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Anthropometry for the assessment of abdominal obesity and coronary risk

Antropometria na avaliação da obesidade abdominal e risco coronariano

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Abstract – The incidence of diabetes, atherosclerosis and sudden cardiac death is high among obese individuals, with significant metabolic and cardiovascular adverse effects being observed when obesity is centered in the abdominal region. The objective of this study was to determine which of the anthropometric indicators of abdominal obesity commonly used show the highest predictive power to discriminate a high coronary risk (HCR) and to propose cut-off values for their use in clinical practice and in population studies on Brazilian adults. The studies published by the research group on non-transmissible chronic diseases of the Public Health Institute (PHI), Federal University of Bahia (UFBA), that compare different anthropometric indicators as predictors of HCR were analyzed. The evidence provided by the studies analyzed suggests the use of the conicity index for the evaluation of abdominal obesity in clinical practice, with cut-off values of 1.25 for men and of 1.18 and 1.22 for women ≤ 49 years and > 50 years, respectively. The waist-height ratio should be used in population studies, with the recommendation that waist should not exceed half the height of a particular subject.

Key words: Abdominal obesity; Anthropometric indicators; Coronary risk.

Resumo – *A incidência de diabetes, aterosclerose e morte cardíaca súbita é bastante frequente em pessoas obesas, porém quando a obesidade está centralizada na região abdominal as repercussões negativas, tanto de ordem metabólica quanto cardiovascular são mais significativas. O objetivo do estudo foi analisar e comparar entre os indicadores antropométricos de obesidade abdominal mais utilizados, quais deles apresentam maior poder preditivo para discriminar risco coronariano elevado (RCE) e propor pontos de corte para sua utilização na prática clínica e populacional em adultos brasileiros. Foram analisados os manuscritos publicados pelo grupo de pesquisa em doenças crônicas não transmissíveis do Instituto de Saúde Coletiva (ISC) da Universidade Federal da Bahia (UFBA) que compararam diversos indicadores antropométricos como preditores de RCE. As evidências com base nos estudos analisados permitem sugerir para avaliação da obesidade abdominal: na prática clínica, utilizar o índice de conicidade (Índice C) com os pontos de corte de 1,25 para homens, 1,18 e 1,22 para mulheres até 49 anos e a partir de 50 anos de idade, respectivamente; em estudos populacionais, utilizar a razão cintura-estatura (RCest) com a mensagem de que a cintura não deve ser maior que a metade da estatura de determinada pessoa.*

Palavras-chave: *Obesidade abdominal; Indicadores antropométricos, Risco coronariano.*

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INTRODUCTION

At present, one issue that raises interest in studies on obesity is the distribution of fat in the body. The incidence of diabetes, atherosclerosis and sudden cardiac death is high among obese individuals, but metabolic and cardiovascular adverse effects are even more significant when obesity is centered around the abdomen[1]. In 1956, Vague[2] developed an index of masculine differentiation that was used to classify fatness into (a) android fat, which is concentrated in the central region and is more common in men, and (b) gynoid fat, which is concentrated in the hips and thighs and is more common in women.

Abdominal obesity can be evaluated by computed tomography, nuclear magnetic resonance imaging and different anthropometric indexes such as waist circumference (WC), waist-to-hip ratio (WHR), conicity (CI) index, and waist--to-height ratio (WHtR). Although computed tomography is the most precise method for the evaluation of abdominal fat, few population studies using this method have been conducted because of its high operational cost. Therefore, anthropometric indicators seem to be a good alternative for the diagnosis of abdominal obesity.

In the 1980s, Larsson et al.[3] correlated WHR with an increased risk of myocardial infarction, stroke, and premature death, with the observation of a strong association between these variables. In contrast to the concepts of that time, the highest risk of myocardial infarction or premature death was found in men with a high WHR and low body mass index (BMI), suggesting that individuals with a concentration of body fat in the abdomen are at high risk of developing cardiovascular diseases Subsequently, WC started to be used for the assessment of abdominal obesity, showing a strong association with abdominal visceral adipose tissue accumulation[4].

In the 1990s, Valdez[5] proposed the CI index as a model to evaluate the distribution of body fat. This index uses body weight, height and WC as variables and is based on the idea that the body of subjects who accumulate fat around the central region of the trunk resembles a double cone, i.e., two cones with a common base, whereas the body of subjects with lower amounts of central fat has the shape of a cylinder. The CI index is calculated using the following equation:

$$\text{CI index} = \frac{\text{Waist circumference (m)}}{0.109\sqrt{\frac{\text{Body weight (kg)}}{\text{Height (m)}}}}$$

After 2000, WHtR has been shown to be strongly associated with different cardiovascular risk factors. In addition, a study conducted in Taiwan identified the most adequate cut-off values of this anthropometric indicator of abdominal obesity based on receiver operating characteristics (ROC) curves to discriminate coronary risk, and suggested the use of these values in population studies[6] The objective of this Point of View was to determine which of the commonly used anthropometric indicators of abdominal obesity show the highest predictive power to discriminate a high coronary risk (HCR), and to propose cut-off values for their use in clinical practice and in population studies on Brazilian adults.

SCIENTIFIC EVIDENCE PRODUCED BY THE RESEARCH GROUP ON NON-TRANSMISSIBLE CHRONIC DISEASES OF THE INSTITUTE OF COLLECTIVE HEALTH (ISC), FEDERAL UNIVERSITY OF BAHIA (UFBA)

One of the first studies of the group comparing different anthropometric indicators and coronary risk using ROC curves was published in 2005[7]. At that time, different anthropometric indicators of abdominal obesity as discriminators of HCR were analyzed and the CI index was found to be the best predictor of cardiovascular diseases. This index can be used in clinical practice for the determination of abdominal obesity. In that study neither WC alone nor BMI was a good predictor of HCR as indicated by the areas under the ROC curve shown in Table 1. The smaller the area under the curve, the lower the predictive value of the anthropometric indicator of obesity for HCR. Cut-off values for the indicators analyzed in that study were also proposed (Table 2). Prior to that study, in 2004[8], cut-off values and their respective sensitivity and specificity were proposed for the use of the CI index as a marker of HCR using the same method (Table 2).

The mechanisms whereby accumulation of abdominal fat influences the increase in metabolic and cardiovascular risk might be related to the excessive production of free fatty acids in the visceral abdominal region. These fatty acids are then disseminated through the portal circulation,

Table 1. Comparison of the areas under the ROC curves (Salvador, Bahia, Brazil).

Indicators of obesity and HCR	Area	95% CI	p value
Men			
CI index and HCR	0.80	0.74 - 0.85	
WHR and HCR	0.76	0.71 - 0.82	
WHtR and HCR	0.76	0.70 - 0.82	
WC e HCR	0.73	0.67 - 0.79	
BMI and HCR	0.64	0.57 - 0.71	0.00
Women			
WHtR and HCR	0.69	0.64 – 0.75	
Women (≤49 years)			
CI index and HCR	0.81	0.70 - 0.92	
WHR and HCR	0.81	0.67 - 0.95	
WC and HCR	0.79	0.68 - 0.91	
BMI and HCR	0.75	0.62 - 0.88	0.07
Women (50-74 years)			
CI index and HCR	0.65	0.58 - 0.73	
WHR and HCR	0.64	0.56 - 0.72	
WC and HCR	0.56	0.48 - 0.64	
BMI and HCR	0.52	0.44 - 0.61	0.05

HCR, high coronary risk; CI index, conicity index; WHR, waist-to-hip ratio; WC, waist circumference; WHtR, waist-to-height ratio; BMI, body mass index; 95% CI, 95% confidence interval.

Table 2. Cut-off values, sensitivity and specificity of obesity indicators as discriminators of high coronary risk (Salvador, Bahia, Brazil).

Obesity indicator	Cut-off	Sensitivity	Specificity
Men			
CI index	1.25	73.91%	74.92%
WHR	0.92	73.91%	64.88%
WC	88.0	65.22%	66.56%
WHtR	0.52	68.0%	64.0%
BMI	24.0	67.39%	52.51%
Women			
WHtR	0.53	67.0%	58.0%
Women (≤49 years)			
WC	84.0	78.57%	75.67%
WHR	0.84	78.57%	72.99%
CI index	1.18	78.57%	65.24%
BMI	26.8	85.71%	61.76%
Women (50-74 years)			
CI index	1.22	60.00%	65.82%
WHR	0.88	52.73%	77.22%
WC	NR		
BMI	NR		

CI index, conicity index; WHR, waist-to-hip ratio; WC, waist circumference; WHtR, waist-to-height ratio; BMI, body mass index; NR, not recommended.

exposing the liver to high fat concentrations. This event, in turn, reduces hepatic removal of insulin, leading to peripheral hyperinsulinemia and a trend towards the development of diabetes. Hyperinsulinemia can also cause alterations in plasma lipid concentrations and arterial hypertensions[9].

A subsequent publication by the research group[10] showed that the cut-off values of WC used to predict metabolic syndrome in Brazilian adults differed from those proposed for the European and North American population (Table 2). Another study published by the same group one year later[11] demonstrated that age is a strong effect-modifying factor in evaluations of abdominal obesity and HCR in females when anthropometric indexes are used Thus, cut-off points of these indicators were proposed for women ≤ 49 years and women > 50 years[12] (Table 2). It should be noted that in women older than 50 years, anthropometric indicators of obesity, except for CI index and WHR, lose their ability to predict HCR as can be seen in Table 1. In this age group, the areas under the ROC curve are lower and the upper limit of the confidence interval is less than 0.50 for some anthropometric markers, a fact not recommending their use.

This loss of power of anthropometric indicators of obesity to predict HCR in women above the age of 50 might be explained by the fact that, for the same WC, the quantity of visceral fat is higher in older women compared to younger ones. Thus, the power of indicators of obesity to discriminate HCR is compromised in women, especially after menopause. These effects seem to be directly associated with female sex hormones that promote changes in adipose tissue metabolism during the postmenopausal period, particularly in visceral adipose tissue[13].

In a previous study from our group, another anthropometric indicator of central obesity, WHtR, was found to be useful to discriminate HCR [14]. The calculation of this indicator is simple and consists of the division of waist by height in cm. This anthropometric marker of central obesity has been frequently used in Asian countries[6]. Since the best cut-off points found were 0.52 for men and 0.53 for women (Table 2), values similar to those reported in other studies using the same method[6], the public health recommendation is that the WC of a subject should not exceed half his/her height. Finally, comparison of the different anthropometric indicators of obesity with WHtR showed that the predictive power of the latter for HCR is intermediate between CI index/WHR and WC/BMI[15] (Table 1).

FINAL CONSIDERATIONS

The evidence provided by studies on anthropometric indicators of obesity and HCR suggests the following strategy for the assessment of abdominal obesity in Brazilian adults: a) clinical practice: use of the CI index with cut-off values of 1.25 for men, and of 1.18 and 1.22 for women ≤ 49 years and > 50 years, respectively; b) population studies: use of WHtR, with the recommendation that waist should not exceed half the height of the subject. Further longitudinal studies investigating anthropometric indicators and HCR in Brazilian adults are needed to confirm the data obtained in the cross-sectional studies analyzed.

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