The Effects of Obesity and Body Fat Distribution on Cardiovascular Risk Factors in Premenopausal Obese Women

PREMENOPOZAL OBEZ KADINLARDA VÜCUT YAĞ DAĞILIMI VE OBEZİTENİN KARDİYOVASKÜLER RİSK FAKTÖRLERİ ÜZERİNE ETKİSİ

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Summary

The correlation of obesity and fat distribution with cardiovascular risk factors such as dyslipidemia and hypertension were investigated in 45 premenopausal obese women aged from 25 to 50 years. Total body fatness was evaluated with body mass index (BMI) and % fat mass (FM) while body fat distribution was evaluated with waist-to-hip ratio (WHR) and visceral adipose tissue thickness (VAT).

Obese women (BMI>30 kg/m^2) were found to have higher total cholesterol (total-C) (pO.01) and triglyceride (TG) levels (pO.OOl), and lower high density lipoprotein cholesterol (HDL-C) (pO.OOl). Diastolic and systolic blood pressures were found to be higher in obese women than controls (p<0.01). A positive correlation was detected between BMI and VAT (p<0.05). With increasing WHR, there was a significant trend for blood pressure and TG to increase, and HDL-C to decrease. Intraabdominal fat accumulation was positively correlated with TG concentrations (p<0.05). A nega-tive correlation between HDL-C levels and intraabdominal fat accumulation was detected (p<0.05).

In conclusion, visceral fat accumulation is suggested to be a potential coronary risk factor alone, independent from obesity. The assessment of intraabdominal visceral fat should be considered when treating and predicting the development of coronary artery disease in obese subjects.

Key Words: Blood pressure, Fat distribution, Lipoprotein metabolism, Obesity

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Özet

Yaşları 25-50 arasında değişen 45 premenopozal obez kadında dislipidemi ve hipertansiyon gibi kardiyovasküler risk faktörleri ile obezite ve yağ dağılımı arasındaki ilişki araştırıldı. Total vücut yağı; vücut kitle indeksi (VKİ) ve % vücut yağ kitlesi (VYK) ile, vücut yağ dağılımı ise; bel-kalça oranı (BKO) ve visseral yağ dokusu kalınlığı (VYD) ile değerlendirildi.

Obez kadınlar (VKİ>30 kg/m^2) daha yüksek total kolesterol (p<0.01) ve trigliserid (pO.OOl) ve daha düşük HDL kolesterol düzeylerine sahipti (pO.OOl). Hem sistolik ve hem de diastolik kan basıncı obez grupta kontrol grubundan daha yüksekti (pO.01). VKİ ve VYD arasında pozitif bir korelasyon bulundu. BKO artışı ile kan basıncı ve trigliserid düzeyinde artma, HDL-kolesterol düzeyinde azalma eğilimi gözlendi. İntraabdominal yağ birikimi ile trigliserid konsantrasyonları arasında pozitif (p<0.05), HDL-kolesterol konsantrasyonları arasında negatif bir ilişki vardı (pO.05).

Sonuç olarak visseral yağ birikiminin, obeziteden bağımsız olarak, potansiyel bir koroner risk faktörü olduğu düşünüldü. Bu nedenle obez kişi-lerde koroner arter hastalığı gelişim riskinin önceden belirlenmesinde visseral yağ dokusu kalınlığının ölçülmesi düşünül-melidir.

Anahtar Kelimeler: Kan basıncı, Yağ dağılımı, Lipoprotein metabolizması, Obezite

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Obesity is a major public health problem due to its associations with increased cardiovascular risks. The obese state has been recognized to accentuate the known risk factors for atherosclerotic disease as dyslipidemia, hypertension, glucose intolerance and insulin resistance (1). The most common clinical state characterized by insulin resistance is obesity with a centralized distribution of adipose tissue (2). Abdominal or android type fat

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accumulation is considered to be an independent risk factor for cardiovascular disease both in men and in women (3).

Although there are sophisticated methods such as imaging to document total body fat and its distributions, anthropometric measurements remain important in clinical practice (4). With regard to this, BMI is often used to reflect general obesity while WHR is used to assess central adiposity. An increase in BMI is usually associated with an increase in WHR. The evaluation of regional body fat distribution seems to be clinically important. Computed tomography (CT) is a gold standard method to evaluate body fat distribution (5).

Although there are reports suggesting that intraabdominal fat deposition may constitute a greater cardiovascular risk than general obesity (4,6), most workers still hold the view that both general and central obesity are important cardiovascular risks and are complementary to each other (7).

The aim of our study was to investigate the relationship between cardiovascular risk factors such as dyslipidemia and hypertension and total fatness (BMI and %body fat) and body fat distribution (WHR and VAT) in the premenopausal obese women.

Materials and Methods

The subjects were premenopausal, non-smoker, obese women. Forty-five obese women (aged: 25-50 years, BMI>30 kg/m^2 and WHR>0.85), free from active disease or drugs known to affect body weight and lipid profiles were included in the study. Diabetic obese subjects were excluded from the study. A control population of 21 volunteers (aged: 25-52 years, BMI<25 kg/ m^2 and WHR<0.75), without any defined type of obesity, was randomly selected from participants in health check-ups.

Body fatness was estimated in two ways. First as BMI, which was calculated as body weight (expressed in kg) divided by body $height^2$ (expressed in m^2). Second, as body fat mass (FM) (normal value 20-30%), which was measured by means of bioelectrical impedance analysis (BIA) (Bodystat 1500 tool). BIA was carried out in a fasting state, without drinking water after midnight. With minimum clothing, the subjects lay supine with arms and legs abducted, and not touching the body. Two current electrodes were placed, one each on the dorsal surface of the right hand and right foot, at the distal metacarpals and metatarsals, respectively.

Body fat distribution was also estimated in two ways. These were WHR and VAT. WHR is a conventional clinical marker of abdominal obesity. Waist circumference was measured as the minimum measurement between the xyphoid process and umblicus; hip circumference was measured at the level of most protruding points of greater trocanthers. WHR is the ratio of these two circumferences. Visceral adipose tissue thickness was determined at L4-L5 levels by computed tomography (CT Max 640 Axial sections). Blood pressure was measured with an indirect method in supine position. A standard pressure cuff was placed around the left upper arm with a sphygmomanometer. Systolic blood pressure (SBP) and diastolic blood pressure (DBP) were measured twice and the lowest value was recorded. Hypertension was defined as SBP>145 mmHg and DBP>85 mmHg. Plasma total-C, HDL-C and TG levels were measured with commercial kits (Boehringer Menheim, Germany) on an automated analysis system (Hitachi 704).

Statistical analysis was performed using the SPSS (version 6.0). Results are presented as the mean± standard deviation (s.d.). The differences between obese and nonobese group were evaluated by student's t test. Pearson's correlation analysis was carried out to investigate any relationship between changes in BMI, VAT, WHR and FM%, and changes in the plasma lipid measurements and blood pressures. A p-value of <0.05 was considered to be significant.

Results

Table 1 presents the mean value±SD for the clinical, anthropometric and metabolic variables of obese and non-obese subjects.

The markers of general obesity (BMI and FM) and abdominal obesity (WHR and VAT) were significantly (pO.OOl) higher in obese group than in controls. The mean total-C and TG concentrations were moderately elevated in obese group. The difference between two group was statistically significant (p<0.01 and pO.OOl respectively). On the contrary, HDL-C level was lower in obese subjects than non-obese subjects (pO.OOl). When correla-

Table **1.** Clinical, anthropometric and metabolic variables of obese and non-obese women

	Obese women	Non-obese women	P values
n	45	21	
Age (years)	37.8±10.7	37.3±7.3	ns
BMI (kg/m^2)	36.3±6.5	23.3±2.6	<0.001
WHR	0.86±0.01	0.73±0.03	<0.001
FM (%)	43±6.9	26.3±6.2	<0.001
VAT (mm)	52.8±16.4	19.6±4.9	O.001
Total-C (mg/dl)	195.4±43	172.7±20.9	<0.01
TG (mg/dl)	234.4±89.8	115.8±28.9	<0.001
HDL-C (mg/ml)	39.5±10.9	60.4±18.5	<0.001
SBP (mmHg)	144±27	118±14	<0.01
DBP (mmHg)	89±20	73.5±7	<0.01

BMLbody mass index, WHR.waist.to.hip ratio, FM.fat mass, VAT.visceral adipose tissue thicbtess, Total-Ctotal cholesterol, TG: triglyceride, HDL-C:high density lipoprotein cholesterol, SBP.systolic blood pressure, DBP.diastolic blood pressure.

tion between BMI and VAT was analysed, a significant and positive con-elation was observed (r:0.53, p<0.05). With increasing WHR and VAT, there was a significant trend for BP and TG to increase, and HDL-C to decrease. For TG concentrations, positive correlation was also observed with intraabdominal fat accumulation (r:0.45, p<0.05). HDL-C levels were negatively correlated with WHR and VAT (r:-0.48, p<0.05).

Discussion

Results of the present study indicate that changes in body fat distribution and body fat accumulation are associated with alterations in the plasma lipid profile and blood pressure in premenopausal obese women. Hypeiiipidemia and/or dyslipidemia are important consequences of obesity and may account for at least a part of the relationship between overweight and coronary heart disease (CHD) (2,3,8-11). In this study, obese subjects were found to have higher levels of total-C and triglyceride, and lower levels of HDL-C. Similarly, lipid abnormalities in obese subjects have been shown in previous studies (2,8,10-12). But, the most common lipid abnormality was increased triglyceride and decreased HDL-C levels. Many epidemiological studies have suggested that the localisation of adipose tissue intraabdominally is linked to many cardiovascular risk factors and is a more important predictor of cardiovascular disease (10,11,13,14). Visceral fat accumulation has been shown to be associated with insulin resistance (2,10,12,14). Intraabdominal fat mass may be the source for hypertriglyceridemia and adverse modification of the ratio of hepatic lipase/lipoprotein lipase activities, as a consequence directly or indirectly of insulin resistance (11). The insulin resistance was greater with increasing WHR (12,15,16), and insulin resistance results in an increased hepatic glucose release, and a decreased catabolism of triglycerides contributing to an impaired glucose tolerance and to reduced HDL-C levels (10).

Many investigators have shown that there was an association between increased visceral fat accumulation and increased triglyceride and supressed HDL-C levels (10,11,16). Our results are concordant with these reports. We found out a positive correlation between triglyceride levels and VAT accumulation and WHR. On the contrary, a negative correlation was found out between HDL-C levels and VAT accumulation and WHR. In the present study, body fat (both BMI and FM %) did not show any relationship with plasma total-C, triglyceride and HDL-C levels. Couillard et al. have shown highly significant correlation between body fat (%) and total-C levels (11). In addition, we did not find any relationship between total-C levels and WHR and VAT. Accordingly, some investigators have not found relationship between total-C levels and body fat distribution (2,8,10). But, some reports have suggested that individuals with a central fat distribution have higher blood levels of TG, total-C and LDL-C, and lower levels of HDL-C regardless of their sex (17,18).

number of cross-sectional studies have re-
d correlations of increased abdominal or trun-
besity with higher blood pressure (19,20).
ver such studies cannot determine whether
ased abdominal obesity preceded blood pres-
elevations (21,22). Our data demonstrated that
crease in intraabdominal fat accumulation is
iated with higher blood pressure.

Although there are many methods to assess the
nt of adipose tissue and its distribution, anthro-
tric measurement remains the most widely
method in clinical practice. BMI is often used
flect general obesity while WHR is used as
er of central obesity (4). In one study, a positive
lation was found out between BMI and VAT. In
tudy, WHR and VAT were used as markers of
fat distribution while BMI and % FM were
for the evaluation of total body fat. Our obese
cts had both general obesity (BMI>30 kg/m²)
bdominal obesity (WHR>0.85).

In conclusion, in premenopausal obese women
abdominal fat distribution, dyslipidemia and
rtension are frequent and increased TG and
eased HDL-C levels are the most common
abnormalities. Intraabdominal fat accumula-
is associated with increased TG and decreased
L-C levels. Although BMI and WHR are simple
ators for evaluation of obesity and its distribu-
WHR and VAT can improve the asssesment
ardiovascular risk at obese population.

REFERENCES

usilahti P, Tuomilehto J, Vartiainen E et al. Body weight, ardiovascular risk factors, and coronary mortality. 15-year ollow-up of middle-aged men and women in eastern inland. Circulation 1996; 93: 1372-79.

anhala MJ, Pitkajarvi TK, Kumpusalo EA et al. Obesity ype and clustering of insulin resistance-associated cardio-ascular risk factors in middle-aged men and women. Int J bes Relat Metab Disord 1998; 22(4):369-74.

anson JE, Colditz GA, Stampfer MJ et al. A prospective udy of obesity and risk of coronary heart disease in omen. N Engl J Med 1990; 322:882-9.

uliot MC, Despres JP, Lemieux S et al. Waist circumfer-nce and abdominal sagittal diameter: Best simple anthro-ometric indexes of abdominal visceral adipose tissue ac-umulation and related cardiovascular risk in men and omen. Am J Cardiol 1994; 73:460-8.

an der Kooy K, Seidell JC. Techniques for the measure-ent of visceral fat: A practical guide. Int J Obes Relat etab Disord 1993; 17: 187-96.

6. Richelsen B, Pedersen SB. Associations between different anthropometric measurements of fatness and metabolic risk parameters in non-obese, healthy, middle-aged men. Int J Obes Relat Metab Disord 1995; 19:169-74.

7. Galanis DJ, Mc Garvey ST, Sobal J et al. Relations of body fat and fat distribution to the serum lipid, apolipoprotein and insulin concentrations of Samoan men and women. Int J Obes Relat Metab Disord 1995; 19:731-8.

8. Martins JM, Carreiras F, Falcao J et al. Dyslipidaemialn female overweight and obese patients. Relation to anthropometric and endocrine factors. Int J Obes Relat Metab Disord 1998; 22(2): 164-70.

9. Twisk JW, Kemper HC, Mechelen W et al. Body fatness: Longitudinal relationship of body mass index and the sum of skinfolds with other risk factors for coronary heart disease. Int J Obes Relat Metab Disord 1998; 22:915-22.

10. Ko GT, Chan JC, Woo J et al. Simple anthropometric indexes and cardiovascular risk factors in Chinese. Int J Obes Relat Metab Disord. 1997; 21:995-1001.

11. Couillard C, Lemieux S, Moorjani S et al. Associations between 12 year changes in body fatness and lipoprotein-lipid levels in men and women of the Quebec Family Study. Int J Obes Relat Metab Disord. 1996; 20:1081-88.

12. Hollmann M, Runnebaum B, Gerhard I: Impact of waist-to-hip-ratio and body-mass -index on hormonal and metabolic parameters in young, obese women. Int J Obes Relat Metab Disord. 1997;21:476-83.

13. Kahn HS, Williamson DF: Abdominal obesity and mortality risk among men in nineteenth-century North America. Int J Obes Relat Metab Disord. 1994; 18:686-91.

14. Bjorntrop P. Abdominal obesity and the metabolic syndrome. Annals of Medicine 1992; 24:465-8.

15. Stout RW: Overview of the association between insulin and atherosclerosis. Metabolism 1985; 34:7-12.

16. Evans DJ, Hoffman RG, Kalkhoff RK et al. Relationship of body fat tomography to insulin sensitivity and metabolic profiles in premenopausal obese women. Metabolism 1984; 33:68-75.

17. Wing RR, Bunker CH, Kuller LH et al. Insulin, body mass index and cardiovascular risk factors in premenopausal women. Arteriosclerosis 1989; 9:479-84.

18. Baumgartner RN, Roche AF, Chumlea WM et al. Fatness and fat patterns: Associations with plasma lipids and blood pressures in adults, 18 to 70 years of age. Am J Epidemiol 1987; 126:614-28.

19. Croft JB, Strogatz DS, Keenan NL et al. The independent effects of obesity and body fat distribution on blood pressure in black adults: the Pitt County Study. Int J Obes Relat Metab Disord 1993; 17:391-7.

20. Gillum RF, Mussolino ME, Madans JH. Body fat distribution and hypertension incidence in women and men. The NHANES I Epidemiologic Follow-up Study. Int J Obes Relat Metab Disord 1998; 22:127-34.

21. Folsom AR, Prineas RF, Kaye SA et al. Incidence of hypertension and stroke in relation to body fat distribution other risk factors in older women. Stroke 1990; 21:701-6.

22. Selby JV, Friedman GD, Quesenberry CP Precursors of essential hypertension. Am J Epidemiol 1989; 129:43-53.