40 mg/dL in men were considered as low HDL-C levels. Serum TG ≥150 mg/dL was defined as hypertriglyceridemia [20,21]. Serum cholesterol levels ≥ 200 mg/ld. and LDL-C levels ≥ 100 mg/dL were considered as abnormal levels [22]. Dyslipidemia was described as high serum cholesterol, LDL-C, or TG levels, or low HDL-C or using lipid lowering medications [20,21].

2.6. Statistical analyses

SPSS software version 21.0 was used to perform statistical analyses (SPSS Inc., Chicago, IL, USA). Quantitative variables were presented as mean ± standard deviation (SD), and categorical variables were declared as percentage. Categorical variables (e.g. BMI and obesity indices) were compared using chi-squared test with 95% confidence interval. Two-tailed independent sample *t*-test was used to compare serum lipids, blood pressures and anthropometric values in two obesity categories. Two-tailed *p*-values were applied to distinguish significant values and figures less than 0.05 were considered reliable.

Table 1
comparison of blood pressures and serum lipids in patients with and without obesity by BMI and waist circumference.

	BMI				WC			
	Non-Obesity (n = 99)	Obesity [a] (n = 58)	OR[c]	(95% CI)	Non-Obesity (n = 49)	Obesity [b] (n = 108)	OR[c]	(95% CI)
SBP (mmHg)	129.35 ± 18.76	131.93 ± 19.32	1.01	(0.99–1.03)	125.39 ± 15.32	132.54 ± 20.05	1.03	(1.00–1.05)*
DBP (mmHg)	82.28 ± 10.55	85.26 ± 10.57	1.02	(0.99–1.06)	80.04 ± 7.99	84.90 ± 11.33	1.06	(1.02–1.11)*
TG (mg/dL)	152.94 ± 98.36	161.21 ± 62.91	1.00	(1.00–1.01)	141.90 ± 98.61	162.39 ± 80.61	1.00	(1.00–1.01)
HDL-C (mg/dL)	42.69 ± 9.35	46.53 ± 10.04	1.03	(0.99–1.07)	42.98 ± 10.26	44.62 ± 9.53	0.49	(0.95–1.03)
LDL-C (mg/dL)	97.99 ± 31.66	98.05 ± 29.57	1.00	(0.99–1.01)	99.27 ± 31.74	97.45 ± 30.51	1.00	(0.98–1.01)
Chol (mg/dL)	169.75 ± 40.01	176.71 ± 36.63	1.00	(0.99–1.01)	169.96 ± 41.86	173.39 ± 37.52	1.00	(0.99–1.01)

Values are mean ± SD. *P < 0.05.
Chol Cholesterol; *DBP* diastolic blood pressure; *HDL-C* high density lipoprotein cholesterol; *LDL-C* low density lipoprotein cholesterol; *SBP* systolic blood pressure; *TG* triglycerides.
[a] BMI ≥30 kg/m^2.
[b] WC ≥ 102 cm in men and ≥ 88 cm in women [24].
[c] After adjustment for energy intake, age and sex.

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