Original Article

Relation between Anthropometric Indicators and Risk Factors for Cardiovascular Disease

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Abstract

Background: **Studies have been carried out to identify the best anthropometric predictor of chronic diseases in different populations.**

Objective: **To verify the relation between anthropometric measures and risk factors (lipid profile and blood pressure) for cardiovascular diseases.**

Methods: **Transversal study carried out with 180 males and 120 females, with mean age 39.6±10.6 years old. Body mass index (BMI), waist circumference (WC), body fat percentage (%BF), waist-to-hip ratio (WHR), lipid profile, glycemia and blood pressure were the variables assessed.**

Results: **BMI, WC and WHR were higher among males, and %BF were higher among females ($p<0.001$). The proportion of altered cases of WHR and %BF in relation to LDL-cholesterol and total cholesterol (TC) was higher among males. The individuals considered normal for WC presented alteration in the values of LDL-c, TC and HDL-cholesterol. There was a correlation between BMI and WC (males: $r=0.97$ and females: $r=0.95$; $p<0.001$). Among males, the best correlation ($p<0.001$) was presented between WC and WHR ($r=0.82$) and among females, %BF and WC ($r=0.80$). Triglycerides (TG) presented correlation to WHR (males: $r=0.992$; females $r=0.95$; $p<0.001$), and to WC (males: $r=0.82$; females $r=0.79$; $p<0.001$). In the multiple analysis (prevalence ratio - PR, confidence interval - CI), the BMI were associated with total cholesterol (PR=1.9; 95%CI 1.01-3.69; $p=0.051$) among males and slightly associated with TG/HDL-cholesterol (PR=1.8; IC95% 1.01-3.45; $p=0.062$) among females.**

Conclusion: **BMI and WHR were the anthropometric indicators with strongest relation to lipid profile in both sex groups. This data support the hypothesis that BMI and WHR may be considered as risk factors for cardiovascular disease. (Arq Bras Cardiol 2010; 94(4):451-457)**

Key words: **Cardiovascular diseases; obesity; anthropometry/methods; risk factors.**

Introduction

The cardiovascular disease is widely considered the main death and disability cause around the world. Despite the decrease in the proportion of death occurrences due to cardiovascular disease in developed countries, in the last decades, these indexes have significantly increased in low and medium-income countries[1].

A positive relation have been established between cardiovascular manifestations and genetic, environmental and lifestyle factors. The multiplicative effect of the co-existence of these manifestations and the risk factors, which exponentially increase the risk for coronary arterial disease, is emphasized[2]. With the Framinghan study[3], the first risk factors for cardiovascular disease were identified: arterial hypertension, high cholesterol levels or reduced HDL-cholesterol levels, smoking, *diabetes mellitus* and aging.

Yonder, the guidance from World Heart Federation[4] point out other risk factors that may increase the general risk, such as: overweight/obesity, physical inactivity, atherogenic diet, stress (socioeconomic and psychosocial), family history of premature cardiovascular disease and genetic or racial factors.

Obesity and, more recently, overweight are increasing problems in many countries, including Brazil, and many attempts have been made as to identify the best anthropometric predictor of chronic diseases in different populations. Abdominal adiposity has been considered one of the best predictors for cardiovascular diseases. However, although the imaging diagnosis technique is the most effective method, it is limited when employed in epidemiological studies due to its high costs and methodological difficulties. Therefore, anthropometric markers, like waist circumference and waist-to-hip ratio, for example, have been widely used in epidemiological studies carried out in Europe[5] an in the United

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States[6]. Notwithstanding, there are few studies available that explore the accuracy of such measures in developing countries. Besides, there is controversy with regard to the best indicator of abdominal fat[7].

The objective of this paper was to verify the relation between anthropometric measures and risk factors (lipid profile and blood pressure) for cardiovascular disease.

Methods

Transversal study, carried out between August and October 2005, based on medical records of individuals admitted in a Prevention and Rehabilitation clinic, with care characterized as Private or Supplementary Medicine System, in Florianópolis, Santa Catarina, Brazil. The sample studied (n=300) was chosen from the total of admittances (n=708). Inclusion criteria were: adults (20-59 years old) of both sexes and that were not under medication treatment for hypertension, diabetes and dislipidemia (undiagnosed). Exclusion criteria: pregnant (n=40) and nursing (n=37) women, athletes (n=780) and those who were in use of medications (n=253). Anthropometric measures and anatomical reference points were collected according to Ross and Marfell-Jones[8]. Weight was measured in a mechanical plataform scale with capacity for 150 kg, 100 g scale, model 110 CH (Welmy Indústria e Comércio Ltda., Santa Bárbara do Oeste, São Paulo, Brazil). The height was measured with a stadiometer, model Wood, with specificity of 0.001 m (WCS/CARDIOMED, Curitiba, Paraná, Brazil). Nutritional status was qualified based on body mass index (BMI) in kg/m^2, according to the World Health Organization (WHO) in 1998[9]. The body fat percentage (%BF) was obtained by means of the SIRI formula [% Fat = (4.95/ body density) - 4.5 x 100], based on the body density estimative determined by the equations proposed by Durnin and Wolmersley[10]. The measures of tricipital, biciptal, subescapular and suprailiac cutaneous fold were taken with a plicometer, model Slimguide. All instruments are Berfer (Francisco Berral de La Rosa, Córdoba University, Spain). Three measurements were taken, and the arithmetic mean was used as final value. The %BF was assessed according to Heyward and Stolarczyk[11]. Waist circumference was expressed in centimeters, in the iliac board with an inextensible measuring stick, model Gulick, Mabbis (CARDIOMED, Curitiba, Paraná, Brazil). The hip circumference was expressed in centimeters in the most protuberant gluteal area in a horizontal plane[12]. The waist-to-hip ratio was obtained from the values of waist and hip circumferences, and their classification was based on cut points recommended by WHO[9]. Blood pressure (BP) in mmHg was obtained by means of a sfignomanometer with mercury column; model Aneroide, Wan-Med (CARDIOMED, Curitiba, Paraná, Brazil). Blood Pressure was gauged three times, with a two-minute interval between each gauging, and the mean values were registered according to the determinations of IV *Diretrizes Brasileiras de Hipertensão Arterial*[13]. Lipid profile was characterized based on serum levels of total cholesterol (TC) and triglycerides (TG), both in mg/dl, obtained through an automatic colorimetric enzymatic method[14]. The high-density lipoprotein cholesterol (HDL-cholesterol) (mg/dl) was determined by the selective precipitation method along with the dosage of automatic colorimetric enzymatic method[14]. The low-density lipoprotein cholesterol (LDL-cholesterol) (mg/dl) was obtained through the Friedewals formula[14], validated for values of TG till 400 mg/dl[14]. Glycemia (mg/dl) was determined by hexokinasis method[15]. Cutoff points were employed according to Grundy et al[16] and Grund et al[17].

The study was approved by the Ethics Research Committee of Universidade Federal de Santa Catarina (protocol number 376/05) and is in compliance with the World Medical Association, Declaration of Helsinki[18].

The analyses were made by means of SPSS version 14.0 (SPSS Inc., Chicago, United States) and STATA (Stata Corporation, College Station, United States) software. Initially, the descriptive analysis of variables was presented by means of proportions, means and standard deviations. The non-pared t test was used for independent samples as to compare the mean results of the assessed variables. Pearson's coefficient of linear correlation was utilized to assess the level of correlation between the tested variables.

The assembly of the logistic model had the finality of observing how the anthropometric variables (BMI, WC, WHR and %BF) can predict, in probabilistic means, the presence of the risk factor for dislipidemia. The anthropometric variables were used as predictors and indicators of the presence or not of dislipidemia: 0 (absence) and 1 (presence). The independent variables selected for the analysis were: total cholesterol (TC), LDL and HDL-cholesterol, triglycerides (TG), systolic and diastolic blood pressure (SBP and DBP) and fasting glycemia.

The association between the anthropometric variables and independent variables among males and females was carried out by means of prevalence ratios, confidence intervals, chi-square and linear tendency test. The multiple analysis was made by means of Poisson regression, presenting the prevalence ratios and respective 95% confidence intervals. The variables with $p<0.20$ at the bivariate analysis were included in the multiple analysis. The criteria of variables permanence in the final model was $p \leq 0.05$.

Results

The sample gathered 300 patients (180 males [60%] and 120 females) with mean age 39.59 ± 10.6 years old. In Table 1 it is observed that there was a significant diffeence between sexes for the following variables: age ($p < 0.05$), BMI ($p < 0.01$), and %BF, WC, WHR, HDL-cholesterol, TG and difference ($p < 0.001$).

In the distribution of the sample by percentage of altered values of lipid fractions, blood pressure and glycemia according to normal and altered values of anthropometric variables, it is observed that males have higher percentage of altered cases for WC [n = 59 (32.8%)], WHR [n = 77 (42.8%)] and %BF [n = 174 (96.7%)].

For the altered cases of WHR and %BF in relation to LDL-cholesterol and TC, we observed a greater number of cases among males [LDL-c *versus* RCQ (42.9%) and %GC (100%); CT *versus* RCQ (47.8%) and % GC (100%)]. Normal WC was in greater number of altered cases for LDL-cholesterol (64.6%), TC (61.1%), HDL-cholesterol (71.7%). All individuals who

Table 1 - Anthropometric and clinical characteristics according to sex

Variables	Total	Males	Females	p-value
Age (years)	39.6 ± 10.6	38.6 ± 10.6	41.1 ± 10.4	0.043*
BMI (kg/m²)	25.61± 4.33	26.22 ± 3.76	24.70 ± 5.05	0.003**
%BF	28.67 ± 5.87	26.94 ± 5.83	31.29 ± 4.92	< 0.001***
WC (cm)	83.79 ± 12.35	88.6 ± 10.4	76.4 ± 11.3	< 0.001***
WHR	0.84 ± 0.09	0.89 ± 0.068	0.75 ± 0.069	< 0.001***
TC (mg/dl)	200.6 ± 40.1	200.7 ± 39.7	200.3 ± 40.9	0.945
LDL-c (mg/dl)	123.9 ± 33.0	125.2 ± 32.0	121.9 ± 34.6	0.395
HDL-c (mg/dl)	51.0 ± 13.0	47.0 ± 10.1	57.0 ± 14.5	< 0.001***
TG (mg/dl)	128.8 ± 78.3	79.4 ± 25.6	202.7 ± 72.1	< 0.001***
TG/ HDL-c	2.63 ± 1.73	1.79 ± 0.77	3.88 ± 2.03	< 0.001***
SBP (mmHg)	127.2 ± 14.3	127.5 ± 14.8	126.8 ± 13.5	0.693
DBP (mmHg)	82.5 ± 9.6	82.6 ± 9.4	82.2 ± 9.8	0.695
Fasting glycemia (mg/dl)	94.6 ± 17.9	93.8 ± 14.3	95.8 ± 22.3	0.352

*Values expressed by mean and standard deviation (X ± SD); Significant difference: *p<0.05; **p<0.01; ***p<0.001. BMI - body mass index; %BF - percentage of body fat; WC - waist circumference; WHR - waist-to-hip ratio; TC - total cholesterol; TG - triglycerides; LDL-cholesterol - low-density lipoprotein cholesterol; HDL-cholesterol - high-density lipoprotein cholesterol; SBP - systolic blood pressure; DBP - diastolic blood pressure.*

presented altered values for LDL-cholesterol and TC had also %BF altered (Table 2).

Table 3 shows the correlation of anthropometric indicators between each other, to lipid profile, glycemia and blood pressure according to sex. The most evident correlation was verified between BMI and WC for men (r=0.970; p<0.001) as much as for women (r=0.945; p<0.001). The correlation between indicators of abdominal fat, WC and WHR was similar in both sexes (males: r=0.821; females: r=0.801; p<0.001). Among females, %BF was more strongly related to WC (r=0.767; p<0.001) than among men. In the analysis between anthropometric variables and lipid profile, it was observed that the most evident correlation happened between WHR and TG (males: r=0.992; females: r=0.953; p<0.001) and between WHR and TG/HDL-cholesterol (males: r=0.875; females: 0.798; p<0.001), followed by WC and TG (r=0.817; females: r=0.792; p<0.001). The remaining correlations between anthropometric variables and lipid profile, as considering TC, LDL-c and HDL-c, were slight, though significant. Glycemia was not correlated to any anthropometric indicators. Similarly, there was no correlation between anthropometric variables and diastolic blood pressure levels. On the contrary, a significant, but slight, correlation was observed between BMI and WC and the systolic blood pressure levels among females (Table 3).

In the bivariate analysis, for males, a positive linear variable of BMI and LDL-cholesterol was found (p=0.030), TC (p=0.005). Among females, a positive linear relation was also observed between BMI and TV (p=0.092) and TG (p=0.036) (Table 4). The variable WHR also presented a positive linear relation to HDL-cholesterol (p=0.161) among males and, among females, the relation was observed between TG and HDL-cholesterol (p=0.142). In the multivariate analysis, BMI is associated to total cholesterol among males (PR=1.9; 95%CI 1.01-3.69; p=0.051). Among females, we observed that BMI may relate to TG/HDL-cholesterol (PR=1.8; 95%CI 1.01-3.45; p=0.062) (Table 4).

Discussion

Epidemiological studies have showed a clears correlation between obesity and cardiovascular risk factors[19,20]. In the diagnosis of the nutritional status of the studied population, assorted by BMI, overweight and obesity were prevalent. It was similar to what happened with the studied of Ribeiro et al[21] that studied an adult population from Minas Gerais, Brazil, with regard to BMI, and observed 41.7% of overweight and 11.1% of obesity. The National research of Health and Nutrition (PNSN, from the Portuguese Pesquisa Nacional de Saúde e Nutrição) (1989) showed that about 40% of the adult Brazilian population presented overweight in some degree[20].

However, it is emphasized that using BMI as classificatory measure of nutritional status may be useful in population studies, yet it is few accurate with regard to body fat distribution. In this manner, the measures like WHR and WC may give additional information concerning obesity nature[22,23].

Dalton et al[24] investigated the correlation between BMI, WC and WHR to cardiovascular diseases risk factors in an adult Australian population and also found differences in the prevalence of overweight and obesity. These authors, based on BMI, found 39% of Australian adults with overweight and 20.8% with obesity. When WC was utilized, 30.5% of the adults were labeled as obese, while only 15.8% fit this classification when based on WHR. Additional data proved that there were differences between sexes for WC and WHR parameters: the prevalence of overweight was higher among men, and obesity was more significant among women.

In the present investigation, we observed that men presented slight higher values of HDL-c and systolic blood pressure. Mean values for HDL-c were lower among men than among women. However, females presented mean values of triglycerides were statistically more elevated. Males, however, presented higher mean values of WC and WHR than females,

Table 2 - Percentage of altered values of lipid fractions, blood pressure and glycemia according to normal and altered values of anthropometric variables

Anthropometric variables		BMI (kg/m²)		WC (cm)		WHR		%BF	
		Normal	Altered	Normal	Altered	Normal	Altered	Normal	Altered
Males (M)		< 25	≥ 25	< 94	≥ 94	< 0.9	≥ 0.90	< 15%	≥ 15%
Females (F)				< 80	≥ 80	< 0.8	≥ 0.80	< 23%	≥ 23%
n (%)	M	77 (42.8)	103 (57.2)	121 (67.2)	59 (32.8)	103 (57.2)	77 (42.8)	06 (3.33)	174 (96.7)
n (%)	F	77 (64.2)	43 (35.8)	87 (72.5)	33 (27.5)	90 (75.0)	30 (25.0)	08 (6.67)	112 (93.3)
Lipid fractions n (%)									
LDL-c ≥130mg/dl	M	24 (29.3)	58 (79.7)	53 (64.6)	29 (35.4)	47 (57.3)	35 (42.9)	-	82 (100.0)
	F	25 (58.1)	18 (41.9)	28 (65.1)	15 (34.9)	29 (67.4)	14 (32.6)	01 (2.3)	42 (97.7)
TC ≥ 200mg/dl	M	24 (26.7)	66 (73.3)	55 (61.1)	35 (38.9)	47 (52.2)	43 (47.8)	-	90 (100.0)
	F	31 (54.4)	26 (45.6)	37 (64.9)	20 (35.1)	38 (66.7)	19 (33.3)	01 (1.7)	56 (98.3)
TG ≥ 150 mg/dl	M	-	-	-	-	-	-	-	-
	F	55 (57.9)	40 (42.1)	62 (65.3)	33 (34.7)	65 (68.4)	30 (31.6)	02 (2.1)	93 (97.9)
HDL-c									
< 40 mg/dl	M	62 (45.9)	73 (54.1)	96 (71.1)	39 (28.9)	87 (64.4)	48 (35.6)	06 (4.4)	129 (95.6)
< 50 mg/dl	F	57 (68.7)	26 (31.3)	62 (74.7)	21 (25.3)	64 (77.1)	19 (22.9)	06 (7.2)	77 (92.8)
TG/ HDL-c < 3,8	M	-	1 (100.0)	-	1 (100.0)	-	1 (100.0)	-	1 (100.0)
	F	21 (47.7)	23 (52.3)	21 (47.7)	23 (52.3)	19 (43.2)	25 (56.8)	-	44 (100.0)
FG ≥ 100 mg/dl	M	24 (43.6)	31 (56.4)	39 (70.9)	16 (29.1)	29 (52.7)	26 (47.3)	01 (1.8)	54 (98.2)
	F	18 (66.7)	09 (33.3)	20 (74.1)	07 (25.9)	20 (74.1)	07 (25.9)	01 (3.7)	26 (96.3)
SBP ≥ 130 mmHg	M	29 (38.2)	47 (61.9)	52 (68.4)	24 (31.6)	42 (55.3)	34 (44.7)	01 (1.3)	75 (98.7)
	F	30 (57.7)	22 (42.3)	33 (63.5)	19 (36.5)	35 (67.3)	17 (32.7)	02 (3.9)	50 (96.1)
DBP ≥ 85 mmHg	M	21 (35.6)	38 (64.4)	39 (66.1)	20 (33.9)	31 (52.5)	28 (47.5)	-	59 (100.0)
	F	24 (61.54)	15 (38.5)	26 (66.7)	13 (33.3)	28 (71.8)	11 (28.2)	02 (5.1)	37 (94.8)

*Values expressed by mean and standard deviation (X ± SD); Significant difference: ***p < 0.001. BMI - body mass index; %BF - percentage of body fat; WC - waist circumference; WHR - waist-to-hip ratio; TC - total cholesterol; TG - triglycerides; LDL-cholesterol - low-density lipoprotein cholesterol; HDL-cholesterol - high-density lipoprotein cholesterol; FG - fasting glycemia; SBP - systolic blood pressure; DBP - diastolic blood pressure.*

which suggests and excess of intra-abdominal adipose tissue. Such data may have contributed with the alterations observed in lipid profile. Cercato et al[20] obtained similar results after studying a sample of 1,213 Brazilian adults of both sexes, as men presented higher mean values of WC and WHR and lower mean values of HDL-c.

Velásquez-Meléndez et al[25] assessed the predictive capacity of WC in 79 females and observed that WC ≥ 80 cm corresponded to 89.8% of females with BMI ≥ 25 kg/m² and WC ≥ 88 cm, and 88.5% of females with BMI ≥ 30 kg/m². These authors showed that abdominal obesity, defined as WC ≥ 88 cm, was significantly associated with arterial hypertension.

In the study of Pereira et al[26], carried out with 3,282 adult individuals from Rio de Janeiro, Brazil, it was observed that WHR presented smaller correlation to BMI and higher capacity of predicting hypertension in comparison to other indicators of fat disposal, which allows a better discrimination of individuals with risk for chronic diseases.

In the present research, the correlation between anthropometric indicators showed that WC was more strongly related to BMI and WHR than to %BF. This finding suggests that WHR would be less dependent on total adiposity. Such results were similar to those observed in other studies[5,24,27].

Sampaio et al[28], with the purpose of assessing the correlation between BMI and anthropometric indicators of fat distribution in adults and old-aged people, also observed a positive and strong correlation between BMI and WC[28].

An investigation carried out with a population from Rio Grande do Sul, Brazil[29], showed a prevalence of inadequate cases of 5.6% for total cholesterol and 7% for glycemia higher than 126 mg/dl. Ribeiro et al[21] observed values superior to the reference value for TC (47.2%), and inferior values for HDL-c (42.7%) and arterial hypertension in 37.2% of the sample. The prevalence of arterial hypertension observed in both sexes in the present study was elevated in comparison to the estimative of arterial hypertension in the Brazilian population, which is of 15%, according to *Ministério da Saúde* in 2004[30].

The present study verified that males present a higher percentage of altered cases for WC, WHR and %BF. The percentage of altered cases of WHR was higher in comparison

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Table 3 - **Correlation between anthropometric variables, lipid profile, glycemia and blood pressure according to sex**

Males (n = 180)	BMI (kg/m²)	WC (cm)	WHR	%BF
WC (cm)	r = 0.97***			
WHR	r = 0.652***	r = 0.821***		
%BF	r = 0.599***	r = 0.686***	r = 0.619***	
LDL-c (mg/dl)	r = 0.271**	r = 0.278***	r = 0.174***; p = 0.019	r = 0.246; p = 0.001
TC (mg/dl)	r = 0.327***	r = 0.330***	r = 0.226; p = 0.002	r = 0.332***
TG (mg/dl)	r = 0.645 ***	r = 0.817***	r = 0.992***	r = 0.633***
HDL-c (mg/dl)	r = -0.216; p = 0.004	r = -0.252; p = 0.001	r = -0.285***	r = -0.61; p = 0.416
TG/HDL-c	r = 0.567***	r = 0.718***	r = 0.875***	r = 0.511***
Glycemia (mg/dl)	r = 0.066; p = 0.380	r = 0.066; p = 0.379	r = 0.068; p = 0.361	r = 0.022; p = 0.771
SBP (mmHg)	r = 0.007; p = 0.920	r = 0.010; p = 0.889	r = 0.013; p = 0.861	r = 0.011; p = 0.884
SBP (mmHg)	r = 0.001; p = 0.992	r = -0.23; p = 0.578	r = 0.019; p = 0.804	r = -0.037; p = 0.180
Females (n = 120)				
WC (cm)	r = 0.945***			
WHR	r = 0.639***	r = 0.801***		
%BF	r = 0.717***	r = 0.767***	r = 0.664***	
LDL-c (mg/dl)	r = 0.133; p = 0.148	r = 0.178; p = 0.052	r = 0.229; p = 0.012	r = 0.301***
TC (mg/dl)	r = 0.125; p = 0.174	r = 0.190; p = 0.038	r = 0.264; p = 0.004	r = 0.319***
TG (mg/dl)	r = 0.650***	r =0.792***	r = 0.953***	r = 0.634***
HDL-c (mg/dl)	r = -0.238; p = 0.009	r = -0.245; p = 0.007	r = − 0.184; p = 0.044	r = -0.150; p = 0.101
TG/HDL-c	r = 0.636***	r = 0.731***	r = 0.798***	r = 0.521***
Glycemia (mg/dl)	r = -0.014; p = 0.878	r = 0.072; p = 0.437	r = 0.147; p = 0.110	r = 0.140; p = 0.878
SBP (mm Hg)	r = 0.210; p = 0.021	r = 0.195; p = 0.033	r = 0.172; p = 0.061	r = 0.168; p = 0.066
DBP (mm Hg)	r = 0.124; p = 0.176	r = 0.093; p = 0.311	r = 0.091; p = 0.325	r = 0.074; p = 0.420

*Significant values: ***p < 0.001; BMI - body mass index; %BF - percentage of body fat; WC - waist circumference; WHR - waist-to-hip ratio; TC - total cholesterol; TG - triglycerides; LDL-cholesterol - low-density lipoprotein cholesterol; HDL-cholesterol - high-density lipoprotein cholesterol; SBP - systolic blood pressure; DBP - diastolic blood pressure.*

to LDL-c and TC among males, which appear to be in a worse situation in comparison to females with regard to cardiovascular diseases[31]. In the assessment of the percentage of total BF, it was observed that for the altered cases, almost all individuals presented alteration in the indicators of dislipidemia, blood pressure and glycemia in both sexes. The percentage of BF was associated with risk factors in diabetic women[32].

In the present investigation, WC was not a predictor for cardiovascular diseases risk, for the majority of the individuals that presented normal WC showed altered values for LDL-c, TC, HDL, glycemia and blood pressure, similarly to the results observed by Ross et al[33]. These findings support the hypothesis that the disposal of relatively higher quantities of intra-abdominal fat adversely affects the concentrations of lipid and of circulating lipoproteins.

A Brazilian study that assessed 1,213 adults from São Paulo evidenced that the main dislipidemia associated with central obesity would be represented by the significant increase of triglycerides levels and/or by the decrease of HDL-c levels[20]. Similarly, Hu et al[34] studied a sample of American Indians and verified that the main lipid/lipoprotein abnormalities related to obesity were the decrease of HDL-c and the increase of triglycerides, mainly among men. These authors also observed that central adiposity were more frequently associated with normal lipid profiles.

In the present study, we observed that TC and LDL-c were more frequently correlated to BMI among males and to fat percentage among females. That is, were more significantly correlated to total adiposity measures, which suggests that total body fat may be more relevant in relation to these variables (TC and LDL-c) than to fat disposal in the central portion of the body. These findings were similar to those found by other researchers[7,24].

In the bivariate analysis, the anthropometric indicators BMI and WHR were associated with cardiovascular disease risk factors (LDL-c and TC among males and TG and TG/HDL-c among females). In the conjunct analysis of WHR in relation to HDL-c (males) and TG/HDL-c (females), it was verified that visceral adiposity may be considered as a cardiovascular disease risk factor[35]. In the multiple analysis, BMI was associated to TC among men. Among females, there was a tendency on the association of BMI with HDL-c. BMI

Table 4 - Bivariate analysis of anthropometric and lipid variables according to normal and altered values by sex and adjusted by age

Variables	Males (n = 180)				Females (n = 120)			
BMI	n (%)	PR**	CI%	p-value*	n (%)	PR	CI%	p-value
LDL-c (mg/dl)								
Normal	45 (45.9)	1.0		0.030				
Altered ≥ 130	58 (70.7)	1.5	1.04 - 2.27					
TC (mg/dl)								
Normal	37 (41.1)	1.0		0.005	17 (27.0)	1.0		0.092
Altered ≥ 200	66 (73.3)	1.8	1.19 - 2.66		26 (45.6)	1.7	0.91 - 3.11	
TG (mg/dl)								
Normal					03 (12.0)	1.0		0.036
Altered ≥ 150					40 (42.1)	3.5	1.08 - 11.34	
TG/HDL-c								
Normal					17 (46.0)	1.0		0.025
Altered < 3.8					26 (31.3)	1.98	1.09 - 3.61	
WHR	Males (n = 180)				Females (n = 120)			
HDL-c (mg/dl)								
Normal	29 (64.4)	1.0		0.161				
Altered M < 40 F < 50	48 (35.6)	0.8	0.62 - 1.07					
TG/ HDL-c								
Normal					05 (6.6)	1.0		0.142
Altered < 3.8					25 (56,8)	1.2	0.95 - 1.43	
Multiple analysis adjusted by age								
BMI	n (%)	PR**	95%CI	p-value*	n (%)	PR	95%CI	p-value
TC (mg/dl)								
Normal	37 (41.1)	1.0		0.051				
Altered ≥ 200	66 (73.3)	1.9	1.01 - 3.69					
HDL-c (mg/dl)								
Normal					17 (46.0)	1.0		0.062
Altered M < 40 F < 50					26 (31.3)	1.8	1.01 - 3.45	

*Pearson's chi-square test; ** Linear tendency test; PR - prevalence ratio; 95%CI - confidence interval; BMI - body mass index; %BF - percentage of body fat; WC - waist circumference; WHR - waist-to-hip ratio; TC - total cholesterol; TG - triglycerides; LDL-cholesterol - low-density lipoprotein cholesterol; HDL-cholesterol - high-density lipoprotein cholesterol.*

may be considered a risk factor for cardiovascular diseases for males, and WHR tends to be a risk predictor of cardiovascular diseases for females.

Conclusion

BMI and WHR were the anthropometric indicators that presented higher correlation to lipid profile in both sexes. These data support the hypothesis that BMI and WHR may be considered as risk factors for cardiovascular disease.

Study limitations

As we dealt with a 300-patient sample, there might have been an elevated prevalence of normality for TG (100%) among men.

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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