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Waist-to-height ratio and the conicity index are associated to cardiometabolic risk factors in the elderly population

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Abstract *The purpose of this study was to determine and compare a magnitude of the association between anthropometric indicators with risk of cardiometabolic risk in the elderly. This is a cross-sectional study with 402 elderly people attended by the Family Health Strategy in the city of Viçosa-MG. Risk factors for excess body fat, hypertension, blood glucose and serum lipid changes. An association between conicity index (CI) and waist-to-height ratio (WtHR) with cardiometabolic risk factors was assessed by multiple linear regression analysis. Sample was composed of 60.4% of women and 36.3% of overweight elderly. The connectivity index and a waist-to-height ratio were higher in 57.2% and 88.1% in the elderly, respectively. The results showed that the increase in body fat, diastolic blood pressure, triglycerides, glycemia and reduction of HDL-cholesterol are related to higher values of anthropometric indices evaluated. However, the waist-to-height ratio presented a greater magnitude of association with the cardiometabolic risk factors than the connectivity index.*

Key words *Elderly, Anthropometry, Waist-height ratio, Risk factors*

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Introduction

The elderly population growth is a worldwide event and has been accelerated in Brazil[1]. The enlargement of the top of the Brazilian age pyramid is observed by the growth of the population aged 60 and over, which should expand from 13.8% in 2020 to 33.7% in 2060[2].

The occurrence of chronic noncommunicable diseases has increased parallel to the elderly population increase and is largely attributed to the significant overweight and obesity prevalence in this population[3]. These diseases are associated with high morbidity and mortality and high socioeconomic cost[4].

Excessive fat concentration in the abdominal region is related to a higher incidence of metabolic alterations, particularly cardiovascular diseases[5], and anthropometric indicators of abdominal obesity can predict morbidity and mortality for these diseases[6,7]. Body composition and fat distribution evaluations have gained more importance in clinical practice in addition to epidemiological studies because central adiposity is a predictor of cardiovascular diseases independently from other risk factors. These high fat concentrates in the abdominal region have been linked to metabolic and cardiovascular alterations regardless of age[8].

Imaging exams, such as computed tomography, best perform visceral fat measurements, however, they present high cost and exposure to radiation and require specialized operation[8]. Simple measurements such as weight, height and perimeters, present the advantages of simplicity, speed and affordable cost and can be employed for any age group[9].

The Conicity Index (CI) was proposed in the early 1990s to evaluate obesity and body fat distribution and associate central obesity to cardiovascular diseases. The parameters used were weight, height and waist circumference, and they were based on the development of the double-cone body shape with fat accumulation around the waist[10].

The waist-to-height ratio (WtHR) has an advantage over the isolated waist circumference (WC) since it presents direct height regulation and allows a single cut-off point regardless of gender and ethnicity[11,12].

CI and WtHR are recognized as good central obesity indicators and have been studied as cardiometabolic risk factors in different age groups[8,13,14]. Few studies are currently available with samples exclusively elderly and divided by sex to accurately assess the association between the indicators of cardiometabolic risk.

In studies with the elderly population, easy methodologies that display the magnitude of cardiometabolic risk factors are important during early treatment in order to effectively plan interventions, minimizing obesity aggravations and promoting health and life quality. The objective of this study was to determine and compare the magnitude of the association between CI and WtHR with cardiometabolic risk factors in the elderly population part of the Family Health Strategy in the city of Viçosa-MG.

Methodology

This work is part of an epidemiological study called "Epidemiological study of the functional capacity in elderly patients with metabolic syndrome". This is a cross-sectional study conducted with 402 elderly individuals from 60 to 95 years old, of both sexes, and attending the Family Health Strategy (*Estratégias Saúde da Família* - ESF) in Viçosa-MG. The individuals were randomly selected from the total population database served for ESF from August 2011 to June 2012. In Viçosa, there are 15 ESF units that serve 60.3% of the elderly population, covering urban and rural areas, totaling 6,298 elderly people.

The sample size was calculated for the matrix study under a 65% prevalence for metabolic syndrome[15], 95% confidence level, and a 5% tolerated error. The estimated sample was 331 elderly, which added 20% to possible losses, totaling 398 elderly. In this study, the total sample consisted of 402 elderly people. Sample size calculation was performed on the Stat Calc Epi-Info (version 3.5.1 - Centers for Disease Control and Prevention, Atlanta, USA).

Data collection was performed at two ESF meetings. During the first meeting, the elderly received information about the study objectives and signed the consent form. During the second meeting, we performed anthropometric evaluation and arterial blood pressure measurement.

Anthropometric evaluations measured weight, height, waist circumference (WC) and hip circumference (HC) according to recommended protocols[16]. The participating elderly were weighed on a digital electronic scale (Kratos® - Linea model - São Paulo-SP, Brazil) with a capacity of 200 kg and a sensitivity of 100g, and the patients wore light clothing (previously

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oriented) without any coat, shoes or accessories. Their height was obtained using a portable vertical anthropometer (Welmy® - Santa Barbara d'Oeste, Brazil) with an extension of 2.2 m, divided in centimeters and subdivided in millimeters. BMI was obtained from the weight (kg) to squared height (m²) ratio and classified according to the recommendation of the Pan American Health Organization (PAHO)[17]. The waist (WC) and hip (HC) circumference evaluations were performed using an inelastic tape measure (Cardiomed®, Brazil), with the WC done above the umbilical scar and both measurements with three repetitions.

From the anthropometric measurements, the waist-to-hip ratio (WHR), WtHR and CI were also calculated. The CI was determined based on weight, height and waist circumference, using the mathematical equation proposed by Valdez[10].

CI cut-off point was 1.25 for men[13,18] and 1.36 for women[19]. For the WtHR, the 0.5 cut-off point represented the best balance between sensitivity and specificity, indicating an WtHR greater or equal to this value related to a higher cardiovascular risk[11].

The resting blood pressure was measured by the indirect auscultatory method, which used a stethoscope and a mercury sphygmomanometer (Tycos1, Model EC 048). The guidelines were followed according to the VI Brazilian Guideline for Hypertension[20].

At the second meeting, we performed tetrapolar bioimpedance (BIA)[21] to analyze the body fat percentage and the blood collection. The body composition was analyzed by means of the biodynamics® bi-metallic electrical impedance to obtain the percentage of body fat (% BF). The cut-off point was 35% for females and 25% for males, both suggested as a risk factor for adiposity[22].

For the biochemical evaluation, 5 mL of venous blood were collected after 12-hours of fasting to evaluate serum concentrations of glucose, total cholesterol, Low Density Lipoprotein (LDL), High Density Lipoprotein (HDL), and triglycerides.

The research project was approved by the Human Research Ethics Committee of the Federal University of Viçosa (opinion no. 039/2011) and fully complied within the norms for research involving human beings, resolution 196/96 of the National Health Council and the Helsinki Declaration.

The elderly received a report with their data and orientation on the results. Participants at risk were referred to the Municipal Program for the Elderly and/or Family Health Strategy, where they received medical and nutritional support.

Data were analyzed in STATA software, version 9.1 (Stata Corp., College Station, United States). Descriptive analysis was stratified by sex. Frequencies, averages and standard deviation data were presented. Variable normality was assessed by the Shapiro-wilk test. The variables WHR, BF, SBP, HDL, LDL and TG were not normal distributions and were transformed into log for comparison analysis of means since WtHR and CI were transformed into log for regression analysis. Student's t-test was used to compare the means of demographic, anthropometric, body composition, clinical and biochemical variables, waist-to-height ratio and conicity index according to sex. The association between CI and WtHR with independent variables was assessed by multiple linear regression analysis. Only variables associated to CI and WtHR at a level of significance lower than 0.20 in the bivariate linear regression analysis were included in the final model. The final model was performed through the stepwise-forward regression, where the variables enter one by one in the final equation. The significance of the final model was evaluated by the F test of the variance analysis and the adjustment by the coefficient of determination. The premises of linearity and absence of aberrant observations were met. The residues were evaluated according to the assumptions of normality, homoscedasticity, linearity and independence. In addition, the multicollinearity verification was performed among the variables included in the model. The level of significance considered was $\alpha = 5\%$.

Results

The sample consisted of 402 elderly, 60.4% female. Most of the elderly were between 70 and 79 years old (44.8%). There was a high prevalence of risk factors such as elevated WtHR (88.1%), high CI (57.2%), excess weight (36.3%), high waist circumference (72.4%), hypertension (71.4%), hypercholesterolemia (87.8%), low HDL (54.0%), high LDL (75.1%), %) and hypertriglyceridemia (33.3%).

Most of the risk factors assessed individuals presented differences between the groups, with no statistical difference between men and women for the variables: WHR, systolic blood pressure (SBP), glycemia, total cholesterol (TC), LDL and triglycerides (TG) (Table 1).

Table 2 compares age, anthropometric, clinical and biochemical indicators according to the waist-to-height ratio (WtHR) cut-off point for cardiovascular risk. Regarding anthropometry, elderly men and women with WtHR at risk for metabolic alterations (WtHR $\geq$ 0.50) presented statistically significant means for BMI, HC, WHR,%BF and CI. Similarly, biochemical tests showed lower mean values only for HDL ($p < 0.01$) and higher values for triglycerides ($p < 0.05$) in both sexes and for glycemia (p = 0, 01) in the male sex.

Table 3 compared the means for age as well as anthropometric, clinical and biochemical indicators according to the conicity index (CI) concerning cardiovascular risk. Anthropometric data indicated significant mean values for BMI, HC, WHR, %BF and WtHR ($p < 0.05$) in the elderly population assessed for both sexes, with CI at risk of metabolic alterations.

Biochemical indicators did not present statistical significance, except for triglyceride in men from the high-risk group for metabolic alterations according to CI. There was no statistical difference in SBP and diastolic blood pressure (DBP) among the elderly for both sexes according to WtHR and CI (Tables 2 and 3).

In the bivariate linear regression analysis, the variables associated to CI were BF, TG, HDL, glycemia and age, while LDL was only associated in males. For the WtHR, the variables associated to bivariate linear regression were BF, DBP, TG, HDL and glycemia, whereas LDL was only associated in males and SBP only in females. In the final model, HDL was excluded from all models except for WtHR in men, glycemia was excluded for women in both the WtHR and CI models, DBP was excluded from the male WtHR model, and LDL did not remain in any of the models. After the multivariate analysis, cardiometabolic risk factors, body fat, TG, HDL, DBP and glycemia were independently correlatedto the anthropometric indexes WtHR and/or CI (Table 4).

Figure 1 shows the positive relationship between the anthropometric indicators and the number of cardiometabolic risk factors. We also observed the following pattern: the higher the CI and RCE values the higher the number of associated risk factors in the elderly.

Discussion

The elderly population in the city of Viçosa presented a high prevalence of cardiometabolic risk factors, being associated with anthropometric indicators (CI and WtHR). The results demonstrated that the risk factors were independently associated with WtHR and CI in the elderly population.

The current demographic and epidemiological transition speed in Brazil in the last decades has imposed new challenges for society, especially for health system managers and researchers, in view of the impact this transition has on public health[23].

BMI is a nutritional status measurement useful for population studies, however, it does not evaluate body fat distribution. For this assessment, central obesity measurements must be evaluated to obtain additional information on the nature of obesity[16].

The current research observed that women presented higher anthropometric measurements and body composition values. The mean values for HDL-cholesterol were lower among men than women. However, men had statistically higher DBP mean values. Women presented higher mean values for WC, CI and WtHR than men, suggesting a greater amount of intra-abdominal adipose tissue.

Based on the results of the multiple regression analysis, in our study, body fat, TG, HDL, DBP, glycemia and age were associated to WtHR and CI. In men, body fat presented the most significant association to both CI and WtHR (α = 0.0032 and 0.0048, respectively). Age was also important in the CI model (α= 0, 0016) since TG and glycemia were the factors of smallest magnitude in both models. In women, body fat was also the most expressive association factor for both models, especially for WtHR (α= 0.0023 and 0.0080), and age and TG in the CI model had the same magnitude of association as in men.Finally, in the WtHR model, although not associated with TG and glycemia, there was a positive association with DBP (α= 0.0018) and inversion with HDL (α= -0,0016).

Therefore, in determining and comparing the magnitude of the association between CI and WtHR with cardiometabolic risk factors, WtHR seems to be a better predictor than CI when body fat is the associated variable for both sexes. In addition, among women, WtHR is associated to DBP and HDL.

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Table 1. Anthropometric, clinical and biochemical evaluation of the elderly according to sex, attended in the Family Health Strategy of Viçosa - MG.

Variables	Men (n = 159) Mean (SD)	Women (n = 243) Mean (SD)	P value*
Age (years)	71,2 (7,04)	72,8 (7,03)	0,02
BMI (Kg/m2)	25,35 (4,13)	27,60 (4,62)	<0,001
WC (cm)	92,30 (11,42)	95,55 (11,48)	<0,01
HC (cm)	94,55 (6,89)	98,02 (8,95)	<0,001
WHR	0,97 (0,076)	0,96 (0,09)	0,19
BF (%)	33,40 (7,43)	40,92 (6,42)	<0,001
CI	1,30 (0,08)	1,34 (0,12)	<0,01
WtHR	0,56 (0,07)	0,63 (0,08)	<0,001
SBP (mmHg)	139,28 (23,39)	140,04 (22,84)	0,74
DBP (mmHg)	84,09 (12,54)	80,92 (12,17)	0,01
Glycemia (mg/dL)	117,95 (35,62)	113,28 (35,23)	0,21
TC (mg/dL)	195,09 (43,57)	196,13 (51,51)	0,84
HDL (mg/dL)	41,62 (14,44)	48,47 (17,43)	< 0,001
LDL (mg/dL)	128,48 (40,38)	123,51 (44,92)	0,28
TG (mg/dL)	127,33 (74,97)	131,60 (62,19)	0,55

*Test t de Student. SD: standard deviation; BMI: Body Mass Index; WC: Waist Circumference; HC:HipCircumference; WHR:waist-to-hip ratio; BF: Body Fat; CI: Conicity Index; WtHR: Waist-to-Height Ratio; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; TC:total cholesterol; HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein; TG: Triglycerides.

Table 2. Comparison of the anthropometric, clinical and biochemical indicators of the elderly according to the waist-to-height ratio(WtHR) and sex, attended in the Family Health Strategy of Viçosa - MG.

Variables	Men (n = 159)		P value*	Women(n = 243)		P value*
	WtHR < 0,50 (n = 40)	WtHR ≥ 0,50 (n = 119)		WtHR < 0,50 (n = 8)	WtHR ≥ 0,50 (n = 235)	
Age (years)	70,1 (6,64)	71,6 (7,15)	0,23	73 (9,07)	72,8 (6,98)	0,95
BMI (Kg/m2)	20,90 (2,0)	26,80 (3,50)	<0,001	20,50 (3,10)	27,80 (4,5)	< 0,001
HC (cm)	88,40 (5,17)	96,61 (6,15)	<0,001	86,91 (9,43)	98,40 (8,71)	< 0,001
WHR	0,88 (0,04)	1,0 (0,06)	<0,001	0,82 (0,07)	0,96 (0,09)	< 0,001
BF (%)	31,10 (9,28)	34,17 (6,56)	0,03	30,20 (2,31)	41,20 (6,25)	< 0,001
CI	1,21 (0,06)	1,33 (0,06)	<0,001	1,17 (0,07)	1,34 (0,11)	< 0,001
SBP (mmHg)	135,95 (24,22)	140,4 (23,10)	0,29	137,5 (22,52)	140,12 (22,90)	0,75
DBP (mmHg)	82,61 (12,62)	84,56 (12,53)	0,41	80,62 (15,68)	80,93 (12,08)	0,94
Glycemia (mg/dL)	105,63 (17,94)	121,99 (38,95)	0,01	86,14 (13,08)	113,68 (35,5)	0,27
TC (mg/dL)	190,85 (47,68)	196,48 (42,27)	0,49	206,97 (72,73)	195,83 (50,99)	0,60
HDL (mg/dL)	45,19 (10,39)	38,83 (11,88)	<0,01	57,35 (16,39)	46,74 (11,52)	< 0,01
LDL (mg/dL)	124,15 (37,01)	128,74 (39,97)	0,54	103,19 (27,76)	123,83 (43,39)	0,24
TG (mg/dL)	84,61 (42,03)	141,32 (78,16)	<0,001	76,08 (22,53)	133,18 (62,25)	0,02

* Test T de Student. Variables presented on mean (± standard deviation).WtHR: Waist-to-Height Ratio;BMI: Body Mass Index; HC: Hip Circumference; WHR: waist-to-hip ratio; BF: Body Fat; CI: Conicity Index; SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; TC: total cholesterol; HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein; TG: Triglycerides.

WtHR ≥ 0,50 corresponds to a higher cardiovascular risk.

These results differ from the literature data available because they comprise a sample exclusively elderly and associate the risk factors separately. Past studies have usually used predefined cardiovascular risk scales or categorizations such as the relationship between triglycerides and HDL for evaluation of high cardiovascular risk, occurrence of metabolic syndrome and coronary risk determined by the Framingham cohort[14,24,25].

The waist-to-height ratio ≥ 0.5 may be a simple and effective index to identify greater metabolic risk[26]. Waist circumference values smaller

Table 3. Comparison of the anthropometric, clinical and biochemical indicators of the elderly according to the conicity index (CI) and sex, attended in the Family Health Strategy of Viçosa - MG.

Variables	Men (n = 159)		P value*	Mulheres (n=243)		P value*
	CI< 1,25 (n = 39)	CI ≥ 1,25 (n = 120)		CI< 1,36 (n = 133)	CI ≥ 1,36 (n = 110)	
Age (years)	69,9 (6,04)	72,0 (7,2)	0,01	72,2 (7,5)	76,7 (6,4)	0,09
BMI (Kg/m2)	22,6 (3,0)	26,2 (4,1)	< 0,001	26,6 (4,3)	28,90 (4,6)	< 0,001
HC (cm)	90 (5,6)	96,1 (6,6)	< 0,001	95,8 (8,3)	100,7 (8,9)	< 0,001
WHR	0,9 (0,05)	1,0 (0,06)	< 0,001	0,91 (0,09)	1,01 (0,07)	< 0,001
BF (%)	28,7 (6,7)	34,9 (7,05)	< 0,001	39,7 (6,5)	42,4 (6,0)	< 0,01
WtHR	0,48 (0,04)	0,58 (0,06)	< 0,001	0,58 (0,06)	0,67 (0,06)	< 0,001
SBP (mmHg)	140,5 (23,1)	138,9 (23,6)	0,71	139 (21,7)	142,4 (24,2)	0,41
DBP (mmHg)	84,5 (12,3)	83,9 (12,6)	0,80	80,8 (12,0)	81,0 (12,4)	0,88
Glycemia (mg/dL)	110,7 (24,2)	120,2 (38,3)	0,16	111,5 (35,1)	115,6 (35,5)	0,39
TC (mg/dL)	188,1 (44,5)	197,3 (43,2)	0,27	197,2 (47,6)	194,6 (48,7)	0,69
HDL (mg/dL)	43,6 (9,8)	39,4 (12,2)	0,06	47,9 (11,8)	45,7 (11,4)	0,16
LDL (mg/dL)	124,4 (34,3)	126,7 (36,7)	0,74	125,6 (39,6)	125 (41,6)	0,91
TG (mg/dL)	87,6 (45,2)	139,9 (78,2)	< 0,001	126,5 (58,4)	138,1 (66,4)	0,17

* Test T de Student. Variables presented on mean (± standard deviation).CI: Conicity Index;BMI: Body Mass Index; HC: Hip Circumference; WHR: waist-to-hip ratio; BF: Body Fat; WtHR: Waist-to-Height Ratio;SBP: Systolic Blood Pressure; DBP: Diastolic Blood Pressure; TC: total cholesterol; HDL: High Density Lipoprotein; LDL: Low Density Lipoprotein; TG: Triglycerides.

CI ≥ 1,25 and 1,36correspond to higher cardiovascular risk for men and women, respectively.

Table 4. Factors associated with the development of cardiovascular diseases, according to the conicity index (CI) and waist-to-height ratio (WtHR) in the elderly in Viçosa - MG.

Variables	Men			Women		
	β	CI(95%)	P value	β	CI (95%)	P value
IC						
Gordura corporal	0,0032	0,0019 - 0,0045	< 0,001	0,0023	0,0009 - 0,0036	0,001
Triglicerídeos	0,0002	0,0001 - 0,0003	0,001	0,0002	0,0001 - 0,0003	0,008
Glicemia	0,0004	0,0001 - 0,0006	0,007		-	
Idade	0,0016	0,0002 - 0,0030	0,021	0,0016	0,0004 - 0,0029	0,010
RCE†						
Gordura corporal	0,0048	0,0024 - 0,0072	< 0,001	0,0080	0,0057 - 0,0104	< 0,001
Triglicerídeos	0,0006	0,0003 - 0,0008	< 0,001		-	
Glicemia	0,0007	0,0002 - 0,0012	0,008		-	
PAD		-		0,0018	0,0004 a 0,0032	0,010
HDL		-		-0,0016	-0,0029 a -0,0002	0,023

PAD: Pressão arterial diastólica; HDL: High Density Lipoprotein. † Modelo ajustado por idade.

than the half-height value aid in the prevention of cardiovascular risk[12]. The execution simplicity of the WtHR alongside the simplicity of a single cut-off point make this indicator a practical tool for monitoring abdominal adiposity in the population[11]. In this sense, the results of the multivariate analysis of this study present WtHR as a predictor of cardiometabolic risk factors also in the elderly of Viçosa.

A study with a 15- to 74-year-old Iranian population showed that the WtHR was one of the anthropometric indicators to best identify cardiovascular risk factors in men, and a highly significant association was found with serum lipids, especially HDL and triglycerides. WtHR was also a significant predictor for hyperglycemia[27]. In the present study, the values of TG and glycemia were associated with WtHR in males and inversely associated with HDL in females. Another study with elderly men showed correlation of WtHR with HDL, triglycerides and SBP[28].

The WtHR and BMI are the indicators more associated to metabolic syndrome in Brazilian elderly than WHR, CI and WC[29]. In a similar way,

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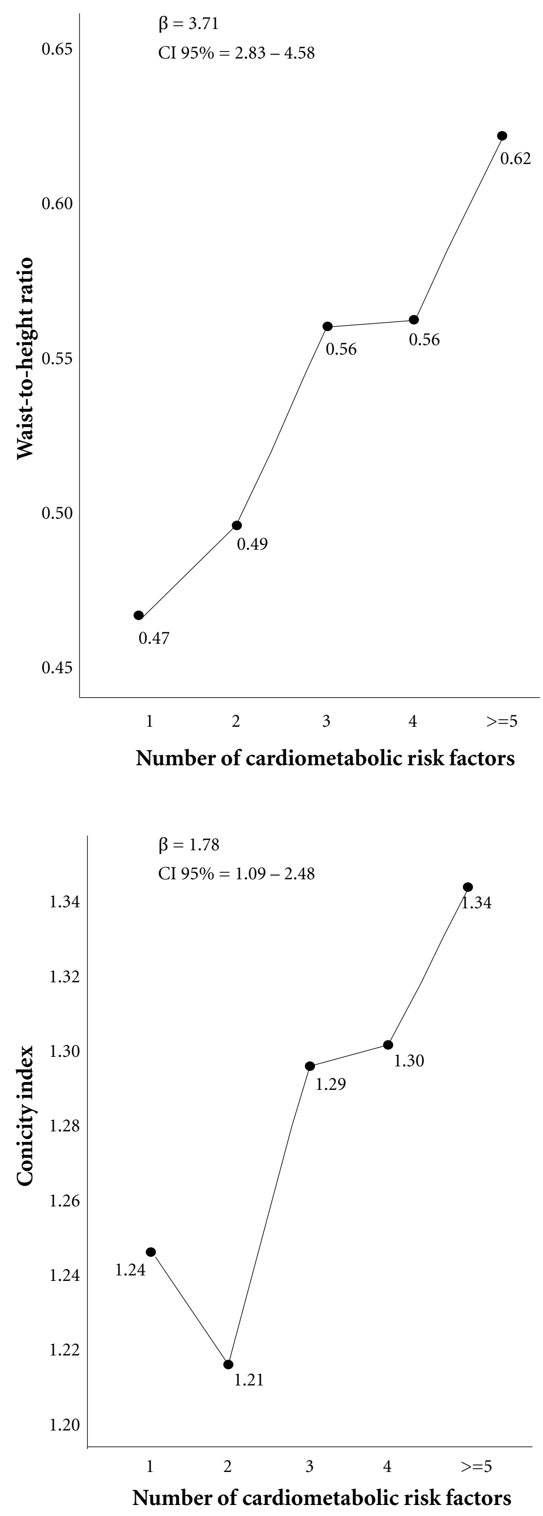

Figure 1. Association of the conicity index and waist-to-height ratio with the number of cardiometabolic risk factors in the elderly in Viçosa.

CI 95%: confidence interval of 95%

we found such positive association for WtHR with the number of cardiometabolic risk factors, but CI was also associated to these factors, though more discreetly.

Studies have been conducted with WtHR to identify high coronary risk as well as to discriminate cardiovascular diseases[12,25]. According to a systematic review, WtHR was better in predicting cardiovascular disease than WC and BMI in 86% of the assessed men and 91% in women[30]. Our research with an exclusively elderly population complements the investigations by amplifying the studied age range.

Study comparison is somewhat limited because of different cut-off points and age range which highly influence the result interpretation. For example, in a study with adult and elderly women, WtHR was better than CI only in older women, suggesting that the population over 60 years of age should be analyzed in part because of the physiological alterations of aging[8]. Corroborating with these data, the magnitude of association of the WtHR with the cardiometabolic risk factors was higher than the CI in the elderly population for both sexes.

In this study, the CI was less efficient in predicting cardiometabolic risk factors than the WtHR, with a lower magnitude of association. On the other hand, studies have evaluated positively the use of CI. In a systematic review, Pinheiro-DaCunha[31] concluded that most studies consistently used CI and advocated its use as an anthropometric indicator of central obesity and coronary disease risk. In a study with adults and elderly, CI was able to detect most cases of visceral obesity in men than in women in both age groups[8]. Some studies have shown that CI is also a good predictor of high coronary risk and cardiovascular risk, as well as WtHR[32-34].

A study carried out in Bahia with 270 women between the ages of 30 and 69 found anthropometric indicators of abdominal obesity to present similar performance in discriminating high coronary risk, however, CI was the indicator with the best discriminatory power[35]. According to a study by Pitanga and Lessa[36] conducted in the city of Salvador with 968 adults and elderly individuals from 30 to 74 years of age, CI better discriminated high coronary risk, followed by waist to hip ratio. And in southern Brazil, a study recommended the use of BMI and WC combined with CI as an excellent diagnostic power to determine health risk in relation to body fat accumulation[37].

High CI was also related to a greater chance of developing cardiovascular diseases in a female population from 30 to 74 years of age[24]. Another study with a group of 113 elderly women aged 60-83 in the city of Viçosa-MG found CI and WtHR to be correlated with fasting glycemia, triglycerides and HDL. We found an independent, although discrete, association of TG with CI in both sexes and with glycemia in males.

The association found among the anthropometric indicators of central obesity (CI and WtHR) and serum lipids in the elderly is justified by other studies, one of which evaluated 1,213 Brazilian adults. This study assessed the main dyslipidemias associated to central obesity and correlated them to a significant increase in levels of triglycerides and/or a decrease in the levels of HDL-cholesterol[38], precisely the result we found, positive association with TG and inverse with HDL. Similarly, Hu et al.[39], studying a sample of American Indians, found that the main lipid abnormalities related to obesity were HDL-cholesterol reduction and triglycerides increase, especially in men. These authors also observed that central adiposity was significantly associated to abnormal lipid profiles. TG and HDL association to abdominal adiposity was also similar to the results found by other researchers[40,41].

The absence of a gold standard for nutritional disorder diagnosis in the elderly population reveals that the nutritional evaluation of this group can be accomplished by associating different indicators as their individual limitations can be overcome through their joint use[42]. Visceral adiposity can be highly discriminated by both anthropometric indicators, CI and WtHR, and is considered a major cardiovascular risk factor because it is associated with hypertriglyceridemia, a decrease in HDL and an increase in LDL, which increases atherogenic risk[8].

As a limitation of this study, we can cite the absence of well-established cut-off points for CI by age and according to sex for the elderly population, which challenges the use of this criterion for comparison. In our study, we used the cut-off point of a similar population, adopting for women a proposal for elderly women from the same city[19] and for men the cut-off point proposed by several authors for adult and elderlypopulations[13,18].

The diversity of anthropometric indicators to estimate obesity contributes to a criteria choice that considers the population studied, sex, age and the objective of the evaluation. In addition, it is important to consider the availability and feasibility of the measurement instruments[35].

This research contributes to emphasize the risks of obesity and points out the association of anthropometric indicators, in addition to predicting obesity, with cardiometabolic risk factors. Abdominal obesity generates damage to individual health and high social cost, and therefore, early diagnosis is essential for nutritional surveillance measures.

Conclusion

Considering that excess fat in the abdominal region is associated with the appearance of cardiovascular diseases, the definition of simple performance indicators allows the detection of individuals at risk. Preventing a disease means a gain in quality of life, especially for the elderly, and for this it is necessary to observe the risk factors and control them.

In conclusion, cardiometabolic risk factors such as BF, TG, HDL, glycemia and DBP were independently associated with WtHR and CI in the elderly population assessed. However, the WtHR presented a greater magnitude of association with cardiometabolic risk factors than CI, besides having an association with DBP and HDL in women. The CI association to the variables assessed were more discrete for both sexes.

These indices may be useful as tools for monitoring risk factors in the population and may help health professionals when resources for routine biochemical evaluation are scarce and sophisticated equipment for body composition analysis are not present.

The anthropometric indicators analyzed presented satisfactory performances to discriminate some risk factors in the elderly. We hope these results contribute to abdominal obesity and its associated factors evaluation in this population, providing information for health professionals to act in the prevention of this multifactorial condition, avoiding its consequences.

However, it is valid to recognize that other variables should be considered during the evaluations, such as the use of medications, pathologies, lifestyle, socioeconomic conditions and dietary habits, because they are strongly associated with metabolic alterations.

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Collaborations

LC Milagres worked on data research, methodology, analysis and interpretation; KO Martinho worked on research, methodology, data delineation, analysis and interpretation; DC Milagres contributed in the interpretation, in the discussion of the data and in the revision of the article; FS Franco worked on research and contributed in the interpretation, data discussion and article revision; AQ Ribeiro participated in the design, coordination and orientation of the study, analysis and discussion of the data and the final revision of the article; JF Novaes participated in the design, orientation of the study, discussion of the data and the final revision of the article.

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