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RESEARCH

OBESITY PREVALENCE IN THE ELDERLY AND THE ASSOCIATION BETWEEN OBESITY AND CARDIOVASCULAR RISKS

ABSTRACT

Introduction: Obesity prevalence is increasing among the elderly and obesity is association with diseases. The aim of this study was to determine obesity/ abdominal obesity prevalence according to four different anthropometric indices, and the effect of obesity on cardiovascular (CV) risk in the elderly.

Materials and Method: This cross-sectional study involved 2,502 elderly participants, 65 years and older, who were parts of Balcova's Heart Project. The dependent variable was CV risk factors; the independent variable was obesity. Obesity measures were Body Mass Index (BMI), waist circumference (WC), waist-to-hip ratio (WHpR), and waist-to-height ratio (WHtR). Data were analyzed using t-test, Chi-square, Pearson's correlation and Logistic regression analyses.

Results: The prevalence of obesity according to body mass index was 48.7%, WC: 52.4%, WHpR: 65.2%, and WHtR: 93.7%. High levels of all of anthropometric measurements were risk factors for diabetes, hypertension and metabolic syndrome. All measurements, except for BMI in women, were risk factors for dyslipidemia in both sexes. WHtR and WHpR in men and WC and WHpR in women were predictors of Framingham risk scores. In women, WHtR had more predictive value for CV risk, except for the Framingham risk score; in men WHtR had more predictive value than all other risks.

Conclusion: In both genders, obesity (determined with anthropometric measurements) is associated with CV risks. However, abdominal obesity (WHtR and WC) is more effective than BMI in determining CV risk.

Key Words: Aged; Obesity, Abdominal; Cardiovascular Diseases.

ARAŞTIRMA

YAŞLILARDA OBEZİTE SIKLIĞI VE OBEZİTENİN KARDİYOVASKÜLER RİSKLERLE İLİŞKİSİ

ÖZ

Giriş: Obezite prevalansı yaşlılar arasında artmaktadır ve obezite pekçok hastalıkla ilişkilidir. Bu çalışmanın amacı yaşlılarda dört farklı yönteme göre obezite/ abdominal obezite sıklığını ve obezitenin kardiyovasküler (KV) risk etmenlerine etkisini belirlemektir.

Gereç ve Yöntem: Çalışma toplum tabanlı kesitsel bir çalışmadır. Balçova'nın Kalbi Projesi'ne katılan 65 yaş ve üzeri 2,502 yaşlıyı kapsamaktadır. Bağımlı değişken KV risk etmenleridir. Bağımsız değişken obezitedir. Obezite Beden Kütle Indeksi (BKI), bel çevresi (BÇ), bel kalça oranı (BKO), bel boy oranına (BBO) göre belirlenmiştir. Olası karıştırıcı etmenler cinsiyet, yaş, öğrenim durumudur. Veri analizinde t testi, Ki-kare ve Lojistik regresyon analizi ile Pearson Korelasyon Analizi kullanılmıştır.

Bulgular: Obezite sıklığı BKI'ye göre %48.7, BÇ'ye göre %52.4, BKO'ya göre %65.2, BBO'ya göre %93.7'dir. Diyabet, hipertansiyon ve metabolik sendrom için tüm antropometrik ölçümlerdeki yükseklik risk oluşturmaktadır. Dislipidemi için kadınlarda BKI hariç diğer ölçümler her iki cinsiyette de risk oluşturmaktadır. Framingham risk düzeyi için erkeklerde BBO ve BKO, kadınlarda BÇ ve BKO belirleyicidir. Ancak BBO kadınlarda Framingham risk düzeyi hariç tüm KV riskler için, erkeklerde ise tüm riskler için diğer ölçütlere göre daha belirleyicidir.

Sonuç: Her iki cinsiyette de antropometrik ölçümlerle belirlenen obezite kardiyovasküler risklerle ilişkili bulunmuştur. Ancak KV risklerin belirlenmesinde abdominal obezite (BBO ve BÇ) BKI'den daha etkili bulunmuştur.

Anahtar Sözcükler: Yaşlı; Abdominal Obezite; Kardiyovasküler Hastalık.

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INTRODUCTION

Obesity is an important problem worldwide. Because of its increasing prevalence, it is also increasing among the elderly. It is associated with unhealthy dietary habits and a sedentary life, as well as a metabolic rate that reduces with age (1). Obesity is considered to be an important public health issue because of its association with diseases such as diabetes mellitus (DM), hypertension, dyslipidemia, coronary heart disease and congestive heart failure in the elderly, and with a poor quality of life (2-4).

All guidelines recommend using the Body Mass Index (BMI) for the diagnosis of obesity and its classification. On the other hand, it is well known that BMI alone is not sufficient to determine obesity and to evaluate its association with mortality due to muscle loss and accumulation of fat in the elderly. According to the literature, android type obesity (meaning abdominal obesity) is strongly correlated with cardiovascular risk, compared to gynoid type obesity (5,6). Abdominal obesity is associated with elevated fatty acid secretion, adipocytes, hyperinsulinemia, insulin resistance, hypertension and dyslipidemia, which increase cardiovascular risk. Due to a decrease in height in the elderly, adiposity should be measured in addition to BMI to determination obesity classification. (6). In the elderly, evaluation of fat distribution using measures such as waist circumference (WC) and waist hip ratio (WHpR) is important (2,4). Cross-sectional and cohort studies have shown that waist height ratio (WHtR), WC and BMI might estimate DM and other cardiovascular events. Compared to BMI, indices that include waist circumference such as WC, WHpR, and WHtR are better indicators of obesity. The main limitation in using WHpR is that after weight loss, the waist and hip circumferences can decrease by the same amount, which results in the same ratio (5).

The two objectives of this study were to determine obesity and abdominal obesity prevalence according to different anthropometric indices, and to determine the effect of obesity on cardiovascular risk, in elderly participants in the Balcova Heart (BAK) Project.

MATERIALS AND METHOD

This cross-sectional, community-based study was a part of the BAK project, conducted in the Balcova District of Izmir. The BAK project aims to reduce cardiovascular disease (CVD) incidence and prevalence through risk factor modification at both the individual and population levels (7). Population of the elderly was 7578 (3504 male and 4074 female); it was planned to reach all of them without sample selection. The address information of the elderly was obtained from Balcova Municipality. The interviews were conducted at homes by trained interviewers. Among 7578 older people (65 years and above), 2,947 were reached during the BAK project, and all anthropometric measurements were performed in 2,502 older people. CV risk factors such as DM, hypertension, dyslipidemia, metabolic syndrome (MS) and Framingham risk scores were the dependent variables, while obesity was the independent variable. Obesity was determined via BMI and abdominal obesity was determined by WC, WHpR and WHtR. Age, sex and educational status were evaluated as confounding factors.

Measurements and Definition of The Variables

Weight was measured on a calibrated digital scale (100 g sensitive) with light clothes and without shoes; height was measured with a wall stadiometer (KaWe Medizintechnik, Asperg, Germany) without shoes. Waist and hip circumference were measured with a non-elastic tape measure while standing still, feet together, arms at both sides. WC was measured at the mid- point between the lowest rib and iliac crest, and hip circumference was measured at the largest point of the hip. Blood pressure was measured twice by the same nurse via sphygmomanometer on the right arm after five minutes of rest, and the mean values of systolic and diastolic pressure were recorded. A venous blood sample was taken via vacutainer after 12 hours of fasting. The following criteria were used:

Diabetes Mellitus: Fasting blood glucose ≥126 mg/dl or pre-diagnosed or using any antidiabetic medication cases were evaluated as ‘diabetic’.

Hypertension: Systolic pressure ≥140 mmHg and/or diastolic pressure ≥90 mmHg or pre-diagnosed hypertensive or using any antihypertensive medication participants were considered as ‘hypertensive’.

Dyslipidemia: Having one abnormality in serum lipids (total cholesterol, HDL-C, LDL-C and triglycerides) was evaluated as ‘dyslipidemia’. Cut-off points were as follows: Total cholesterol ≥240 mg/dl, LDL-C ≥160 mg/dl, triglyceride ≥200 mg/dl, HDL-C < 40 mg/dl for men, <50 mg/dl for women.

MS: MS was determined according to NCEP- ATP III criteria. The NCEP ATP III panel defined metabolic syndrome as the presence of three or more of the following risk factors: *1*) increased waist circumference (>102 cm for men, >88 cm for women); *2*) elevated triglycerides (≥150 mg/dl); *3*) low HDL cholesterol (<40 mg/dl in men, <50 mg/dl in women); *4*) hypertension (≥130/≥85 mmHg); and d *5*) impaired fasting glucose (≥110 mg/dl) (8).

Framingham equation: Participants 75 years or older and those with pre-diagnosed coronary heart disease and stroke are considered as having high risk, so risk score was not calculated for these individuals. Individuals with DM were not dropped out from the analysis, as diabetes history was taken into account in Framingham risk equation. Data on age, gender, smoking status, total cholesterol, HDL-C, blood pressure and diabetes history were used to estimate risk score. Those participants who had a risk score ≥20% were classified as 'high risk' (9).

BMI: Those participants who had a BMI ≥30.0 kg/m^2 were considered as 'obese'.

WC: Women who had a WC >88 cm and men who had a WC >102 cm were evaluated as 'obese'.

WHpR: WHpR was defined as WC divided by hip circumference; women having a WHpR ≥0.85 and men having a WHpR ≥0.90 were considered as 'obese'.

WHtR: WC was divided by height to calculate WHtR; those participants who had a WHtR ≥0.5 were evaluated as 'obese'.

Data Collection

Data was collected in two stages. In the first stage, trained interviewers visited the participants at home, completed a pre-structured questionnaire and invited the participants to Community Centres (CCs) for measurements and blood sample collection. The homes were visited three times in different days and hours. The elderly not found at home were invited to CCs, through an invitation letter including description of the project and telephone number of the interviewer. In order to ensure the participation of the people, mass media was used in local level. In addition, announcements were made via posters, banners and monthly bulletin. The second stage was conducted at the CCs. Anthropometric measurements were conducted by trained CC staff and blood samples were taken by trained nurses. Blood samples were taken to and analyzed in the Dokuz Eylul University Central Laboratory. Ethical approval was received from the local ethics committee and written informed consent was obtained from every participant.

Data Analysis

The data was analyzed using SPSS software (SPSS for Windows, version 15.0; 1999, SPSS Inc, Chicago, IL, USA). Continuous variables were presented as means ± Standard deviation and categorical variables were presented as percentages. The associations between sex and the anthropometric indices were evaluated via independent samples t tests and chi-square tests. Correlations among the anthropometric measurements were assessed via Pearson correlations. Logistic regression (LR) models were performed to calculate crude and adjusted OR for men and women separately. Age (continuous) and educational status (uneducated / primary/ secondary and above) were evaluated as confounding factors in the LR models.

RESULTS

Among participants (n=2,502), 61.1% were female. Overall mean age was 71.9±5.4 (65-94): 71.5±5.2 (65-92) for men and 72.1±5.4 (65-94) for women. Socio-demographic characteristics of the participants and CV risk are presented in Table 1. The age group of 65-74 was significantly higher in men than women (p=0.015). According to education status, there was significant difference between women and men (p<0.001); the women's education was lower than that of the men. Regarding DM and elevated TG, there was no difference between men and women (p=0.580 and p=0.231, respectively). All of the risk factors for CVD, except Framingham risk score, were higher in women than in men (Table 1).

The prevalence of obesity according to BMI was 48.7%, WC: 52.4%, WHpR: 65.2%, and WHtR: 93.7%. Mean values of anthropometric measurements and obesity/abdominal obesity prevalence according to sex is presented in Table 2. The mean WC and WHpR were significantly higher for men than for women (p<0.001 for both), while the mean WHtR and BMI were significantly higher for women than for men (p<0.001 for both). When obesity was defined using appropriate cut-off values for men and women, it was found that women were more frequently classified as obese than men according to BMI (p<0.001), WHtR (p<0.001) and WC (p<0.001), whereas men were found to be more frequently classified as obese according to WHpR (p<0.001).

Table 1— Socio-demographic Characteristics of the Participants and CVD Risk

Characteristic	Men n (%)	Women n (%)	Total n (%)	p*
Age				
65-74	716 (73.5)	1054 (69.0)	1770 (70.7)	0.015
75+	258 (26.5)	474 (31.0)	732 (29.3)	
Education status				
Illiterate	38 (3.9)	372 (24.5)	410 (16.5)	<0.001
Literate	39 (4.0)	211 (13.9)	250 (10.0)	
Primary (5 years)	454 (46.8)	773 (50.8)	1227 (49.3)	
Secondary (3 years)	113 (11.6)	84 (5.5)	197 (7.9)	
High school (3 years)	242 (24.9	70 (4.6)	312 (12.5)	
University	84 (8.7)	11 (0.7)	95 (3.8)	
Diabetes Mellitus	239 (24.7)	390 (25.7)	629 (25.4)	0.580
Hypertension	666 (68.6)	1264 (83.5)	1930 (77.7)	**<0.001**
Metabolic syndrome	274 (28.1)	700 (45.8)	974 (38.9)	**<0.001**
Dyslipidemia	508 (52.2)	959 (62.8)	1467 (58.6)	**<0.001**
Elevated total cholesterol	164 (16.8)	428 (28.0)	592 (23.7)	**<0.001**
Elevated LDL	177 (18.2)	353 (23.1)	530 (21.2)	**0.003**
Elevated TG	152 (15.6)	212 (13.9)	364 (14.5)	0.231
Decreased HDL	340 (34.9)	680 (44.5)	1020 (40.8)	**<0.001**
Framingham risk score (High)	270 (49.8)	78 (9.2)	348 (25.0)	**<0.001**

* Chi-square analysis (comparison between men and women groups)
In Chi-square analysis, education status was grouped as illiterate+literate, primary and secondary+high school+university
LDL: Low-density lipoprotein, TG: Triglyceride, HDL: High-density lipoprotein
Framingham risk score cannot be calculated for participants 75 years and older and those with pre-diagnosed coronary heart disease and stroke

Table 2— Mean Values of Anthropometric Measurements and Obesity Prevalence According to Obesity Indices.

Anthropometric measurement	Men	Women	Total	p*
BMI Mean±SD (kg/m^2)	28.00±4.18	31.42±5.16	30.09±5.09	<0.001
WC Mean±SD (cm)	96.34±10.57	93.52±10.87	94.61±10.84	<0.001
WHpR Mean±SD	0.94±0.07	0.86±0.07	0.89±0.08	<0.001
WHtR Mean±SD	0.58±0.06	0.62±0.07	0.60±0.07	<0.001
BMI (BMI?30 kg/m2) n (%)	291 (30.0)	924 (60.6)	1215 (48.7)	<0.001
WC (M>102 cm; W>88 cm) n (%)	274 (28.1)	1037 (67.9)	1311 (52.4)	<0.001
WHR (M≥0.90; W≥0.85) n (%)	757 (77.8)	872 (57.1)	1629 (65.2)	<0.001
WHtR (≥0.50) n (%)	888 (91.2)	1454 (95.3)	2342 (93.7)	<0.001

*t test (comparison between men and women groups)
BMI: Body Mass Index, WC: Waist circumference, WHpR: Waist-to-hip ratio, WHtR: Waist-to-height ratio, M: Men, W: Women.

The correlations between WC and WHtR (for men r=0.94, p<0.001; for women r=0.94, p<0.001); between WHtR and BMI (for men r=0.85, p<0.001; for women r=0.73, p<0.001); and between WC and BMI (for men r=0.83, p<0.001; for women r=0.72, p<0.001) were found to be high in both sexes. Relatively lower correlations were found for WHpR and WC (for men r=0.77, p<0.001; for women r=0.57, p<0.001); WHpR and WHtR (for men r=0.74, p<0.001; for women r=0.55, p<0.001); and WHpR and BMI (for men r=0.49, p<0.001; for women r=0.05, p=0.048).

The effect of obesity on CVD risk according to sex is shown in Tables 3 and 4. Elevated anthropometric measurements posed a risk for DM, hypertension and metabolic syndrome. Except for BMI in women, all other measurements were positively correlated with dyslipidemia

Table 3— Association Between Obesity and Diabetes Mellitus, Hypertension and Dyslipidemia According to Sex.

	Diabetes Mellitus		Hypertension		Dyslipidemia	
	Crude OR (95% CI)	Adjusted OR** (95% CI)	Crude OR (95% CI)	Adjusted OR** (95% CI)	Crude OR (95% CI)	Adjusted OR** (95% CI)
Men						
BMI (≥30.0 kg/m^2)	1.470* (1.078-2.004)	1.481* (1.084-2.024)	1.700* (1.245-2.322)	1.829* 1.330-2.511)	1.468* (1.112-1.937)	1.423* (1.076-1.881)
WC (>102 cm)	1.444* (1.051-1.971)	1.466* (1.068-2.011)	1.853* (1.342-2.558)	1.944* (1.399)	1.420* (1.071-1.883)	1.389* (1.045-1.846)
WHpR (≥0.90)	1.832* (1.238-2.712)	1.842* (1.243-2.729)	1.955* (1.431-2.671)	2.033* (1.476-2.800)	1.848* (1.359-2.513)	1.830* (1.344-2.492)
WHtR (≥0.5)	2.355* (1.229-4.514)	2.361* (1.232-4.526)	2.895* (1.849-4.533)	2.961* (1.874-4.677)	2.302* (1.444-3.669)	2.324* (1.455-3.713)
Women						
BMI (≥30.0 kg/m^2)	1.485* (1.165-1.892)	1.443* (1.130-1.843)	2.387* (1.822-3.127)	2.551* (1.940-3.356)	1.172 (0.948-1.448)	1.164 (0.940-1.441)
WC (>88 cm)	2.023* (1.544-2.651)	1.995* (1.521-2.616)	2.577* (1.966-3.337)	2.608* (1.985-3.425)	1.453* (1.166-1.810)	1.442* (1.156-1.797)
WHpR (≥0.85)	1.640* (1.291-2.048)	1.672* (1.312-2.131)	1.670* (1.280-2.181)	1.627* (1.243-2.130)	1.506* (1.222-1.857)	1.507* (1.220-1.861)
WHtR (≥0.5)	3.321* (1.510-7.305)	3.220* (1.461-7.101)	3.983* (2.447-6.482)	3.864* (2.362-6.323)	2.470* (1.527-3.994)	2.472* (1.524-4.009)

*p<0.05
** Adjusted for age and educational status.
BMI: Body Mass Index, WC: Waist circumference, WHpR: Waist-to-hip ratio, WHtR: Waist-to-height ratio.

risk. For Framingham risk scores, WHtR and WHpR in men, and WC and HpR in women were found to be predictive (Tables 3 and 4).

DISCUSSION

This study examined obesity and abdominal obesity prevalence according to anthropometric measurements and the effect of obesity on cardiovascular risk in the elderly. In other studies, BMI is often used for determining obesity, with waist circumference as a secondary measure.

In our study, the prevalence of obesity was found to be 48.7% according to BMI (Men: 30.0%, Women: 60.6%), 52.4% according to WC (M: 28.1%, W: 67.9%), 65.2% according to WHpR (M: 77.8%, W: 57.1%), and 93.7% according to WHtR (M: 91.2%, W: 95.3%). Except for WHpR, women were more obese than men. According to the results of the TEKHARF and METSAR studies in Turkey, the prevalence of obesity (BMI ≥30.0 kg/m^2) was higher in women than in men aged 60 years and older (10,11). In a study in Sivas (a central Anatolian city) in 2005, the prevalence of obesity (BMI ≥30.0 kg/m^2) was 24.8% in people aged 65 years and over: 39.5% in women and 9.5% in men. The results were lower than in our study (12). We found the prevalence of obesity, as determined by BMI, to be the same in men and higher in women, similar to studies in the United States and Spain (1,2,13,14). The prevalence of obesity is lower in France, The Netherlands, Italy, Brazil, China and Taiwan than that found in our study. The frequencies of obesity in these studies were determined in women aged 60 years and older in France and in Brazil, 63-70 year-olds in the Netherlands, 65-74 year-olds in China, and 65 and over and 67-78 year-olds in Italy (3,15-19). Although the studies have used different methods, it is observed that, in Turkish elderly, prevalences of obesity and abdominal obesity are high, and increase with age. As a conclusion, it is an important health problem of the older people in Turkey.

The prevalence of abdominal obesity determined by WC is high among our study group. Reports of the frequency of central obesity in the ENRICA study in Spain and studies in

Table 4— Association Between Obesity and Metabolic Syndrome and High Framingham Risk Score According to Sex.

	Metabolic Syndrome		High Framingham Risk Score	
	Crude OR (95% CI)	Adjusted OR** (95% CI)	Crude OR (95% CI)	Adjusted OR** (95% CI)
Men				
BMI (≥30.0 kg/m^2)	4.641* (3.434-6.272)	4.636* (3.424-6.277)	1.458* (1.012-2.099)	1.420 (0.984-2.050)
WC (>102 cm)	7.401* (5.409-10.128)	7.458* (5.436-10.232)	1.279 (0.880-1.858)	1.236 (0.847-1.804)
WHpR (≥0.90)	5.267* (3.213-8.635)	5.237* (3.193-8.588)	1.643* (1.096-2.463)	1.625* (1.083-2.440)
WHtR (≥0.5)	12.152* (3.807-38.790)	12.169* (3.811-38.860)	4.615* (2.261-9.440)	4.495* (2.197-9.196)
Women				
BMI (≥30.0 kg/m^2)	2.751* (2.217-3.415)	2.800* (2.251-3.483)	1.572 (0.940-2.629)	1.572 (0.939-2.631)
WC (>88 cm)	7.477* (5.715-9.783)	7.445* (5.689-9.744)	2.886* (1.533-5.434)	2.847* (1.510-5.366)
WHpR (≥0.85)	2.287* (1.855-2.819)	2.276* (1.843-2.810)	1.678* (1.034-2.722)	1.651* (1.015-2.687)
WHtR (≥0.5)	15.609* (5.665-43.013)	15.593* (5.651-43.031)	5.119 (0.697-37.605)	5.000 (0.678-36.866)

*p<0.05
** Adjusted for age and educational status.
BMI: Body Mass Index, WC: Waist circumference, WHpR: Waist-to-hip ratio, WHtR: Waist-to-height ratio.

Brazil, the UK and The Netherlands were also relatively similar to our results. Frequencies of abdominal obesity in these studies were determined in elderly participants who were 60 years and over in Spain and Brazil (14,15). Our results on the prevalence of central obesity were the same as those for women aged over 65 in Latin America and in the Caribbean (SABE) study in Mexico City, and in men in the Santiago study (20). A common result of these studies was that the prevalence of obesity is higher in women than in men. Comparability among studies is problematic because age groups and cut-off levels of abdominal obesity indices are different across studies.

In our study, all of the anthropometric measurements for both sexes were found to be associated with CVD risk factors. Only BMI in women was not decisive for dyslipidemia. WHtR and WHpR in men and WC and WHpR in women were effective in predicting the level of Framingham risk. WHtR was the best measurement for predicting CVD risk factors, while WHpR or WC in men and WC in women were the second-best predictors. Metabolic syndrome was the risk most strongly associated with anthropometric measurements, and WHtR and WC were the most effective predictors of metabolic syndrome. Although different results have been obtained from other studies, they seem to support our results overall. In two studies conducted with adults, WHtR was more effective than other anthropometric measurements to determine metabolic syndrome (21,22). In Guasch-Ferre et al.'s study of people aged 60 years and older, WC and WHtR were more associated with dyslipidemia, diabetes, fasting blood glucose and metabolic syndrome than BMI. However, BMI was a more powerful determinant of hypertension (5). In a Taiwanese study with the elderly, BMI and WC were more strongly associated with hypertension than was WHtR (3). A study in Italy with the elderly found that WC was more strongly related to CVD risk than was BMI (23). In France, research with the elderly found stronger relationships with CVD risk for BMI in men and WHtR in women, and with Hispanic participants, BMI and WC were more strongly related to diabetes (24,25).

The Framingham equation is used to calculate CVD risk, but it is impossible to precisely account for multiple variables (such as age and level of obesity) when determining levels of risk. According to Dalton et al., "[w]ithout the development of a complicated set of age-specific cut-offs, it may be better to simply be guided by an analysis unadjusted for age. Based purely on the results presented here, and ignoring the currently used cut-off points, it therefore appears better in clinical practice to use WHtR to identify those patients who may be at increased risk of having risk factors for CVD" (26).

The main limitation of this study is that it used a cross-sectional approach to determine the risk of CVD from obesity as evaluated by anthropometric measurements. The results are correlational, so it is not possible to be certain of the direction of causality. Prospective studies provide more valuable evidence for determining this relationship. The study was conducted in the İzmir Balcova district and results reflect this region. In addition individuals with health problems are more likely to participate to this kind of studies, which might caused an overestimation of obesity prevalence. Strengths of our study include a community-based sample, a large sample size, measurements performed by the same trained people, and blood samples analyzed in a standardized laboratory.

In conclusion, obesity prevalence is high in the elderly. In both sexes, obesity which is determined by anthropometric measurements is associated with cardiovascular risks. However, abdominal obesity (WHtR and WC) is more effective than BMI in determining the risk of CVD.

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