



Original/*Obesidad*

Anthropometry to identify high visceral fat area in postmenopausal women

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Abstract

Introduction: the evaluation of the body fat distribution by anthropometry can serve to identify excess visceral fat. This diagnosis will enable implementation of specific measures to both prevent and treat excess visceral fat in postmenopausal women.

Objective: the aim of this study was to analyze different anthropometric indicators and identify the best cutoff points to discriminate subjects with high visceral fat area (HVFA) in postmenopausal women.

Methods: cross-sectional study with a sample of 255 postmenopausal women. Different Receiver Operating Characteristic (ROC) curves were constructed and the areas under them compared in terms of the conicity index (C-index), body mass index (BMI), waist-to-hip ratio (WHR), waist circumference (WC), weight-to-height ratio (WHtR) and HVFA. Sensitivity and specificity identified the best cutoff points between the different anthropometric indicators in order to discriminate subjects with HVFA. The confidence interval was set at 95%.

Results: statistically significant areas under the ROC curve were found for all anthropometric indicators analyzed. The following cutoff points, with their respective sensitivities and specificities to discriminate subjects with HVFA, were suggested: C-index (1.19; 75.00%–74.77%); BMI (27.3 kg/m²; 81.08%–80.37%); WHR (0.98; 90.54%–83.18%); WC (85 cm; 85.14%–81.31%); and WHtR (0.55; 80.41%–80.37%).

Conclusion: these results demonstrate that anthropometric indicators identify HVFA well in postmenopausal women and can be used instead of more sophisticated exams to detect high levels of visceral fat.

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Key words: Anthropometry. Abdominal fat. Menopause.

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ANTROPOMETRÍA PARA LA IDENTIFICACIÓN DE ZONA DE GRASA VISCERAL ALTA EN MUJERES POSMENOPÁUSICAS

Resumen

Introducción: la evaluación de la distribución de la grasa corporal por antropometría puede servir para identificar el exceso de grasa visceral. Este diagnóstico permitirá la aplicación de medidas específicas para prevenir y tratar el exceso de grasa visceral en mujeres posmenopáusicas.

Objetivo: el objetivo de este estudio fue analizar diferentes indicadores antropométricos e identificar los mejores puntos de corte para discriminar sujetos con alta área de grasa visceral (AAGS) en mujeres posmenopáusicas.

Métodos: estudio transversal con una muestra de 255 mujeres posmenopáusicas. Se construyeron diferentes curvas Receiver Operating Characteristic (ROC) y las áreas bajo ellas comparadas en términos del índice de conicidad (índice C), el índice de masa corporal (IMC), razón cintura-cadera (RCC), circunferencia de la cintura (CC), relación cintura-estatura (RCEst) y AAGS. La sensibilidad y la especificidad identificaron los mejores puntos de corte entre los diferentes indicadores antropométricos para discriminar sujetos con AAGS. El intervalo de confianza se fijó en 95%.

Resultados: las zonas estadísticamente significativas bajo la curva ROC se encontraron para todos los indicadores antropométricos analizados. Fueron sugeridos los siguientes puntos de corte, con sus respectivas sensibilidades y especificidades, para discriminar sujetos con AAGS: índice C (1,19; 75,00%–74,77%); IMC (27,3 kg/m²; 81,08%–80,37%); RCC (0,98; 90,54%–83,18%); CC (85 cm; 85,14%–81,31%); y RCEst (0,55; 80,41%–80,37%).

Conclusión: estos resultados demuestran que los indicadores antropométricos identifican bien a las mujeres posmenopáusicas con AAGS y pueden ser utilizados en lugar de los exámenes más sofisticados para detectar altos niveles de grasa visceral.

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Palabras clave: Antropometría. Grasa abdominal. Menopausia.

Introduction

Anthropometric indicators, primarily those that analyze fat mass distribution in the body, have been described in the literature as important markers of cardiovascular risk factors^{1,2,3}. Moreover, they can be used as a screening instrument to identify high coronary risk^{4,5,6}.

These anthropometric indicators can also be used to detect excess abdominal fat, especially the visceral fat area. Given that anthropometry is a low-cost, easy-to-interpret method, its use would facilitate assessment of visceral fat, especially in screening tests applied to large population groups^{7,8,9,10}.

Fat accumulation in the abdominal region, particularly the visceral fat area, has been described for decades as the type of fat mass distribution that poses the greatest health risk when obesity is central, and seems to have the highest risk for different metabolic and cardiovascular disorders^{11,12,13}.

The loss of ovarian function in women raises total adiposity levels and transition to android body fat topography¹⁴, increasing annual visceral adiposity gains from 0.15% (in premenopause) to 0.39% (in postmenopause)¹⁵. Excess visceral adipose tissue causes a change in adipokines and chemical mediators which, when taken together, promote a proinflammatory and prothrombotic state in women, contributing not only to an increase in cardiometabolic risk, but also some types of cancer (breast, endometrial and colon)¹⁶, functional decline¹⁷ and bone¹⁸ and muscle¹⁹ disorders.

Thus, it is important to assess body fat distribution in postmenopausal women in order to identify excess visceral fat. This diagnosis will enable implementation of specific measures to both prevent and treat excess visceral fat, especially through physical activity and healthy food habits, with the aim of controlling this undesirable profile and preventing metabolic and cardiovascular disturbances.

In this respect, the present study aimed to analyze different anthropometric indicators and identify the best cutoff points to discriminate subjects with high visceral fat area (HVFA) in postmenopausal women.

Methods

Study design

The study is part of the “Shape up during menopause” program, a randomized controlled trial approved by the Portuguese Foundation for Science and Technology (POCI/DES/59049/2004)²⁰. It was designed to examine the effects of exercise on cardiovascular risk, fall risk, and physical fitness in postmenopausal women.

The women volunteered to take part in the project as a response to announcements made in the community (regional newspapers, leaflets, television reports, among others) or after referral by their family doctor.

The study was in compliance with Declaration of Helsinki procedures²¹, and all participants gave their written consent. Assessments were conducted in the Laboratory of Physical Fitness, Exercise and Health (LAFES) at UTAD, and all assessments were performed by technically and scientifically trained evaluators.

Sample

The sample was composed of 255 postmenopausal women with mean age of 57.2±6.6 years. Before inclusion into the study, the reproductive and medical history of each woman was collected. The inclusion criteria were the following: (a) the inexistence of early menopause; (b) the absence of a significant hepatic, hematological, and renal disease; (c) the inexistence of cardiovascular diseases (symptoms of angina pectoris or myocardial infarction in the last 3 months) or uncontrolled hypertension (systolic arterial pressure >200 mmHg and/or diastolic arterial pressure >105 mmHg); (d) de nonuse of β -blockers or antiarrhythmic agents; and (e) the inexistence of skeletal muscle conditions that may alter one’s participation in exercise or may present aggravated symptoms in its execution.

Study variables

The study involved the analysis of the visceral fat area (VFA, cm²) and the following anthropometric variables: conicity index (C-index), body mass index (BMI), waist-to-hip ratio (WHR), waist circumference (WC) and waist-to-height ratio (WHtR).

Instrumentation and data collection

Height (H) was measured with a SECA 220 stadiometer (Seca Corporation, Hamburg, Germany), in accordance with procedures established by Heyward & Wagner²², considering a tolerance limit of 2 mm. Body mass (BM) and VFA were measured by octopolar bioimpedance (InBody720, Biospace Co. Ltd, Seoul, Korea), complying with preparation standards specified in the literature²³. This device has eight electrodes (1 on the palm and thumb of each hand and one on each heel and the front of each foot), allowing analysis of 5 body regions (right and left arms, trunk and right and left legs), using 6 different frequencies (1 kHz, 5 kHz, 50 kHz, 250 kHz, 500 kHz, and 1000 kHz) and reactance at three frequencies (5 kHz, 50 kHz, and 250 kHz). The InBody 720 is a valid device for assessing body composition in middle age²⁴, with VFA defined as a cross-section of the abdominal area, at the L4-L5 level, demonstrating high correlation with intra-abdominal adiposity (r between 0.759 and 0.922, $p < 0.05$) obtained by computerized tomography²⁵.

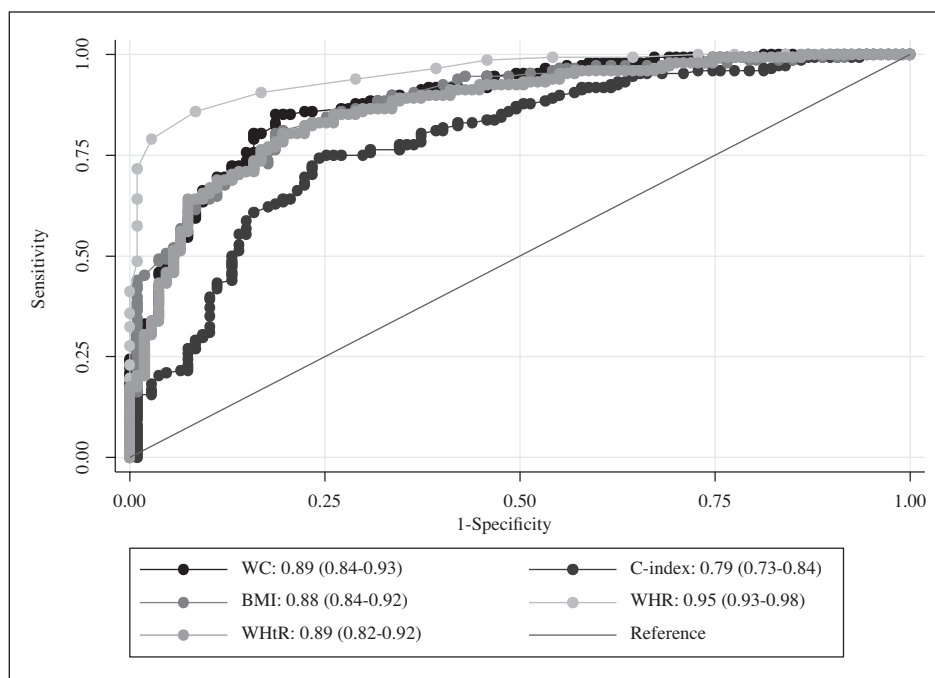


Fig. 1.—Areas under ROC curves with 95% CI of anthropometric indicators and HVFA. C-index, conicity index; BMI, body mass index; WHR, waist-to-hip ratio; WHtR, waist-to-height ratio; WC, waist circumference.

Electrode contact points were previously cleaned with an electrolytic tissue recommended by the manufacturer and data were imported to Excel, using Lookin'Body 3.0 software (Biospace Co. Ltd, Seoul, Korea). The presence of high visceral adiposity was considered for VFA values $\geq 130 \text{ cm}^2$ ²⁶.

Waist (WC) and hip (HC) circumferences were measured with a Rosscraft anthropometric tape (Blaine, WA, USA), according to criteria proposed by Callaway *et al.* ²⁷ and considering a tolerance limit of 1 cm.

BMI (BM/H), WHR (WC/HC) and WHtR (WC/H) were estimated and the C-index was determined by the measures of weight, height and waist circumference, using the following mathematical equation²⁸:

$$\text{C-index} = \frac{\text{Waistcircumference}(m)}{0.109 \sqrt{\frac{\text{BodyMass}(kg)}{\text{Height}(m)}}}$$

Technical errors in BM, H, WC, HC and VFA were determined by duplicate measures in 10 postmenopausal women, according to the formula $TE = (\frac{d^2}{2n})^{0.5}$ (*d*, difference between the two assessments; *n*, number of elements in the sample), obtaining the following values: 0.06 kg; 0.09 m; 0.38 cm; 0.40 cm and 0.97 cm², respectively.

Statistical analysis

The predictive power and the cutoff points for the C-index, WHR, WC, WHtR and BMI as discriminators of HVFA were determined using Receiver Operating

Characteristic (ROC) curves, frequently applied to determine cutoff points in diagnostic or screening tests²⁹.

The total area under the ROC curve was identified for C-index, WHR, WC, WHtR and HVFA. The higher the area under the ROC curve, the higher the discriminatory power of the obesity indicators for HVFA. The confidence interval (CI) was set at 95%. A 95% CI determines whether the predictive capacity of obesity indicators is due to chance, its lower limit not being less than 0.50³⁰.

Sensitivity and specificity were then calculated, in addition to cutoff points for the C-index, WHR, WC, WHtR and BMI as discriminators of HVFA.

Data were analyzed using the Stata 12.0 statistical program (StataCorp LP, Texas, USA).

Results

Sample characteristics are illustrated in Table I.

The areas under the ROC curve for the C-index, BMI, WHR, WC, WHtR as discriminators of HVFA are shown in table II. All the anthropometric indicators of obesity analyzed exhibited statistically significant areas for discriminating subjects with HVFA.

Table III shows the cutoff points and their respective sensitivities and specificities for anthropometric indicators of obesity analyzed as discriminators of HVFA.

Discussion

The study analyzed the discriminatory power and cutoff points of different anthropometric indicators for HVFA in postmenopausal women. Even though all an-

Table I
Descriptive analysis of the sample (n = 255)

Variables	Mean ± SD	Range
Age (years)	57.2 ± 6.6	40.6 – 79.6
Weight (kg)	69.2 ± 11.3	45.8 – 108.7
Height (m)	1.55 ± 5.2	1.42 – 1.70
Visceral Fat Area (cm ²)	134.4 ± 26.9	42.2 – 206.1
Body Mass Index (kg/m ²)	28.8 ± 4.6	18.8 – 43.0
Waist-to-Hip Ratio	1.00 ± 0.07	0.81 – 1.21
Waist Circumference (cm)	86.9 ± 9.9	64.5 – 120.0
Waist-to-Height Ratio	0.56 ± 0.1	0.41 – 0.7
Conicity Index	1.20 ± 0.1	1.05 – 1.5

SD, standard deviation.

Table II
Areas under ROC curves of anthropometric indicators and high visceral fat area (HVFA)

Obesity Indicators	Area	CI (95%)	p-value
C-index and HFVA	0.79	0.73 – 0.84	
WHR and HFVA	0.95	0.93 – 0.98	
WC and HFVA	0.89	0.84 – 0.93	
BMI and HFVA	0.88	0.84 – 0.92	
WHtR and HFVA	0.87	0.82 – 0.91	0.00

C-index, conicity index; WHR, waist-to-hip ratio; WC, waist circumference; BMI, body mass index; WHtR, waist-to-height ratio; CI, confidence interval.

Table III
Cutoff points, sensitivity and specificity of anthropometric indicators as discriminators of high visceral fat area

Anthropometric indicators	Cutoff point	Sensitivity	Specificity
C-index	1.19	75.0%	74.7%
WHR	0.98	90.5%	83.2%
WC	85.0	85.1%	81.3%
BMI	27.3	81.1%	80.4%
WHtR	0.55	80.4%	80.4%

C-index, conicity index; WHR, waist-to-hip ratio; WC, waist circumference; BMI, body mass index; WHtR, waist-to-height ratio.

thropometric indicators analyzed showed statistically significant areas for identifying HVFA, WHR exhibited the largest area, and C-index the smallest area under the ROC curve. WC, WHtR and BMI displayed similar areas and intermediate discriminatory power.

Similar results were obtained in a study of 55 obese women, 22 in premenopause and 32 in postmenopause⁷, with WHR the anthropometric indicator most significantly correlated with visceral fat, as measured by computerized tomography, irrespective of age.

In another study with 191 adults of both sexes⁹, a comparison of WHtR and the C-index showed that both indicators were good discriminators of HVFA. Cutoff points of 1.30 for the C-index and 0.58 for WHtR were proposed as discriminators of HVFA in women aged 60 years or older. These values are higher than those recorded in the present study (cutoff points of 1.19 for the C-index and 0.55 for WHtR for identifying HVFA in postmenopausal women).

In another recent study, analysis of 194 adults and elderly individuals¹⁰ showed that WHtR exhibited areas under the ROC curve for discriminating subjects with HVFA similar to those of our study (0.87 in adult women and 0.81 in elderly women). With respect to cutoff points for WHtR, slightly higher values than those obtained in our study were proposed (0.59 in adult women and 0.58 in elderly women).

In a study of 690 Chinese adults⁸, the power of BMI, WHR and WC as discriminators of visceral abdominal obesity was analyzed. Although WC has been considered the most accurate indicator, both WHR and BMI exhibited good areas under the ROC curve.

In relation to WC, a study that analyzed the performance of anthropometry in predicting visceral fat, found that this indicator displayed a good area under the ROC curve, which qualifies it to be used as a discriminator of HVFA³¹. The cutoff point of the present study was 88.2, slightly higher than that observed in the present study (85 cm).

The results regarding the discriminatory power of anthropometric indicators of obesity for HVFA in our investigation are in line with those of other studies^{8,9,10,31}. Of the indicators analyzed, the C-index, WHR, WHtR and WC express the central distribution of body fat well, possibly because all of these used waist circumference in their calculations. Although waist circumference is not used to calculate BMI, it also exhibits good discriminatory power for HVFA.

According to the findings obtained in the present study, even though the largest area under the ROC curve was observed in WHR, all the anthropometric indicators analyzed can be used to detect the high visceral fat area in postmenopausal women.

These findings are important for public health because the most sophisticated methods for measuring visceral fat, such as computerized tomography and magnetic resonance, are invasive and costly. Moreover, excess abdominal fat is a risk factor for different metabolic and cardiovascular disorders, primarily in postmenopausal women^{32,33}, requiring constant monitoring.

Therefore, given the low cost of anthropometry, it is suggested that measures be taken to assess visceral fat using anthropometric indicators of obesity in postmenopausal women. This may contribute to identifying

excess visceral fat with subsequent prescription of physical activity and healthy eating habits, in order to control this undesirable profile, which could prevent metabolic and cardiovascular complications.

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