CSP CADERNOS DE SAÚDE PÚBLICA
REPORTS IN PUBLIC HEALTH

ARTIGO
ARTICLE

Waist-to-height ratio as an anthropometric marker of overweight in elderly Brazilians

Razão cintura-estatura como marcador antropométrico de excesso de peso em idosos brasileiros

Razón cintura-estatura como marcador antropométrico de exceso de peso en ancianos brasileños

Márcia Mara Corrêa [1,2]
Elaine Tomasi [1]
Elaine Thumé [1]
Elizabete Regina Araújo de Oliveira [2]
Luiz Augusto Facchini [1]

doi: 10.1590/0102-311X00195315

Abstract

This study's objective was to identify the cut-off point for waist-to-height ratio (WHtR) with the best sensitivity, specificity, and accuracy for the elderly Brazilian population, using body mass index (BMI) as the anthropometric reference. A representative sample of the Brazilian population consisted of 5,428 elderly individuals participating in an epidemiological survey. The variables were weight, height, and waist circumference (WC). WHtR was assessed with BMI as the gold standard, using two proposals for classification of the elderly population's nutritional status. The ideal cut-off point for WHtR simultaneously showing the highest sensitivity and specificity was determined using the receiver operating characteristic (ROC) curve. Sensitivity from 94.9% to 98.4%, specificity from 43% to 55.4%, and values for area under the ROC curve from 0.878 to 0.883 were identified with a cut-off point of 0.55. We recommend use of WHtR in clinical practice due to its simplicity and good power to detect overweight in the elderly.

Overweight; Aged; Body Mass Index; Waist-Height Ratio

Correspondence
M. M. Corrêa
Universidade Federal de Pelotas.
Av. Duque de Caxias 250, 2º andar, Pelotas, RS
96030-000, Brasil.
marciamara@uol.com.br

[1] Universidade Federal de Pelotas, Pelotas, Brasil.
[2] Universidade Federal do Espírito Santo, Vitória, Brasil.

Introduction

According to forecasts, by 2025 Brazil will have more than 35 million elderly individuals, the world's sixth largest elderly population in absolute terms [1].

The World Health Organization (WHO) [2] has defined active aging, highlighting equitable access to health care and continuing development of health promotion and disease prevention actions. The identification of groups with increased vulnerability is thus extremely important for targeting public health policies in the elderly population.

Aging involves numerous physiological, morphological, functional, psychological, and social changes that can have direct repercussions on individuals' nutritional status [3], since both malnutrition and overweight contribute greatly to increased morbidity and mortality [4].

Various methods for nutritional assessment have been described in the literature [5], and use of conventional methods has been recommended due to their practicality, low cost, and diagnostic precision [6]. Such methods feature anthropometry, and body mass index (BMI), waist circumference (WC), and waist-to-hip ratio (WHR) have been widely used [7,8,9]. Recently, waist circumference to height ratio (WHtR) has been proposed as an anthropometric measure to assess central adiposity, since it is closely associated with cardiometabolic risk factors and mortality, independently of body weight [10,11,12].

The correlation between variables that measure obesity in the elderly individual is still not well established, due to the distribution of adiposity in the aging process, especially in the abdominal region [13]. WHtR is thus an alternative anthropometric index of central obesity that avoids the limitations of WC due to the inclusion of height in the index, averting potential confounding from height in cardiometabolic risk [14].

The definition of cut-off points for anthropometric indicators with operational simplicity and good accuracy in the detection of individuals at risk can be highly useful in health services, allowing early identification of specific at-risk population groups, as well as for use in epidemiological research [15]. Various studies have found similar cut-off points for WHtR for increased cardiometabolic risk, comparing different populations [16,17,18], as well as men and women, independently of age bracket [19,20]. In fact, a WHtR cutoff of 0.5 for has been proposed as a predictor of cardiometabolic risk according to other anthropometric indices, e.g. BMI, WC, and WHR [21].

Brazil has no population-based study establishing the cut-off for WHtR as an anthropometric indicator of overweight and predictor of non-communicable diseases in the general population, or among the elderly in particular. To fill this gap, the current study aims to identify the cut-off point for WHtR with the best sensitivity, specificity, and accuracy for the elderly Brazilian population using BMI as the anthropometric reference.

Methods

This study with a cross-sectional design used data from a household-based epidemiological survey with a representative sample of the Brazilian population in 2008-2009, the aim of which was to assess access and quality of care in health services. The study included individuals 60 years and older living in urban areas in 100 small, medium, and large municipalities in 23 Brazilian states in the country's five major geographic regions.

The sample size was calculated *a posteriori* to establish the power of the sample obtained in the principal study in relation to the current analyses' objectives. The survey identified 7,015 elderly, of which 275 (3.9%) were not located (losses) and 116 (1.7%) refused to participate. Among the 6,624 remaining elderly, 1,196 interviews were held through key informants, finally leaving anthropometric measures for 5,428 individuals. This sample was sufficient to detect sensitivity and specificity between 80 and 90% (±4%) for the WHtR cut-off, with a 95% confidence level.

Elderly subjects were considered eligible if they were able to answer the questionnaire themselves or had persons responsible for them that could answer the questions, when they were unable to do so. Hospitalized individuals, those deprived of freedom due to court sentences, or those living in long-term institutions were considered ineligible for the study.

The study used data from the 2000 *Brazilian Population Census* conducted by the Brazilian Institute of Geography and Statistics (IBGE. http://www.ibge.gov.br) to select the municipalities and urban census tracts. The standard module for territorial and population reference for the sampling estimates was the urban census tract, defined as a cluster of approximately 300 households and 1,000 inhabitants. Municipalities with fewer than 10 thousand inhabitants were called "very small"; those with 10 thousand to fewer than 20 thousand inhabitants, "small"; those with 20 thousand to fewer than 100 thousand inhabitants, "medium"; 100 thousand to fewer than 1.1 million, "large"; 1.1 million or more, "very large". Using the random numbers table, we selected the sample of municipalities with each size and proceeded to pick the census tract. In each household, all eligible individuals were included, even if the pre-defined quota had already been met.

The data were collected electronically using a PDA (personal digital assistant) palmtop computer from August 2008 to April 2009, by 55 duly trained research assistants in 11 teams, each consisting of four interviewers and a supervisor.

The questionnaire in the PDA contained questions structured in five blocks: identification, health promotion and preventive care, health problems, access and use of health services, and anthropometric measures.

At the end of a work day, 5% of the completed questionnaires were selected for quality control by the supervisor.

At the end of the data collection in each very small and small municipality, or weekly in the medium and large municipalities, the data files were e-mailed to three different members of the study's coordinating committee.

The anthropometric variables collected were weight, height, and waist circumference, measured according to the techniques proposed by Lohman et al. [23]. The elderly had their weight measured on a digital scale with a capacity of 150kg and accurate to 100g (Geratherm Perfect Fitness Digital. Geratherm Medical AG, Geschwenda, Germany), with the individual positioned barefoot on the previously calibrated scale. The clothing worn by the elderly at the time of the measurement were recorded for subsequent subtraction, according to a reference table constructed by the research team. Height and WC were measured with a T87-2WISO (Wiso, São José, Brazil) anthropometric tape measure. For height, the tape measure was attached to a flat wall, with the floor as point zero. Measurement was done according to established techniques [22], and was performed after the elderly had breathed deeply, standing completely straight. WC was measured between the iliac crest and the lower rib margin (midway between the hip and last rib), accurate to 0.1cm. Weight, height, and waist circumference were measured twice for each individual, and the final values were obtained by calculating the arithmetic means.

Weight and height were used to calculate BMI, or body weight (kg) divided by height (m) squared (W/Ht^2).

The Brazilian Ministry of Health recommends the cut-off points proposed by Lipschitz [23] as the reference for assessing BMI in the elderly [24], although most studies on nutritional status in the elderly use the World Health Organization (WHO) criteria [25]. The nutritional status of the elderly was thus assessed in this study according to both the classification proposed by Lipschitz [23] (underweight, BMI $< 22kg/m^2$; normal weight, BMI 22 to $27kg/m^2$; and overweight, BMI $> 27kg/m^2$), and the WHO reference [25] (underweight, BMI $< 18.5kg/m^2$; normal weight, BMI 18.5 to $24.9kg/m^2$; overweight, BMI 25 to $29.9kg/m^2$, and obesity, BMI $\geq 30kg/m^2$). Overweight was defined as BMI $> 27kg/m^2$ with the Lipschitz criterion [23] and $> 25kg/m^2$ with the WHO criterion [25].

WHtR was calculated as WC divided by height – both in centimeters (cm) – with the result varying from close to zero (0) to one (1).

Blood pressure (BP) was measured with an automatic digital wrist device (Geratherm). Two BP measurements were taken with a minimum interval of 15 minutes, the first of which taken 15 minutes after the start of the interview. The measurement was taken on the left wrist as proposed by the National Program for the Control of Arterial Hypertension [26]. The second measurement was used for the calculations. Hypertension was defined as systolic blood pressure (SBP) $\geq$ 140mmHg and/or diastolic blood pressure (DBP) $\geq$ 90mmHg [26].

Anthropometric measurements used in individual health assessment aim to identify early health risk. However, other complementary factors in this assessment should include socio-demographic and behavioral variables and population morbidity. Thus, the covariables used in these analyses were: age in years (< 65; 65 to 69; 70 to 79; and ≥ 80); gender (male; female); family income in minimum wages (< 1; 1 to 1.9; 2 to 4.9; and ≥ 5); years of schooling (0; 1 to 4; ≥ 5); conjugal status (married/civil union; single/widowed); smoking (smoker; former smoker; and never smoked); arterial hypertension (no – < 140/90mmHg; yes – ≥ 140/90mmHg); and self-report of a medical diagnosis of diabetes (yes; no). Sedentary leisure-time lifestyle was assessed using the section on leisure from the long version of the *International Physical Activity Questionnaire* [27], and a score was constructed as the sum of low, moderate, and high-intensity leisure-time physical activities. Sedentary lifestyle was defined as less than 150 minutes a week of leisure-time physical activity [28].

The analysis according to these variables allowed investigating differences in the proposed measurement's validity in order to identify groups with the greatest risk and provide the basis for health recommendations.

Stata 13.1 (StataCorp LP, College Station, USA) was used for the data analysis. Statistical significance for the differences in WHtR according to gender, conjugal status, sedentary leisure-time lifestyle, hypertension, and self-reported diabetes was verified with the Student's t-test. Analysis of variance (ANOVA) was used to verify differences in WHtR according to age, family income, schooling, smoking, and BMI. Statistical significance was set at 5% for all the associations.

The ideal cut-off for WHtR, showing both the highest sensitivity and specificity, was determined using the ROC (receiver operating characteristic) curve. After establishing the cut-off point, we calculated the sensitivity (proportion of elderly with overweight according to BMI that were correctly identified by WHtR) and specificity (proportion of elderly without overweight correctly identified as such by WHtR). Based on the sensitivity and specificity using the best cut-off for WHtR, we calculated the positive predictive value (proportion of elderly with overweight according to BMI among those with overweight identified by WHtR). The area under the ROC curve (AUROC) was used to assess and compare the capacity of WHtR to identify overweight using BMI as the anthropometric reference [15]. AUROC furnishes the overall probability of WHtR correctly classifying presence or absence of overweight, and the estimated area under the curve varies from 0.5 (absence of accuracy) to 1.0 (maximum accuracy). Curves with areas > 0.5 are considered useful in the identification of target situations and curves with areas whose confidence interval includes 0.5 indicate that the predictive capacity of the overweight indicator may be due to chance, while a perfect test has an area under the curve equal to 1.0 [29]. 95% confidence intervals (95%CI) were determined for each of the measurements.

The study protocol was approved by the Institutional Review Board of the School of Medicine, Federal University in Pelotas, Brazil, case review n. 152/2007. Since this study was nested in a larger project conducted in 2008-2009 and did not entail any additional risk to the elderly subjects, the informed consent was the same as that requested for participation in the main study. The principal project's coordinator authorized use of the databank.

Results

The majority of the participants were female (62%), and 45% were younger than 70 years. Most had a family income of 1 to 4.9 times the minimum wage (79%), and only one-fourth had five years of schooling or more. 56% of the sample were married or in civil unions, 86% showed sedentary leisure-time lifestyle, and 15% smoked (Table 1). Approximately one in four elderly had hypertension, and 17% reported a medical diagnosis of diabetes (Table 2).

Regardless of the criterion for anthropometric classification of nutritional status, Lipschitz [23] or WHO [25], there was a predominance of overweight, with 39% and 57%, respectively.

For the elderly as a whole, mean WHtR was 0.60 ± 0.075, with no difference by age or family income. Higher mean WHtR was associated with female gender ($p < 0.001$), lower schooling ($p < 0.001$), single conjugal status ($p = 0.004$), non-smoking ($p < 0.001$), sedentary leisure-time lifestyle ($p < 0.001$), and hypertension and diabetes ($p < 0.001$) (Table 2). Statistically significant differences were also seen in mean WHtR for nutritional status classification variables ($p < 0.001$).

For both curves, the best cut-off point for WHtR in the identification of overweight in the elderly was 0.55 (Figure 1). The curve using the Lipschitz classification [23] showed a higher percentage of

Table 1

Description of the sample and mean values for waist-to-height ratio (WHtR) in elderly Brazilians according to socio-demographic and behavioral characteristics. Brazil, 2009.

Variables	n (%)	Mean WHtR ± SD	p-value *
Age (years)			
< 65	1,351 (25.0)	0.60 ± 0.082	0.699
65-69	1,373 (25.3)	0.60 ± 0.079	
70-79	1,916 (35.4)	0.60 ± 0.080	
≥ 80	776 (14.3)	0.60 ± 0.085	
Sex			
Male	2,093 (38.4)	0.57 ± 0.072	< 0.001
Female	3,329 (61.6)	0.61 ± 0.083	
Family income (minimum wage)			
< 1	191 (3.6)	0.59 ± 0.072	0.595
1-1.9	1,376 (26.0)	0.60 ± 0.085	
2-4.9	2,777 (52.5)	0.60 ± 0.082	
≥ 5	948 (17.9)	0.60 ± 0.076	
Schooling (years)			
0	2,035 (37.8)	0.60 ± 0.084	< 0.001
1-4	1,999 (37.1)	0.60 ± 0.082	
≥ 5	1,352 (25.1)	0.59 ± 0.074	
Conjugal status			
Marrued/Cibil union	3,087 (56.9)	0.60 ± 0.082	0.004
Single/Widowed	2,334 (43.1)	0.60 ± 0.082	
Smoking			
Never smoked	2,683 (49.5)	0.60 ± 0.078	< 0.001
Former smoker	1,943 (35.8)	0.60 ± 0.082	
Current smoker	801 (14.7)	0.57 ± 0.085	
Sedentary leisure-time lifestyle			
Yes	4,661 (86.0)	0.60 ± 0.075	< 0.001
No	758 (14.0)	0.59 ± 0.071	
Total	5,428 (100.0)	0.60 ± 0.075	-

SD: standard deviation.

* Student's t-test or ANOVA, when indicated; signoficat ate p < 0.05.

AUROC and higher sensitivity; the based on the WHO classification [24] showed higher specificity and higher positive predictive value (Table 3).

Tables 4 and 5 describe the validity indicators, i.e.: sensitivity, specificity, area under the ROC curve, and positive predictive value for the 0.55 cut-off of WHtR using the Lipschitz [23] and WHO criteria [25] for BMI classification, stratified according to the elderly population's socio-demographic, behavioral, and morbidity characteristics. For all the covariables analyzed, for both BMI classification criteria, AUROC exceeded 0.8, and the proportion of elderly with overweight correctly identified by WHtR (sensitivity) exceeded 92%, confirming the cut-off point of 0.55 for WHtR as the best for diagnosis of overweight in the elderly.

Discussion

This study in a representative sample of the elderly Brazilian population proposes a cut-off point of 0.55 for weight-to-height ratio as an anthropometric marker of overweight. It was also possible to

Table 2

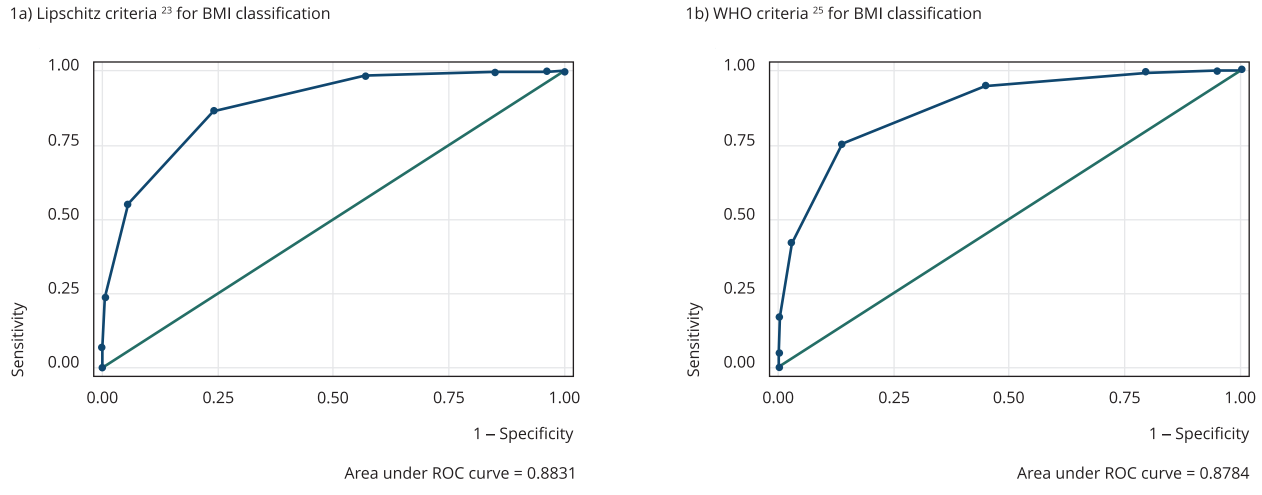
Description of sample and mean values for waist-to-height ratio (WHtR) of elderly Brazilians according to anthropometric characteristics and morbidity. Brazil, 2009.

Variables	n (%)	Mean WHtR ± SD	p-value *
BMI (Lipschitz [23])			
Underweight	1,036 (19.7)	0.51 ± 0.049	< 0.001
Normal weight	2,170 (41.1)	0.58 ± 0.047	
Overweight	2,070 (39.2)	0.66 ± 0.055	
BMI (WHO [25])			
Underweight	210 (4.0)	0.47 ± 0.049	< 0.001
Normal weight	2,068 (39.2)	0.55 ± 0.049	
Overweight	1,983 (37.6)	0.62 ± 0.048	
Obese	1,015 (19.2)	0.69 ± 0.051	
Arterial hypertension (mm/Hg)			
< 140/90	4,064 (76.5)	0.59 ± 0.075	< 0.001
≥ 140/90	1,250 (23.5)	0.61 ± 0.073	
Diabetes			
No	4,529 (83.1)	0.59 ± 0.074	< 0.001
Yes	892 (16.9)	0.61 ± 0.071	
Total	5,428 (100.0)	0.60 ± 0.075	-

BMI: body mass index; SD: standard deviation; WHO: World Health Organization.
* Student's t-test or ANOVA, when indicated; signoficat ate p < 0.05.

Figure 1

ROC (receiver operating characteristic) curve for waist-to-height ratio (WHtR) as an anthropometric indicator of overweight according to the body mass index (BMI) classification criteria proposed by Lipschitz [23] (a) and the World Health Organization (WHO) [25] (b). Brazil, 2009.



Note: the seven cut-off points represented in the graph are from bottom to top: 0.70; 0.65; 0.60; 0.55; 0.50; 0.45 and 0.40.

Table 3

Indicators of validity of the 0.55 cutoff for waist-to-height ratio (WHtR) according to two criteria for body mass index (BMI) classification. Brazil, 2009.

Classification criterion	Indicators of validity			
	Sensitivity (95%CI)	Specificity (95%CI)	AUROC (95%CI)	Positive predictive value (95%CI)
Lipschitz [23]	98.4 (97.7-98.9)	43.0 (41.3-44.7)	0.883 (0.874-0.891)	52.7 (51.1-54.3)
WHO [25]	94.4 (94.1-95.7)	55.4 (53.3-57.4)	0.878 (0.869-0.887)	73.7 (72.3-75.1)

95%CI: 95% confidence interval; AUROC: area under ROC (receiver operating characteristic) curve; WHO: World Health Organization.

calculate mean WHtR according to socio-demographic, behavioral, anthropometric, and morbidity characteristics.

The elderly showed high prevalence of overweight, namely 39% and 57% according to the Lipschitz [23] and WHO [25] criteria, respectively. This finding is worrisome since overweight is an important risk factor for various health problems. The findings have direct implications for the health system and for quality of life in this population group. Measures to deal with overweight are thus needed to back appropriate health policies, programs, and services for health promotion, disease prevention, and recovery in the elderly population.

The Telephone Surveillance System for Risk and Preventive Factors for Chronic Diseases (VIGITEL), covering all 26 Brazilian state capitals and the Federal District, showed a mean annual variation of 1.08% in the prevalence of overweight in the elderly, assessed by the WHO criteria for BMI [25], with prevalence rates of 53.4% in 2006 and 58.5% in 2012 [30].

International [31,32] and Brazilian studies [33,34] have proven the high prevalence of overweight in the elderly population, in contrast with underweight, a phenomenon known worldwide as the nutritional transition, with unhealthy eating patterns and physical inactivity as determinant factors [35]. Considered a worldwide epidemic, affecting practically all ages, socioeconomic groups, and countries [36], the association between overweight and countless diseases makes overweight a serious public health problem [37,38].

Studies in different age brackets have shown that aging leads to the redistribution of adipose tissue and internalization of abdominal fat, especially in women [39,40]. Accumulation of fat tissue, especially in the abdominal region, predisposes to a series of risk factors through a highly frequent association with outcomes that favor the occurrence of cardiometabolic disorders [41,42].

Given that such changes in body composition with aging could alter the cut-off points for other anthropometric measures such as WC and WHR, WHtR becomes a potentially advantageous measure due to its adjustment by height [43], thus justifying a single reference value independently of age and gender [21]. The current study corroborated such evidence, and no significant changes were detected in the cut-off point for WHtR according to the different variables.

The construction of ROC curves and sensitivity and specificity analysis have been recommended in epidemiological studies to assess the validity of anthropometric measures [15]. In this study, the cut-off point of 0.55 showed good predictive capacity for the diagnosis of overweight, regardless of the BMI classification criterion used, with AUROC values of 0.883 for the reference proposed by Lipschitz [23] and 0.878 for the WHO criterion [25].

The findings recommend the use of WHtR as an anthropometric indicator of adiposity in the elderly population, supplanting persistent controversies on the most appropriate cut-off point for BMI for classification of overweight/obesity for this particular group. WHtR was capable of predicting overweight with a single value (0.55), using two different classification references, thus evidencing the indicator's simplicity for use in clinical practice. Another advantage to the use of WHtR is that BMI does not correlate completely with body fat distribution (especially that of abdominal fat), thus making WHtR more advantageous due to the use of WC in its calculation.

Although BMI does not measure body composition, it does have good diagnostic potential for nutritional status in epidemiological studies, with a weak correlation with height and strong cor-

Table 4

Indicators of validity of the 0.55 cutoff for waist-to-height ratio (WHtR) according to the Lipschitz criteria [23] for body mass index (BMI) classification according to socio-demographic, behavioral, and morbidity characteristics in the elderly population. Brazil, 2009.

Variables	Lipschitz [23]			
	Sensitivity (95%CI)	Specificity (95%CI)	AUROC (95%CI)	Positive predictive value (95%CI)
Age (years)				
< 65	98.6 (97.3-99.4)	47.4 (43.7-51.1)	0.897 (0.879-0.912)	59.7 (56.5-62.8)
65-69	98.6 (97.3-99.4)	47.1 (43.5-50.8)	0.900 (0.883-0.916)	59.2 (56.1-62.3)
70-79	98.0 (96.6-98.9)	41.2 (38.5-44.2)	0.880 (0.865-0.895)	49.2 (46.5-51.9)
> 80	98.6 (96.0-99.7)	34.6 (30.6-38.8)	0.877 (0.851-0.899)	37.7 (33.7-41.8)
Sex				
Male	97.6 (96.1-98.7)	52.0 (49.3-54.6)	0.896 (0.882-0.909)	47.7 (45.0-50.5)
Female	98.7 (97.9-99.2)	35.9 (33.7-38.2)	0.871 (0.859-0.882)	55.2 (53.2-57.1)
Familiar income (minimum wage)				
< 1	100.0 (95.1-100.0)	47.7 (38.1-57.5)	0.937 (0.887-0.965)	56.2 (47.2-64.8)
1-1.9	98.4 (96.9-99.3)	41.0 (37.6-44.1)	0.872 (0.853-0.890)	50.2 (47.0-53.3)
2-4.9	98.1 (97.1-98.8)	43.0 (40.6-45.5)	0.888 (0.875-0.899)	52.1 (49.8-54.3)
≥ 5	98.8 (97.1-99.6)	44.7 (40.4-49.1)	0.885 (0.862-0.904)	57.5 (53.7-61.2)
Schooling (years)				
0	98.4 (97.1-99.2)	41.3 (38.6-44.0)	0.892 (0.878-0.906)	47.4 (44.7-50.0)
1-4	98.9 (98.0-99.5)	42.2 (39.3-45.2)	0.887 (0.872-0.900)	55.9 (53.3-58.4)
≥ 5	97.4 (95.47-98.6)	47.4 (43.8-50.9)	0.877 (0.857-0.894)	56.1 (52.8-59.3)
Conjugal status				
Married/Civil union	98.3 (97.4-99.0)	45.2 (42.9-47.6)	0.893 (0.882-0.904)	54.3 (52.2-56.4)
Single/Widowed	98.4 (97.3-99.1)	40.0 (37.4-42.6)	0.872 (0.857-0.885)	50.6 (48.2-53.0)
Smoking				
Never smoked	98.0 (97.0-98.7)	40.0 (37.4-42.5)	0.871 (0.858-0.884)	56.0 (53.8-58.2)
Former smoker	98.8 (97.7-99.4)	41.1 (38.2-44.0)	0.878 (0.862-892)	52.3 (49.6-54.9)
Current smoker	98.9 (96.1-99.9)	54.1 (50.0-58.1)	0.927 (0.906-0.944)	39.6 (35.1-44.3)
Sedentary leisure-time lifestyle				
Yes	98.5 (97.9-99.0)	41.7 (39.8-43.6)	0.883 (0.873-0.892)	52.1 (50.4-53.8)
No	97.3 (94.8-98.8)	50.7 (46.0-55.4)	0.894 (0.868-0.914)	56.4 (52.0-60.8)
Arterial hypertension (mm/Hg)				
< 140/90	98.4 (97.6-98.9)	44.6 (42.6-46.6)	0.883 (0.872-0.892)	51.1 (49.3-53.0)
≥ 140/90	98.2 (96.7-99.1)	38.5 (34.8-42.4)	0.878 (0.859-0.896)	57.5 (54.3-60.6)
Diabetes				
No	98.2 (97.4-98.8)	44.7 (42.9-46.6)	0.883 (0.873-0.892)	50.6 (48.8-52.3)
Yes	99.1 (97.8-99.8)	31.2 (26.8-35.9)	0.869 (0.845-0.891)	61.8 (58.2-65.3)

95%CI: 95% confidence interval; AUROC: area under ROC (receiver operating characteristic) curve.

relation with absolute fat mass. High BMI is positively associated with morbidity and mortality from various chronic non-communicable diseases [24,25,44,45].

However, for better diagnosis of overweight, studies recommend that BMI values be combined with other measures of adiposity such as WC or WHR, in individual and collective assessments, aimed at better prediction of health problems by these adiposity indicators [36,46]. Health professionals should thus look beyond BMI, which is not sufficient by itself to assess early risk, failing to classify a considerable portion of the population at imminent risk [47]. In the current study, 48% to 74% of the population classified as normal weight according to the WHO [25] and Lipschitz [23] criteria, respectively (data not shown), showed WHtR values that indicated increased cardiometabolic risk, which was also found in other studies [48,49].

Table 5

Indicators of validity of the 0.55 cutoff for waist-to-height ratio (WHtR) according to WHO criteria [25] for body mass index (BMI) classification according to socio-demographic, behavioral, and morbidity characteristics in the elderly population. Brazil, 2009.

Variables	OMS [25]			
	Sensitivity (95%CI)	Specificity (95%CI)	AUROC (95%CI)	Positive predictive value (95%CI)
Age (years)				
< 65	94.6 (92.8-96.1)	62.8 (58.4-67.1)	0.895 (0.877-0.911)	80.7 (78.1-83.2)
65-69	94.5 (92.7-96.0)	59.0 (54.1-63.1)	0.898 (0.880-0.941)	77.3 (74.5-79.8)
70-79	95.2 (93.7-96.4)	55.0 (51.5-58.5)	0.878 (0.862-0.893)	73.0 (70.5-75.3)
> 80	96.4 (93.8-98.1)	42.1 (37.4-47.0)	0.862 (0.835-0.885)	57.0 (52.8-61.1)
Sex				
Male	92.6 (90.8-94.1)	66.0 (63.0-69.0)	0.889 (0.875-0.903)	73.4 (70.9-75.8)
Female	96.1 (95.2-96.9)	46.7 (43.9-49.5)	0.870 (0.858-0.881)	73.8 (72.0-75.5)
Familiar income (minimum wage)				
< 1	91.3 (84.1-95.9)	54.4 (42.8-65.7)	0.850 (0.791-0.899)	72.3 (63.8-79.8)
1-1.9	95.9 (94.2-97.2)	53.5 (49.4-57.6)	0.877 (0.859-0.895)	71.9 (68.9-74.7)
2-4.9	94.8 (93.5-95.8)	55.6 (52.7-58.5)	0.879 (0.866-0.891)	73.5 (71.5-75.4)
≥ 5	95.2 (93.1-96.8)	58.1 (52.9-63.2)	0.889 (0.867-0.908)	77.5 (74.2-80.6)
Schooling (years)				
0	95.14 (93.6-96.4)	51.4 (48.1-54.6)	0.880 (0.865-0.894)	67.5 (65.0-69.9)
1-4	96.0 (94.7-97.1)	56.4 (52.8-59.9)	0.885 (0.873-0.902)	77.1 (74.9-79.2)
≥ 5	92.9 (90.8-94.6)	61.3 (57.0-65.4)	0.876 (0.857-0.894)	77.8 (75.0-80.4)
Conjugal status				
Married/Civil union	94.5 (93.3-95.5)	58.6 (55.8-61.3)	0.887 (0.876-0.899)	75.7 (73.9-77.5)
Single/Widowed	95.5 (94.2-96.6)	51.2 (48.1-54.3)	0.868 (0.854-0.882)	71.0 (68.7-73.1)
Smoking				
Never smoked	94.2 (93.0-95.3)	51.8 (48.7-55.0)	0.865 (0.851-0.878)	76.0 (74.1-77.9)
Former smoker	96.2 (94.9-97.3)	54.3 (50.8-57.8)	0.878 (0.863-0.893)	73.9 (71.6-76.2)
Current smoker	94.1 (90.8-96.5)	64.4 (59.9-68.7)	0.903 (0.880-0.922)	62.6 (58.0-67.0)
Sedentary leisure-time lifestyle				
Yes	95.6 (94.7-96.3)	53.8 (51.5-56.0)	0.880 (0.870-0.889)	72.8 (71.2-74.3)
No	91.7 (88.7-94.1)	65.6 (59.9-70.9)	0.885 (0.860-0.907)	79.5 (75.7-82.9)
Arterial hypertension (mm/Hg)				
< 140/90	94.6 (93.5-95.5)	56.6 (54.3-58.9)	0.875 (0.864-0.885)	72.4 (70.7-74.0)
≥ 140/90	95.6 (93.9-96.9)	51.9 (47.2-56.7)	0.882 (0.862-0.899)	77.7 (74.9-80.3)
Diabetes				
No	94.3 (93.3-95.2)	56.6 (54.4-58.7)	0.875 (0.865-0.884)	71.9 (70.2-73.4)
Yes	97.4 (95.8-98.5)	45.7 (39.5-52.0)	0.882 (0.859-0.903)	81.3 (78.3-84.1)

95%CI: 95% confidence interval; AUROC: area under ROC (receiver operating characteristic) curve.

According to a systematic review [50], WHtR is a valid anthropometric index for diagnosis of obesity in the elderly, having been assessed as a good indicator in the prediction of risk factors and cardiovascular diseases, metabolic syndrome, and diabetes, compared to BMI, WC, and WHR, among other parameters. Studies [43,51,52] have also proven that WHtR has high precision in the discrimination of visceral obesity and is more effective than WC and WHR in cardiovascular risk assessment and follow-up in individual and collective clinical practice.

WHtR has been viewed as a simple primary risk assessment tool that identifies more persons at "cardiometabolic risk" than the combination of BMI and WC. Thus, researchers have recommended that the combination of BMI and WC be replaced by the routine use of WHtR, since individuals with high WC are being classified in the healthy BMI range, thus overlooking a large group at potential risk [48].

Importantly, the majority of studies in the elderly population that aim to set cut-off points for WHtR or other anthropometric measures do so on the basis of detecting increased cardiometabolic risk and used the WHO classification criteria [25] for BMI, WC, and WHR.

A prospective study [11] resulting from a 13-year follow-up with a total sample of 5,488 individuals ranging in age from 30 to 83 years, with a specific sample of 1,763 elderly, concluded that WHtR was the best index to predict cardiovascular disease, compared to BMI and WC. The suggested cut-off point in the study was 0.56 for men and women 50 to 69 years of age (close to the value found in our study, i.e., 0.55) and 0.64 for women 70 years or older. The authors concluded that a possible explanation for the findings is that high WHtR can be an independent risk factor, separate from classical cardiometabolic risks.

A strong association between WHtR as a measure of adiposity and cardiometabolic risk factors was reported by Jayawardana et al. [53], corroborated by other studies [10,11,54,55,56] conducted specifically in the elderly population, reporting WHtR cut-off points from 0.50 to 0.60.

Use of the 0.55 cut-off point for WHtR in the diagnosis of overweight should correctly classify 95% to 98% of the elderly (2% to 5% false-negatives) diagnosed with overweight based on BMI, considering, respectively, the cut-off points of > 27kg/m^2 according to Lipschitz [23] and > 25kg/m^2 according to the WHO [25].

The use of more sensitive or specific instruments depends on the target outcome and context in which they are applied. In this sense, in both clinical practice and the epidemiological context, since overweight is an important risk factor that predisposes to the causal chain of non-communicable conditions and diseases, instruments with more sensitive cut-off points allow early identification of individuals at risk, serving as valuable tools for clinical practice and health services administration.

A systematic review [21] aimed at defining the cut-off point for WHtR in diverse populations proposed 0.50 as the best value for both genders, different age groups (children, adolescents, and adults), and different ethnic groups. The authors suggested that a population-based approach to health can be much simpler if the same public health message can be addressed to all population groups. Therefore, considering that the same cut-off point for WHtR found in various populations is close to 0.50, the most appropriate message to the general population would be that a person's waist circumference should be less than half their height [43].

Ashwell [57] proposed WHtR values below 0.50 as low-risk to health, 0.5 to 0.6 as suggestive of risk, and greater than 0.60 as high-risk, and that disease prevention and health recovery measures should be recommend for values above 0.50. The current study found that mean WHtR of 0.60 was indicative of increased risk to health. This could be explained by the high percentages of overweight, assessed by BMI with different classification criteria. Higher mean WHtR values were found in elderly with hypertension and diabetes, diseases in which obesity, and especially abdominal obesity, is a precursor. This corroborates Haun et al. [58], who found WHtR cut-off points of 0.52 for men and 0.53 for women in a sample of young adults and elderly participating in the program entitled Monitoring Cardiovascular Diseases and Diabetes in Brazil (MONIT) in Salvador, Bahia State.

Thus, identification of anthropometric indicators suggestive of risk for chronic diseases in the elderly allows adequately targeting interventions, with great public health benefit, especially considering the possibility of preventing highly prevalent diseases.

One of the study's limitations was that it only measured the elderly's height in the standing position, not confirmed by the so-called knee height technique. Elderly persons' height is known to be potentially underestimated due to the decrease resulting from thoracic kyphosis, scoliosis, osteoporosis, and compression of the intervertebral discs [59], common in aging. The study's strong points feature the use of data from a large recent survey in a representative sample of the elderly Brazilian population, in addition to the methodological quality employed in the study's development, allowing data reliability.

The results suggest the use of WHtR in clinical practice since it is a simple measure, with good predictive power as an anthropometric marker of overweight and a cut-off point very close to the points obtained in diverse populations. Thus, timely studies in Brazil should compare WHtR with different outcomes in both genders and other age groups in order to expand its use in the detection of overweight in the general population and thereby guarantee its use in the safe replacement of BMI.

Contributors

M. M. Corrêa participated in the study design, worked on the data analysis and interpretation, and wrote the article. E. Tomasi and L. A. Fachini contributed in the study design, to the data analysis and interpretation and critical revision, and approved the final version. E. Thumé and E. R, A, Oliveira collaborated in the critical revision and approved the final version.

Acknowledgments

The authors wish to thank the participants of the AQUARES study, funded by the Brazilian Ministry of Health.

References

1. Instituto Brasileiro de Geografia e Estatística. Projeção da população do Brasil por sexo e idade 1980-2050: revisão 2008. Rio de Janeiro: Instituto Brasileiro de Geografia e Estatística; 2008.
2. Organização Mundial da Saúde. Envelhecimento ativo: uma política de saúde. Brasília: Organização Pan-Americana da Saúde; 2005.
3. Santos ACO, Machado MMDO, Leite EM. Envelhecimento e alterações do estado nutricional. Geriatria & Gerontologia 2010; 4:168-75.
4. Chang SH, Beason TS, Hunleth JM, Colditz GA. A systematic review of body fat distribution and mortality in older people. Maturitas 2012; 72:175-91.
5. Willett W. Nutritional epidemiology. 3rd Ed. Oxford: Oxford University Press; 2012.
6. World Health Organization. Physical status: the use of and interpretation of anthropometry. Geneva: World Health Organization; 1995.
7. Leitzmann MF, Moore SC, Koster A, Harris TB, Park Y, Hollenbeck A, et al. Waist circumference as compared with body-mass index in predicting mortality from specific causes. PLoS One 2011; 6:e18582.
8. de Koning L, Merchant AT, Pogue J, Anand SS. Waist circumference and waist-to-hip ratio as predictors of cardiovascular events: meta-regression analysis of prospective studies. Eur Heart J 2007; 28:850-6.
9. Satoh H, Kishi R, Tsutsui H. Body mass index can similarly predict the presence of multiple cardiovascular risk factors in middle-aged Japanese subjects as waist circumference. Intern Med 2010; 49:977-82.
10. Cai L, Liu A, Zhang Y, Wang P. Waist-to-height ratio and cardiovascular risk factors among Chinese adults in Beijing. PLoS One 2013; 8:e69298.
11. Tatsumi Y, Watnabe M, Kokubo Y, Nishimura K, Higashiyama A, Okamura T, et al. Effect of age on the association between waist-to-height ratio and incidence of cardiovascular disease: the suita study. J Epidemiol 2013; 23:351-9.
12. Zhang ZQ. Comparison of various anthropometric and body fat indices in identifying cardiometabolic disturbances in chinese men and women. PLoS One 2013; 8:e70893.
13. Perissinotto E, Pisent C, Sergi G, Grigoletto F. Anthropometric measurements in the elderly: age and gender differences. Br J Nutr 2002; 87:177-86.
14. Schneider HJ, Klotsche J, Silber S, Stalla GK, Wittchen HU. Measuring abdominal obesity: effects of height on distribution of cardiometabolic risk factors risk using waist circumference and waist-to-height ratio. Diabetes Care 2011; 34:e7.
15. Erdreich LS, Lee ET. Use of relative operating characteristic analysis in epidemiology. A method for dealing with subjective judgement. Am J Epidemiol. 1981; 114:649-62.

16. Del Brutto OH, Mera RM; Atahualpa Project Investigators. Indices of abdominal obesity may be better than the BMI to discriminate Latin American natives/mestizos with a poor cardiovascular status. Diabetes Metab Syndr 2014; 8:115-8.
17. Meseri R, Ucku R, Unal B. Waist: height ratio: a superior index in estimating cardiovascular risks in Turkish adults. Public Health Nutr 2014; 17:2246-52.
18. Hsieh SD, Yoshinaga H, Muto T. Waist-to-height ratio, a simple and practical index for assessing central fat distribution and metabolic risk in Japanese men and women. Int J Obes Relat Metab Disord 2003; 27:610-6.
19. Arnaiz P, Grob F, Cavada G, Dominguez A, Bancalari R, Cerda V, et al. Waist-to-height ratio does not change with gender, age and pubertal stage in elementary school children. Rev Med Chil 2014; 142:574-8.
20. Savva SC, Lamnisos D, Kafatos AG. Predicting cardiometabolic risk: waist-to-height ratio or BMI. A meta-analysis. Diabetes Metab Syndr Obes 2013; 6:403-19.
21. Browning LM, Hsieh SD, Ashwell M. A systematic review of waist-to-height ratio as a screening tool for the prediction of cardiovascular disease and diabetes: 0.5 could be a suitable global boundary value. Nutr Res Rev 2010; 23:247-69.
22. Lohman TG, Roche AF, Martorel R. Anthropometric standardization reference manual. Illinois: Human Kinetics Books; 1988.
23. Lipschitz DA. Screening for nutritional status in the elderly. Prim Care 1994; 21:55-67.
24. Hubert HB, Feinleib M, McNamara M, Castelli W. Obesity as an independent risk factor for cardiovascular disease: a 26-year follow-up of participants in the Framingham Heart Study. Circulation 1983; 67:968-76.
25. World Health Organization. Obesity: preventing and managing the global epidemic. Geneva: World Health Organization; 1998. (WHO/NUT/NCD/98.1).
26. Sociedade Brasileira de Hipertensão; Sociedade Brasileira de Cardiologia; Sociedade Brasileira de Nefrologia. VI diretrizes brasileiras de hipertensão arterial. Arq Bras Cardiol 2010; 95:1-51.
27. Craig CL, Marshall AL, Sjostrom M, Bauman AE, Booth ML, Ainsworth BE, et al. International physical activity questionnaire: 12-country reliability and validity. Med Sci Sports Exerc 2003; 35:1381-95.
28. U.S. Department of Health and Human Services. 2008 physical activity guidelines for Americans. Washington DC: U.S. Department of Health and Human Services; 2008.
29. Hanley JA, McNeil BJ. The meaning and use of the area under a receiver operating characteristic (ROC) curve. Radiology 1982; 143:29-36.
30. Malta DC, Andrade SC, Claro RM, Bernal RTI, Monteiro CA. Evolução anual da prevalência de excesso de peso e obesidade em adultos nas capitais dos 26 estados brasileiros e no Distrito Federal entre 2006 e 2012. Rev Bras Epidemiol 2014; 17:267-76.
31. Befort CA, Nazir N, Perri MG. Prevalence of obesity among adults from rural and urban areas of the united states: Findings from NHANES (2005-2008). J Rural Health 2012; 28:392-7.
32. Habib SS. Body mass index and body fat percentage in assessment of obesity prevalence in Saudi adults. Biomed Environ Sci 2013; 26: 94-9.
33. Kümpel DA, Sodré ADC, Pomatti DM, Scortegana HDM, Filippi J, Portella MR, et al. Obesidade em idosos acompanhados pela Estratégia de Saúde da Família. Texto Contexto Enferm 2011; 20:271-7.
34. Silveira EA, Kac G, Barbosa LS. Prevalência e fatores associados à obesidade em idosos residentes em Pelotas, Rio Grande do Sul, Brasil: classificação da obesidade segundo dois pontos de corte do índice de massa corporal. Cad Saúde Pública 2009; 25:1569-77.
35. Popkin BM. Contemporary nutritional transition: determinants of diet and its impact on body composition. Proc Nutr Soc 2011; 70: 82-91.
36. World Health Organization. Obesity: preventing and managing the global epidemic. Geneva: World Health Organization; 2000. (Technical Report Series, 894).
37. Bombelli M, Facchetti R, Sega R, Carugo S, Fodri D, Brambilla G, et al. Impact of body mass index and waist circumference on the long-term risk of diabetes mellitus, hypertension, and cardiac organ damage. Hypertension 2011; 58:1029-35.
38. de Hollander EL, Bemelmans WJ, Boshuizen HC, Friedrich N, Wallaschofski H, Guallar-Castillón P, et al. The association between waist circumference and risk of mortality considering body mass index in 65-to 74-year-olds: a meta-analysis of 29 cohorts involving more than 58,000 elderly persons. Int J Epidemiol 2012; 41:805-17.
39. Scafoglieri A, Provyn S, Bautmans I, Van Roy P, Clarys JP. Direct relationship of body mass index and waist circumference with body tissue distribution in elderly persons. J Nutr Health Aging 2011; 15:924-31.
40. Kanehisa H, Miyatani M, Azuma K, Kuno S, Fukunaga T. Influences of age and sex on abdominal muscle and subcutaneous fat thickness. Eur J Appl Physiol 2004; 91:534-7.
41. Biggs ML, Mukamal KJ, Luchsinger JA, Ix JH, Carnethon MR, Newman AB, et al. Association between adiposity in midlife and older age and risk of diabetes in older adults. JAMA 2010; 303:2504-12.

42. Recio-Rodriguez JI, Gomez-Marcos MA, Patino-Alonso MC, Agudo-Conde C, Rodriguez-Sanches E, Garcia-Ortiz L. Abdominal obesity vs general obesity for identifying arterial stiffness, subclinical atherosclerosis and wave reflection in healthy, diabetics and hypertensive. BMC Cardiovasc Disord 2012; 12:3.
43. Ashwell M, Gunn P, Gibson S. Waist-to-height ratio is a better screening tool than waist circumference and BMI for adult cardiometabolic risk factors: systematic review and meta-analysis. Obes Rev 2012; 13:275-86.
44. Calle EE, Thun MJ, Petrelli JM, Rodriguez C, Weath CW. Body-mass index and mortality in a prospective cohort of U.S. adults. New Engl J Med 1999; 341:1097-105.
45. Stevens J. Impact of age on associations between weight and mortality. Nutr Rev 2000; 25:129-37.
46. Santos DM, Sichieri R. Índice de massa corporal e indicadores antropométricos de adiposidade em idosos. Rev Saúde Pública 2005; 39:163-8.
47. Deurenberg-Yap M, Chew SK, Deurenberg P. Elevated body fat percentage and cardiovascular risks at low body mass index levels among Singaporean Chinese, Malays and Indians. Obes Rev 2002; 3:209-15.
48. Ashwell M, Gibson S. Waist-to-height ratio as an indicator of "early health risk": simpler and more predictive than using a "matrix" based on BMI and waist circumference. BMJ Open 2016; 6:e010159.
49. Ministry of Health. Understanding excess body weight: New Zealand Health Survey. Wellington: Ministry of Health; 2015.
50. Corrêa MM, Thumé E, de Oliveira ER, Tomasi E. Performance of the waist-to-height ratio in identifying obesity and predicting non-communicable diseases in the elderly population: a systematic literature review. Arch Gerontol Geriatr 2016; 31:174-82.
51. Ashwell M, Cole TJ, Dixon AK. Ratio of waist circumference to height is a strong predictor of intra-abdominal fat. BMJ 1996; 313:559-60.
52. Roriz AKC, Passos LCS, de Oliveira CC, Eickemberg M, Moreira RA, Sampaio LR et al. Evaluation of the accuracy of anthropometric clinical indicators of visceral fat in adults and elderly. PLoS One 2014; 9:e10349.
53. Jayawardana R, Ranasinghe P, Sheriff MH, Matthews DR, Katulanda P. Waist to height ratio: a better anthropometric marker of diabetes and cardio-metabolic risks in South Asian adults. Diabetes Res Clin Pract 2013; 99:292-9.
54. Wang J-W, Hu D-Y, Sun Y-H, Wang J-H, Wang G-L, Xie J, et al. Obesity criteria for identifying metabolic risks. Asia Pac J Clin Nutr 2009;18:105-13.
55. Schneider HJ, Glaesmer H, Klotsche J, Bohler S, Lehnert H, Zeiher AM, et al. Accuracy of anthropometric indicators of obesity to predict cardiovascular risk. J Clin Endocrinol Metab 2007; 92:589-94.
56. Zeng Q, He Y, Dong S, Zhao X, Chen Z, Song Z, et al. Optimal cut-off values of BMI, waist circumference and waist: height ratio for defining obesity in Chinese adults. Br J Nutr 2014; 112:1735-44.
57. Ashwell M. Charts based on body mass index and waist-to-height ratio to assess the health risks of obesity: a review. Open Obes J 2011; 3:78-84.
58. Haun DR, Pitanga FJG, Lessa I. Razão cintura/estatura comparado a outros indicadores antropométricos de obesidade como preditor de risco coronariano elevado. Rev Assoc Méd Bras 2009; 55:705-11.
59. Chumlea WC, Baumgartner RN, Vellas BP. Anthropometry and body composition in the perspective of nutritional status in the elderly. Nutrition 1991; 7:57-60.

Resumo

O objetivo deste estudo foi identificar o ponto de corte da razão cintura-estatura (RCE) com melhor sensibilidade, especificidade e acurácia para a população idosa brasileira utilizando o índice de massa corporal (IMC) como referência antropométrica. A amostra representativa da população brasileira foi composta por 5.428 indivíduos idosos, participantes de um inquérito epidemiológico. As variáveis avaliadas foram peso, altura e circunferência da cintura (CC). A RCE foi avaliada tendo como padrão-ouro o IMC utilizando duas propostas de classificação do estado nutricional para a população idosa. O ponto de corte ideal da RCE mostrando simultaneamente a mais alta sensibilidade e especificidade foi determinado utilizando a curva ROC (receiver operating characteristic). Sensibilidade entre 94,9% e 98,4%, especificidade variando de 43% a 55,4% e valores da área sob a curva ROC entre 0, 878 e 0,883 foram identificados para o ponto de corte de 0,55. Recomenda-se a utilização da RCE na prática clínica por sua simplicidade e pelo bom poder de detecção de excesso de peso em idosos.

Sobrepeso; Idoso; Índice de Massa Corporal; Razão Cintura-Estatura

Resumen

El objetivo de este estudio fue identificar el punto de corte de la razón cintura-estatura (RCE) con mejor sensibilidad, especificidad y precisión para la población anciana brasileña, utilizando el índice de masa corporal (IMC) como referencia antropométrica. La muestra representativa de la población brasileña estuvo compuesta por 5.428 individuos ancianos, participantes en una encuesta epidemiológica. Las variables evaluadas fueron peso, altura y circunferencia de la cintura (CC). La RCE se evaluó teniendo como patrón-oro el IMC, utilizando dos propuestas de clasificación del estado nutricional para la población anciana. El punto de corte ideal de la RCE, mostrando simultáneamente la más alta sensibilidad y especificidad, fue determinado utilizando la curva ROC (receiver operating characteristic). Sensibilidad entre 94,9% y 98,4%, especificidad variando de 43% a 55,4% y valores del área bajo la curva ROC entre 0,878 y 0,883 fueron identificados para el punto de corte de 0,55. Se recomienda la utilización de la RCE en la práctica clínica por su simplicidad y por el buen poder de detección de exceso de peso en ancianos.

Sobrepeso; Anciano; Índice de Masa Corporal; Relación Cintura-Estatura

Submitted on 27/Nov/2015
Final version resubmitted on 04/Jul/2016
Approved on 18/Jul/2016