Association of Different Anthropometric Measures and Indices with Coronary Atherosclerotic Burden

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Abstract

Background: **The association between anthropometric parameters and atherosclerotic burden is not well established and few studies have addressed this issue.**

Objective: **To evaluate the association of different anthropometric parameters with the coronary atherosclerotic burden.**

Methods: **Adult patients undergoing coronary angiography were enrolled in the study. Sociodemographic characteristics and cardiovascular risk factors were collected through a standardized questionnaire. Weight, height, waist circumference (WC), abdominal circumference (AbC), hip circumference (HC) and neck circumference (NC) were measured and body mass index (BMI), waist-hip ratio (WHR), abdominal circumference–hip ratio (AbCHR) and waist-height ratio (WHtR) were calculated. The atherosclerotic burden at the coronary angiography was measured through Friesinger score (FS). Significant atherosclerosis was considered when FS ≥ 5.**

Results: **The sample consisted of 337 patients, of whom 213 were men (63.2%). The mean age was 60.1 ± 10 years. Only WHR (r = 0.159 and p = 0.003) showed a significant linear correlation with the coronary atherosclerotic burden as measured by FS. When the sample was stratified by gender, we found a significant correlation between women's AbCHR (r = 0.238 and p = 0.008) and WHR (r = 0.198 and p = 0.028) with FS. Men showed no correlation between anthropometric parameters and FS. After adjusting for gender, age, hypertension, smoking and DM, no anthropometric parameter was associated with coronary atherosclerotic burden as measured by FS in the total sample or when separated by gender.**

Conclusion: **No anthropometric parameter was an independent risk factor for coronary atherosclerotic burden. (Arq Bras Cardiol 2011;97(5):397-401)**

Keywords: **Anthropometry; coronary artery disease; body mass index; waist-hip ratio.**

Introduction

Obesity is one of the major health problems worldwide and is strongly associated with increased cardiovascular mortality[1]. However, the greater risk is not only related to overweight, but mainly to body fat distribution, with high abdominal fat becoming an important risk factor in the development of atherosclerosis[2].

Observational studies have shown quantitative relationships between the several anthropometric indices of obesity and risk of cardiovascular events[3,4]. Specifically, the waist circumference (WC)[5,6] and waist-hip ratio (WHR)[4,5,7,8] have been associated with cardiovascular risk factors. It should be noted that the WHR has also been shown to be a predictor of atherosclerosis[4] and cardiovascular events[3]. However, no conclusion has been reached regarding which anthropometric indices are more strongly associated with coronary atherosclerotic burden, as few studies have investigated this issue[4,9].

This study aims at assessing the correlation of different anthropometric measures and indices with coronary atherosclerotic burden in patients undergoing coronary angiography for suspected coronary artery disease (CAD).

Methods

Patients aged 18 or older who were undergoing coronary angiography for suspected CAD at Centro de Diagnóstico e Tratamento Intervencionista do Hospital São Lucas of PUC/RS were invited to participate in the study. Patients who, at the time preceding the examination, could not stand up to undergo the anthropometric measurements and those unable to answer the study questionnaire were excluded. Data collection was conducted between the months of October 2008 and December 2009.

Sociodemographic Characteristics and Cardiovascular Risk Factors: Sociodemographic data (age, schooling and occupation) and cardiovascular risk factors (smoking,

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hypertension, dyslipidemia, diabetes mellitus and family history of CAD) were collected through interviews, according to a structured questionnaire.

Anthropometric Measures: The weight in kilograms (kg) was measured using a calibrated anthropometric scale (Filizola, São Paulo, Brazil) with capacity for 150 kg and increments of 100 g. The height, in meters, was measured using the anthropometric scale stadiometer as follows: the individual standing with arms hanging at the sides, heels placed side-by-side and the occipital and gluteal regions touching the anthropometric ruler of the scale. Patients were evaluated wearing only hospital gowns and in bare feet. The body mass index (BMI) was calculated using the formula: body weight (kg) / height (m^2)[10]. Waist circumference (WC) was measured at the thinnest part of the abdomen[11] and abdominal circumference (AbC) was measured 1 cm above the iliac crest[10,12]. Hip circumference (HC) was measured at the maximum circumference between the hips and buttocks[13] and the neck circumference (NC) was measured at midpoint of the cervical spine up to the mid-anterior region of the neck. In men with laryngeal prominence, the NC was measured below the prominence[14-16]. The waist-hip ratio (WHR) was calculated using the equation WC divided by HC. The abdominal circumference-hip ratio (AbCHR) was calculated by dividing the AbC by HC. The waist-height ratio (WHtR) was calculated using the results of the WC divided by height. Patients with BMI ≥ 30 kg/m^2 were considered obese[10].

Coronary Atherosclerotic Burden: The coronary atherosclerotic burden was evaluated by Friesinger score (FS)[17] at the coronary angiography. This score ranges from 0 to 15 and separately scores each of the three main coronary arteries. The anterior descending, circumflex and right coronary arteries receive a score from zero to five, according to the following categories: 0 - No arteriographic abnormalities; 1 - parietal abnormalities or minor lesions from 1% to 29%; 2 - At least one stenosis, from 30% to 68%; 3 – diffuse, tubular or multiple lesions in at least two segments with stenosis of 30% to 68%; 4 - at least one of the segments with stenosis of 69% to 99%, but without total proximal occlusion; 5 - total occlusion of a vessel in the proximal portion without any filling of the distal segment. Lesions in the left main coronary artery score for both the anterior descending and circumflex arteries. All coronary lesions were assessed by interventional cardiologists blinded to the anthropometric values.

The research protocol was approved by the Ethics and Research Committee of Pontifícia Universidade Católica do Rio Grande do Sul (PUC/RS), under number #08/04211, and all participants signed the free and informed consent form.

Statistical Analysis: Data were analyzed using the SPSS software, version 17. Descriptive statistics are shown as measures of frequency, means and standard deviations. The correlation between anthropometric measures and Friesinger score was calculated using Pearson's correlation coefficient. P values were subsequently adjusted for the variables (sociodemographic and cardiovascular risk factors) that showed significant association with that score using multiple linear regression, using each of the anthropometric measures separately.

Results

The sample consisted of 337 adult patients undergoing coronary angiography: 213 men (63.2%) and 124 women (36.8%). The mean age was 60.1 ± 10.9 years, with a minimum of 23 and maximum of 89 years.

Table 1 shows the sociodemographic characteristics and cardiovascular risk factors of the sample. Regarding the marital status, most of the sample (69.8%) consisted of married individuals. The percentage of widowed individuals was 14.7%; of single individuals, 5.4%, and separated, 10.2%. The most common level of schooling was four to

Table 1 - Sociodemographic characteristics and risk factors of the sample

Variables	Total sample n = 337 n (%)
Age range	
Adult	168 (49.9)
Elderly	169 (50.1)
Sex	
Female	124 (36.8)
Male	213 (63.2)
Marital status	
Separated	34 (10.2)
Married	233 (69.8)
Widowed	49 (14.7)
Single	34 (10.2)
Years of Schooling	
< 4 years	81 (24.3)
4-8 years	139 (41.6)
> 8 years	114 (34.1)
Profession	
Homemaker	49 (14.6)
Unemployed	11 (3.3)
Employed	51 (15.2)
Self-employed	52 (15.5)
Retired	172 (51.3)
Systemic arterial hypertension	
No	77 (23)
Yes	258 (77)
Dyslipidemia	
No	159 (47.6)
Yes	176 (52.4)
Diabetes *mellitus*	
No	242 (72.2)
Yes	93 (27.8)
Smoker	
No	149 (44.6)
Ex-smoker	115 (34.4)
Yes	70 (21)
Family history of CAD	
No	263 (78.7)
Yes	72 (21.3)
Obesity (BMI ≥ 30Kg/m^2)	
No	233 (69.14)
Yes	104 (30.86)

CAD - Coronary artery disease; BMI - Body mass index.

eight years of study (41.6%), followed by eight or more years of study (34.1%). Most of the sample consisted of retired individuals (51.3%).

The presence of systemic arterial hypertension (SAH) was found in 77% of the total sample, and the use of antihypertensive medication was reported by 75.1%. Most of the sample reported dyslipidemia (52.5%), and 45.4% of patients reported taking lipid-lowering medication. The presence of diabetes was observed in 27.7%. In these, regarding the treatment used, 66.7% reported using oral medication, 24.4%, insulin, and only 8.9% reported using diet alone as treatment.

As for smoking, 44.5% of subjects were non-smokers, 34.6% reported being ex-smokers and 20.9% were active smokers. The presence of positive family history for CAD was reported by 21.5% of the total population. Obesity was present in 30.9% of the sample.

At the simple linear correlation between anthropometric parameters and atherosclerotic burden as measured by Friesinger score in the total sample, only WHR ($r = 0.159$ and $p = 0.003$) showed a significant correlation (Table 2). When the sample was stratified by gender, women had a significant AbCHR ($r = 0.238$ and $p = 0.008$) and WHR ($r = 0.198$ and $p = 0.028$) correlation with atherosclerotic burden. However, all observed correlations showed to be weak. In men, we found no linear correlation between any of the anthropometric parameters and atherosclerotic burden.

Among the classic risk factors, the multivariate analysis showed that gender, age, SAH and smoking were independently associated with atherosclerotic burden measured by Friesinger score. After adjusting for age, sex, SAH, smoking and DM, no anthropometric parameter was associated with coronary atherosclerotic burden.

Discussion

This is one of few studies that evaluated the association between anthropometry and coronary atherosclerotic burden. We evaluated 337 patients submitted to coronary angiography for suspected CAD, and observed that none of the studied anthropometric parameters (BMI, WC, AbC, NC, HC, WHR, AbCHR and WHtR) was an independent risk factor for coronary atherosclerotic burden measured by coronary angiography.

Regarding BMI, the results corroborate the findings of previous studies, in which this parameter is not associated with significant atherosclerosis. One of the limitations of BMI is its incapacity to differentiate between different body compositions. BMI does not indicate excess central obesity, characterized by the accumulation of fat in the mesenteric region and associated with increased risk of atherosclerotic disease. Rossi et al[18] evaluated, in a prospective study, cardiovascular risk factors, BMI, endothelial function and subclinical inflammation in 1,299 patients (69.7% men) submitted to coronary angiography and observed that BMI was not significantly associated with a greater extent of coronary atherosclerosis or mortality[18]. Additionally, other studies showed no correlation between BMI and coronary atherosclerosis[19,20].

In our study, WHR was correlated with atherosclerotic burden measured by Friesinger score in the bivariate analysis. When stratified by gender, it was verified that this correlation was observed only in women. Similarly, another study that evaluated CAD by angiography in patients younger than 60 years (88 men and 39 women) and older than 60 years (85 men and 63 women), WHR was significantly associated with CAD after adjusting for age only in older women ($p = 0.004$)[21].

In the present study, the association of WHR with atherosclerotic burden was not maintained after the

Table 2 - Correlation between anthropometric measures and indices and atherosclerotic burden, adjusted for sex, age, SAH, smoking and DM

	Men (n = 213)			Women (n = 124)			Total (n = 337)		
	r	p	p*	r	p	p*	r	p	p†
Weight	-0.014	0.882	0.095	-0.098	0.152	0.911	0.000	0.995	0.305
Height	-0.063	0.484	0.184	-0.125	0.069	0.985	0.045	0.410	0.303
BMI	-0.051	0.457	0.202	-0.006	0.948	0.944	-0.040	0.468	0.469
AbCHR	0.009	0.896	0.182	0.238	0.008	0.821	0.102	0.061	0.987
WHR	0.049	0.479	0.943	0.198	0.028	0.393	0.159	0.003	0.588
AbC	-0.074	0.284	0.081	0.099	0.277	0.782	0.009	0.871	0.266
WC	-0.028	0.690	0.173	0.117	0.194	0.571	0.086	0.115	0.631
HC	-0.093	0.176	0.158	-0.024	0.238	0.973	-0.085	0.119	0.301
NC	-0.014	0.838	0.636	0.102	0.260	0.308	0.090	0.102	0.857
WHtR	0.019	0.785	0.370	0.118	0.190	0.661	0.090	0.098	0.877

P adjusted for age, SAH, smoking, DM; P† adjusted for sex, age, SAH, smoking, DM.*
BMI - body mass index; AbCHR – abdominal circumference-hip ratio; WHR – waist-hip ratio; AbC - Abdominal circumference; WC - Waist circumference; HC - hip circumference; NC – neck circumference; WHtR – waist-height ratio.

multivariate analysis, considering major risk factors for CAD. In another similar study, the association of WHR with atherosclerotic burden was not maintained after adjusting for other risk factors[20].

However, the Dallas Heart Study[4] assessed the association of different anthropometric measures with the coronary artery calcium score measured by computed tomography and by the presence of atherosclerotic plaques in the abdominal aorta detected by MRI, and only the WHR was independently associated with subclinical atherosclerosis after the multivariate analysis adjustments.

The capacity of the WHR to correlate with atherosclerotic burden may be linked to the fact that this index contemplates two different aspects. The variation in waist circumference reflects a variation in subcutaneous and abdominal visceral fat, whereas the HC incorporates the pelvic structure, gluteal muscle and gluteal subcutaneous fat[22]. Moreover, these differences in fat distribution have their own effects, often contradictory on cardiovascular risk factors. Anatomically, the WHR may indicate a better distribution of body fat[22].

Variations in the site of abdominal obesity measurement may at least partly explain the variability of findings from different studies.

The comparison of four different sites of measurement of the waist circumference showed high correlation between all measures, and the one that showed the highest correlation with body fat mass was measured above the iliac crest[23]. In the Dallas Heart Study[4], the site of waist circumference measurement was 1 cm above the iliac crest.

Although WC and AbC measures are directly related to the amount of intra-abdominal adipose tissue[24,25] and have been associated in several studies to cardiovascular risk factors[5,6] and clinical manifestations of heart disease such as infarction[3], the present study did not find a correlation with increased coronary atherosclerotic burden.

Raymond et al[9] evaluated the association between WC and WHR with the carotid intima-media thickness (IMT) in 1,578 middle-aged men with no clinical cardiovascular disease. WHR, compared to WC, had the strongest correlation with the IMT thickening between individuals of different ages[9].

In this study, there was no significant association of WHR with the coronary atherosclerotic burden. In the Quebec Study[22], the lower WHR was independently associated with lower HDL-cholesterol and high glucose concentrations in men, as well as high triglycerides in men and women. It has also been shown that the WHR is inversely associated with cardiovascular risk factors and that there is an inverse association between the WHR and less body fat determined by dual X-ray scan[4].

Regarding the NC, there was no correlation with atherosclerotic burden. There were no previous studies that evaluated the association of NC with atherosclerotic burden. However, the NC was one of the anthropometric parameters included in this study, due to previous publications that correlated this measure with cardiovascular risk factors[14,15]. Ben-Noun et al[16] suggested the use of NC to identify overweight and obese individuals. Changes in NC were also associated with changes in some metabolic syndrome components (such as triglycerides and WC)[15]. Additional studies are needed to better understand this anthropometric parameter when predicting cardiovascular risk and atherosclerotic burden, as it is a simple and easily obtained measure, which does not require the individual to undress, making it a feasible measure to be performed in clinical practice.

Similarly, the present results showed no association between WHtR and atherosclerotic burden. We found no previous studies that evaluated the association WHtR with atherosclerotic burden. However, WHtR was included in this study because it was strongly correlated with intra-abdominal fat ($r = 0.83$) in literature[26] and also associated with increased risk of acute myocardial infarction[3] and risk factors for cardiovascular disease[27,28].

It is noteworthy the fact that Friesinger score quantifies the extent of atherosclerosis through the angiography of the coronary arteries, without considering the myocardial area at risk associated with a given stenosis. Therefore, a same degree of luminal obstruction in proximal, middle, or distal vessel receives an identical score. Unlike other systems for evaluating the extent of coronary disease, Friesinger score was specifically developed for the assessment of parietal atherosclerosis, regardless of the area of perfused myocardium through the stenosis.

In conclusion, no anthropometric parameter assessed in patients undergoing coronary angiography for suspected coronary artery disease was an independent risk factor for atherosclerotic burden after multivariate analysis.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

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