Association Between Lipid Profile and Adiposity in Women Over Age 60

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Summary

Objective: **To verify the association between lipid profiles and overall or central obesity in women over the age of 60.**

Methods: **The sample was comprised of 388 women over the age of 60 (mean 69; standard deviation 5.9 years). The lipid profile was determined using total cholesterol (TC), HDL cholesterol (HDL-C), LDL cholesterol (LDL-C) and triglyceride (TG) levels. Overall obesity was determined using the body mass index (BMI) and skin fold (SF) measurements. Central obesity was determined using the waist circumference (WC) and waist - hip ratio (WHR). Statistical analysis was conducted using age adjusted partial correlation and one way ANOVA ($p<0.05$).**

Results: **The mean values found for the adiposity variables and lipid profile components indicate an elevated atherogenic risk. In addition, the indicators for overall and central obesity were directly related to TG levels and inversely related to HDL-C levels.**

Conclusion: **The partial correlation analysis and the largest variance found for WC and WHR in comparison to the lipidogram components indicate that both methods could be useful in the early diagnosis of atherosclerosis. (Arq Bras Cardiol 2007;89(3):147-153)**

Key words: **Adiposity; risk factors; atherosclerosis; women.**

Introduction

Cardiovascular diseases, particularly coronary diseases, are the leading cause of mortality throughout the world[1,2]. Atherosclerosis or atherosclerotic disease affects the central and peripheral blood vessels and can be described as an active inflammatory state, characterized by altered inflammatory markers and risk factors[3,4].

Various risk factors for atherogenic development have been described, including increased levels of triglycerides (TG), total cholesterol (TC) and LDL cholesterol (LDL-C); reduced levels of HDL cholesterol (HDL-C), hypertension, diabetes, smoking and a sedentary lifestyle[4,5]. Among these factors, the lipid profile has been studied extensively due to its elevated association with atherogenesis[6-9]. Likewise, body obesity has also been investigated as a risk factor for atherosclerotic and cardiovascular diseases[10-15].

Central obesity is a proven indicator for all causes of mortality in elderly Brazilian women and also elevates the risk for future cardiovascular events[14,15]. These results indicate the importance of investigating how these anthropometric indicators can be used to identify individuals at high risk to develop atherosclerosis.

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Adiposity can be evaluated using anthropometric methods that have various benefits, since they are noninvasive, low cost, easy to perform, widely used in clinics and epidemiological studies, and are an indirect method to assess health risks[16-18].

The most common anthropometric methods used to evaluate adipose tissue accumulation are: waist circumference (WC), waist - hip ratio (WHR), body mass index (BMI) and skin fold measurements (SF). Even though various studies have verified the relation of atherogenic risk with anthropometric measurements and lipid profiles, the results of how the anthropometric variables are associated with the lipid profile are not totally conclusive[10,11,19].

As a result, the association between the direct (lipid profile) and indirect (anthropometric variables to measure the accumulation of adipose tissue) risk factors for atherosclerotic disease is not clear enough to assist the diagnosis of this clinical picture. Therefore, the objective of this study was to verify the association between the lipid profile (TC, TG, LDL-C, HDL-C) and overall obesity, using BMI and SF measurements, and central obesity, using WC and WHR measurements, in women over age 60.

Methods

The study design was an Observational Cross Sectional, Descriptive and Correlational Study. Data was collected between April and July 2006.

Population and Sample - In order to conduct a stratified sample selection, the following steps were taken: 1)

Registration of community groups in the city of Curitiba, Parana, through partnerships with the institutes that offer recreational activities to the population in that region. 2) Mapping of all registered groups in the eight city districts. 3) Simple random allocation of the groups to be invited to participate in the study, done by region. 4) Visit to the group, explanation of the study procedures and invitation for voluntary participation in the study that was extended to the community group members as well as their immediate family members and close friends.

After concluding the sample selection, as described above, the data collection schedule was established. The sample was comprised of 388 women (mean age 69; standard deviation 5.9 years) that were age 60 or older on the data collection date. However, 5 women who had triglyceride levels over 400.0 mg/dl were excluded, resulting in N = 383 for the LDL cholesterol variable.

Most of the women in the sample were white and from a low socioeconomic class (76.3%). Only 23.4% of these women reported that they had undergone medical treatment for dyslipidemia and 13.3% for diabetes. Almost half of the sample (45.7%) reported a family history of coronary disease (father, mother or sibling); 4.4% were smokers; and 63.3% practiced some type of physical exercise on a regular basis (at least 2 hours per week).

After thoroughly explaining the study objectives, procedures, benefits and possible risks involved, the participants signed the consent form, stipulating their voluntary participation. The study protocol was approved by the Ethics Committee of the Biological Sciences Division of the Federal University of Parana, in accordance with the norms established in the Helsinki Declaration and Resolution 196/96 of the National Health Board for studies involving humans.

Instruments and Procedures - In order to avoid the influence of circadian variations, all assessments were conducted between 8:00 a.m. and 10:00 a.m. In addition, the participants were instructed to not perform any vigorous physical activities the day before their appointment and to fast for two hours before the assessment. The assessments were conducted at the Physical Education Department – Physiology Laboratory of the Exercise and Sports Research Center at the Federal University of Parana

The anthropometric variables were obtained in accordance with the procedures outlined by Lohman and associates[20].

To determine height (HGT, centimeters) the individual was placed in the orthostatic position with feet close together, side by side; barefoot, using minimal clothing. In addition, they were asked to maintain inspiratory apnea, with their head in the Frankfort 90º plane. All heel, pelvic waist, scapular waist and occipital region surfaces were in contact with the stadiometer (SANNY, model: STANDARD, precision: 0.1 cm) that was attached to the wall.

Body mass (BM, kilograms) was measured with the individual in the orthostatic position, barefoot, wearing minimal clothing. The individual was asked to equally distribute their body mass between the lower limbs while on the scale (TOLEDO, model: 2096 PP; precision: 0.1 kg).

Body mass index (BMI) was obtained using the quotient body mass/height^2, in which BM is expressed in kg and HGT in m^2 [21].

Waist circumference (WC, centimeters) was measured at the midpoint between the iliac crest and the external face of the last rib. Hip circumference was measured at the largest circumference in the gluteal region, with the evaluator beside the individual. A non-elastic anthropometric tape measure was used to take the measurements (precision: 0.1 centimeters).

The waist-hip ratio was calculated by dividing the waist circumference (in centimeters) by the hip circumference (centimeters)[21].

Skin folds were measured using Lange skinfold calipers (approximation: 0.5mm) at the following anatomical points: triceps, abdomen, suprailiac, midpoint of the thigh and midpoint of the calf, all on the right side of the body[22].

To avoid variations between evaluators, all anthropometric variables (body mass, height, waist circumference and skinfolds) for all the individuals were taken by the same trained evaluator.

Triglyceride and cholesterol levels were evaluated using the enzymatic method. HDL-C was measured using selective precipitation of the low and very low density lipoproteins (LDL and VLDL). After centrifugation, HDL-C was measured in the supernatant, using the enzymatic method. All measurements were analyzed in the COBAS MIRA PLUS spectrophometer (Roche Diagnostics) equipped with calibration filters and DIASYS serum control. The LABTEST kit was used to measure the total cholesterol and triglyceride levels and the DIASYS kit was used for HDL-C. LDL cholesterol was calculated in accordance with the Friedewald[23] formula: LDL-C = total cholesterol - (HDL-C + triglycerides/5). Five individuals were excluded from the LDL-C measurement sample since their triglyceride levels were over 400.0 mg/dl.

Statistical Analysis - The Kolmogorov Smirnov test was used to determine distribution normality.

Next, central tendency and variability measurements were used for descriptive data analysis. Age adjusted partial correlation was used to verify the degree of association between the anthropometric variables and the lipid profile components, while variance analysis (ANOVA) was used to verify the differences between the central obesity measurements (WC and WHR) in accordance with the lipid profile cut-off points.

Data analysis for the present study was conducted using the computer program: Statistical Package for the Social Sciences (SPSS, version 13.0) for Windows.

Results

The descriptive values of the study variables are shown in table 1. Based on the mean BMI and waist circumference measurements, the individuals can be classified as overweight. WHR also presented higher than normal values. Analysis of the mean lipidogram values demonstrates that HDL-C presents the greatest alterations in relation to normality.

Analysis of the associations between the anthropometric study variables related to bodyobesity and the lipid profiles

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is presented in Table 2. Body obesity had a direct association with triglyceride levels and an inverse association with HDL-C, regardless of the anthropometric measurement procedure used.

Tables 3, 4, 5 and 6 present mean WC and WHR measurements in accordance with the reference points related to increased health risks for each lipidogram component.

WC demonstrated greater variability for the triglyceride cut-off points, while WHR presented differences between the extreme reference points. Nevertheless, both WC and WHR demonstrated

Table 1 - Descriptive Values of the Study Variables

	Mean	Standard Deviation	Minimum	Maximum
Age (years)	69.0	5.9	60.0	87.5
BM (kg)	67.7	11.1	39.0	110.0
HGT (cm)	154.6	6.6	132.0	180.0
BMI (kg/m²)	28.3	4.4	17.4	44.6
Waist (cm)	86.4	9.5	63.0	114.0
WHR	0.85	0.07	0.30	1.10
∑ SF (mm)	154.7	34.0	52.0	254.0
TG (mg/dl)	139.3	66.9	32.8	395.2
TC (mg/dl)	197.3	50.1	72.7	390.3
HDL-C (mg/dl)	47.3	12.5	20.1	87.0
LDL-C (mg/dl)	122.2	44.0	- 48.0	309.2

BM - Body Mass; HGT - Height; WHR - Waist-Hip Ratio; ∑SF - Sum of Skin Folds; TG - Triglycerides; TC - Total Cholesterol; HDL-C - High Density Lipoprotein Cholesterol; LDL-C - Low Density Lipoprotein Cholesterol

Table 2 - Association between Body Obesity and Lipidogram Components

Partial Correlation - age adjusted		p
BMI vs TG	0.147	0.004
BMI vs. TC	0.011	0.831
BMI vs. HDL-C	- 0.155	0.002
BMI vs. LDL-C	0.012	0.819
WC vs. TG	0.200	<0.001
WC vs. TC	0.021	0.680
WC vs. HDL-C	- 0.237	<0.001
WC vs. LDL-C	0.031	0.547
WHR vs. TG	0.198	<0.001
WHR vs. TC	-0.026	0.619
WHR vs. HDL-C	- 0.242	<0.001
WHR vs. LDL-C	-0.020	0.692
∑ SF vs. TG	0.108	0.036
∑ SF vs. TC	0.017	0.738
∑ SF vs. HDL-C	- 0.120	0.019
∑ SF vs. LDL-C	0.021	0.680

BMI - Body Mass Index; TG - Triglycerides; TC - Total Cholesterol; HDL-C - High Density Lipoprotein Cholesterol; LDL-C - Low Density Lipoprotein Cholesterol; WC - Waist Circumference; WHR - Waist-Hip Ratio; ∑ SF - Sum of Skin Folds

Table 3 - Triglyceride Variable Description – mean and standard deviation (in brackets) according to the health risk reference points.

Triglycerides (mg/dl)	<150.0 (n=248)	≥150.0 & <200.0 (n=68)	≥200.0 (n=72)
Age (years)	68.8 (5.9)	69.5 (5.6)	68.7 (5.9)
WC (cm)	85.0 (9.5)	88.3 (9.9)*	89.5 (8.3)*
WHR	0.84 (0.07)	0.86 (0.08)	0.87 (0.05)*

*WC - Waist Circumference; WHR - Waist-Hip Ratio; * differs from the category <150.0; p<0.05.*

Table 4 - Total Cholesterol Variable Description – mean and standard deviation (in brackets) according to the health risk reference points.

Total Cholesterol (mg/dl)	<180.0 (n=160)	≥180.0 & <200.0 (n=60)	≥200.0 & <240.0 (n=93)	≥240.0 (n=75)
Age (years)	69.1 (6.1)	68.5 (6.0)	68.9 (5.4)	68.9 (5.9)
WC (cm)	86.4 (8.8)	87.0 (10.8)	86.0 (9.5)	86.5 (10.0)
WHR	0.86 (0.06)	0.86 (0.06)	0.83 (0.09)	0.85 (0.07)

WC - Waist Circumference; WHR - Waist-Hip Ratio.

Table 5 - HDL Cholesterol Variable Description – mean and standard deviation (in brackets) according to the health risk reference points.

HDL Cholesterol (mg/dl)	<40.0 (n=107)	≥40.0 & <65.0 (n=243)	≥65.0 (n=38)
Age (years)	69.1 (6.0)	68.7 (5.8)	70.2 (6.0)
WC (cm)	88.4 (7.9)	86.1 (9.7)	82.6 (11.1)*
WHR	0.86 (0.06)	0.85 (0.08)	0.82 (0.07)*†

*HDL - HDL-C – High Density Lipoprotein; WC- Waist Circumference; WHR- Waist-Hip Ratio; * differs from the category <40.0; † differs from the category ≥40.0 & <65.0; p<0.05*

Table 6 - LDL Cholesterol Variable Description – mean and standard deviation (in brackets) according to the health risk reference points.

LDL Cholesterol (mg/dl)	<100.0 (n=124)	≥100.0 & <130.0 (n=119)	≥130.0 (n=140)
Age (years)	69.7 (6.3)	68.3 (5.6)	68.9 (5.7)
WC (cm)	85.6 (8.9)	86.9 (10.1)	86.6 (9.6)
WHR	0.85 (0.06)	0.86 (0.08)	0.84 (0.07)

LDL - Low Density Lipoprotein; WC - Waist Circumference; WHR - Waist-Hip Ratio.

similar variance in relation to HDL-C. Mean WC and WHR for TC and LDL-C did not reveal any significant alterations.

Discussion

Obesity is a global epidemic[24,25]. Excess body fat elevates the risk for all types of diseases, including cardiovascular diseases[12,14,15,17,26,27]. The women in this study presented overall and central overweight conditions in accordance with the established cut-off points of BMI ≥ 25.0 and < 30.0; and WC ≥ 80 cm and ≤ 88 cm[28,29]. Therefore, it appears that the majority of these women could present an increased indirect risk for atherosclerosis.

This relationship between obesity and cardiac risk should be analyzed cautiously. According to Romero-Corral and associates[30] in a recent meta-analysis study, overweight defined as a BMI between 25.0 and 30.0 kg/m^2 indicated a reduction in the risk of cardiovascular events, suggesting that a generalized overweight condition acts as a cardioprotector. Nevertheless, the study conducted by Cabrera and associates[15] demonstrated that central obesity, expressed by the WHR, predicts future cardiovascular events in women between 60 and 84 years, indicating a hazard ratio (HR) of 1.72 for WHR values higher than 0.98 (HR=1.72; CI 95%; 1.05-2.82; p=0.03).

Atherogenic risks also can be determined using alterations in direct risk factors, such as the lipidograma[31,33]. According to the III Brazilian Guidelines for Dyslipidemia[33] and SOUZA and associates[31] the following cut-off points elevate the risk for this clinical picture: triglycerides (TG) over 150; total cholesterol (TC) over 180; HDL-C lower than 65; and LDL-C over 100. Therefore, the mean lipid profile component values (Table 1) also demonstrate that these women also presented this elevated risk factor.

The association between the indirect and direct risk factors could aid the clinical diagnosis. Hu and associates[34] examined the association between lipid profile alterations and body obesity in women between the ages of 45 and 74, demonstrating that both overall obesity, defined by BMI, and central obesity, defined by WC, were inversely related to HDL-C [r = (-0.024) and r = (-0.23); (p < 0.001) respectively] and LDL-C [r = (-0.08) (p<0.05) and r = (-0.11) (p < 0.001), respectively]. Only WC was directly related to TG levels (r=0.14; p<0.001).

Another evaluation method of overall obesity assessed in the present study was the sum of the skinfolds. Nevertheless, it appears that body fat distribution alterations related to aging cannot be detected through this method. Therefore, the least significant correlates found in this study, in relation to TG and HDL-C, when compared to the other anthropometric variables, could probably be explained by the fact that this evaluation demonstrates a relatively low estimate of body fat in older individuals[35,36].

The study conducted by SOUZA and associates[31] revealed a tendency, for both genders, that individuals with elevated WC measurements also presented elevated levels of TC and TG (over 240.00 and 200.00, respectively). Lakka and associates[37] investigated the variance between the WC and WHR tertiles with the lipid profiles of adult men, demonstrating that as the person became more obese, triglyceride levels became higher and HDL-C levels became lower. The results in the present study are similar to those found by Lakka, in which obesity evaluated by ∑SF, BMI, WC and WHR was directly associated with TG levels and inversely associated with HDL-C levels. Nevertheless, WC and WHR obtained a higher significance level (p < 0.001).

More precise and similar results to those found in the present study are seen in the study conducted by Cabrera and associates[38] on elderly Brazilian women. The great prevalence of low HDL-C levels was found in the women with elevated values of central adiposity (38% for WHR >1.01; and 35.6% for abdominal circumference (AC) >100cm, p<0.05 for both) indicating an inverse relationship between central obesity and HDL-C. In addition, the direct relationship between central obesity and TG also coincides with the results of the present study. The prevalence of central obesity was 28.6% when analyzed by WHR and 27.9% by AC.

The most significant relationship between WC and WHR with the lipid profile components, can be explained by the fact that central obesity is directly related to visceral adiposity which is an indicator of unfavorable metabolic changes. These effects influence atherogenic development and hypertension, as well as causing alterations such as insulin resistance, glucose intolerance, hypertriglyceridemia, LDL-C index elevation and HDL-C index reduction[33,37,38].

Additionally, the large number of women with low HDL-C levels (91.1%) in which 62.5% were classified as moderate risk with values between 40 and 60 mg/dl and 27.6% were classified as high risk, with values lower than 40 mg/dl, indicates that these individuals have a high atherogenic risk, due to the inverse association between the levels of this lipoprotein and atherosclerosis risk in individuals over the age of 50[39,40]. This anti-atherogenic or atheroprotective effect is well defined: for every HDL-C elevation of 1mg/dl, the risk for coronary diseases drops by approximately 2-3%[39,41,42]. Similarly, in men, the increase of a standard deviation in HDL-C, reduces the probability of new cardiovascular events by 15% (p= 0.015)[43].

Limitations - The study sample was comprised of elderly women from community groups in the city of Curitiba-PR, and therefore did not include individuals with more pronounced levels of dependency, who are generally housebound. The results demonstrate a tendency that excess central obesity can cause negative lipid profile changes for this specific population. Therefore, further studies are required, and in particular, studies involving women over the age of 50, in order to examine these associations and contribute to the early diagnosis of these risk factors for cardiovascular diseases.

Conclusions

In accordance with the results of the present study, the women who presented an excess of central adiposity had lipidogram alterations, mainly lower levels of HDL-C. The partial correlation analysis and the greater WC and WHR variations, when compared to the other indirect and direct (lipidogram components) risk factors, indicates that either method can aid in the early diagnosis of unfavorable metabolic effects caused by the accumulation of body fat, such as the development of atherosclerosis.

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Potential Conflict of Interest

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

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