Hypertriglyceridemic waist and cardiometabolic risk in hypertensive women

Nayra Anielly Lima Cabral[1], Valdinar Sousa Ribeiro[2], Ana Karina Teixeira da Cunha França[3], João Victor Leal Salgado[4], Alcione Miranda dos Santos[5], Natalino Salgado Filho[6], Antonio Augusto Moura da Silva[7]

[1] MSc in Collective Health, Universidade Federal do Maranhão (UFMA); Professor, Faculdade São Luis and Uniceuma, São Luís, MA, Brazil
[2] PhD in Pediatrics, Faculdade de Medicina de Ribeirão Preto; Professor, Department of Medicine III, UFMA, São Luis, MA, Brazil
[3] MSc in Collective Health, UFMA; Professor, Department of Physiological Sciences, UFMA, São Luis, MA, Brazil
[4] MSc in Health Sciences, Universidade de Brasília (UNB); Biochemist, Clinical Analysis Service of Hospital Universitário Presidente Dutra, UFMA, São Luis, MA, Brazil
[5] PhD in Production Engineering, Universidade Federal do Rio de Janeiro (UFRJ); Professor, Department of Public Health, UFMA, São Luis, MA, Brazil
[6] PhD in Nephrology, Universidade Federal de São Paulo (UNIFESP); Professor, Department of Medicine I, UFMA, São Luís, MA, Brazil
[7] Post-doctorate in Perinatal Epidemiology, National Perinatal Epidemiology, University of Oxford, England; Professor, Department of Public Health, UFMA, São Luis, MA, Brazil

Summary

Objective: To evaluate the association between hypertriglyceridemic waist (HW) and cardiometabolic risk factors in women with hypertension. **Methods:** A cross-sectional study was performed in 218 patients monitored by HiperDia (Enrollment and Monitoring Program for Hypertensive and Diabetic Individuals) in two health units in São Luis, MA, Brazil. The dependent variable was HW and the independent variables were sociodemographics, lifestyle, anthropometrics, and health problems. **Results:** HW was present in 33% of the sample and was predominant in women aged ≥ 60 years (56.4%), non-whites (81.7%), those with eight or fewer years of schooling (57.3%), and those belonging to socioeconomic class C (49%). Excess weight (68.8%) and hypercholesterolemia (68.8%) were observed. HW was associated with: smoking (PR: 2.08; p = 0.017), overweight (PR: 2.46; p = 0.010), obesity (PR: 4.13; p < 0.001), hypercholesterolemia (PR: 1.87; p = 0.015), high levels of high-density lipoproteins (HDL) cholesterol (PR: 3.41; p < 0.001), and fasting glycemia ≥ 100 mg/dL or being diabetic (PR: 1.86; p = 0.006). After adjustment, total cholesterol (PR = 1.78; p = 0.012), HDL-cholesterol (PR: 3.03; p < 0.001), body mass index (BMI) ≥ 25 to < 30 kg/m² (PR = 2.60; p = 0.005), and BMI ≥ 30 kg/m² (PR = 3.61; p < 0.001) remained associated. **Conclusion:** A high prevalence of HW and its association with altered lipid profile and excess body weight was observed. HW showed to be an important diagnostic tool for the monitoring of hypertensive women with metabolic risk, which is low cost, easily accessible, and useful in clinical practice, especially in primary health care in the Brazilian Unified Health System (Sistema Único de Saúde – SUS).

Keywords: Waist circumference; hypertriglyceridemia; hypertension.

Study conducted at the Post-graduate Program in Collective Health, UFMA, São Luis, MA, Brazil

Submitted on: 04/14/2012
Approved on: 06/18/2012

Financial support:
Fundação de Amparo à Pesquisa e ao Desenvolvimento Científico e Tecnológico do Maranhão (FAPEMA)

Correspondence to:
Nayra Anielly Lima Cabral
Rua G, Quadra A, Casa 6
Olho d'água
Jardim Atlântico – São Luis, MA, Brazil
CEP: 65067-430
Phone: +55 98 8815-6783
n_anielly@yahoo.com.br

Conflict of interest: None.

Introduction

The hypertriglyceridemic waist (HW) is defined as the simultaneous presence of increased waist circumference (WC) associated with high levels of triglycerides (TG)[1]. The prevalence of HW ranges from 10.8% in Spanish women[2], 10.9% in Brazilian adult women[3], 23.6% in Iranian women[4], and 33.6% in Chinese women[5].

The clinical importance of HW is the high correlation of WC with apolipoprotein B and insulin levels, and of TG with the small, dense particles of LDL (low density lipoprotein) cholesterol[1,4,6,7]. Thus, HW can be used as first-screening phenotype to identify patients likely to be characterized as carriers of the atherogenic metabolic triad: fasting hyperinsulinemia, hyperapolipoprotein B, and high concentration of small LDL particles[8], both in adults and adolescents[1].

Furthermore, its discriminatory power to identify patients with cardiometabolic risk profile is comparable to that of the National Cholesterol Evaluation Program for Adult Treatment Panel III (NCEP-ATP III) and that of the International Diabetes Federation (IDF)[6], as it has good sensitivity, specificity[9], and low cost to identify individuals at higher cardiometabolic risk[7,10,11].

It has been observed that, of the cardiovascular diseases (CVD), systemic arterial hypertension (SAH) exposes the patient to greater risk for HW[12]. Thus, the use of this phenotype may make the cardiovascular risk assessment of individuals a more practical, feasible, and less expensive approach, especially in primary health services in the country[3]. However, there have been few studies that have analyzed HW, especially among the population treated in the Brazilian Unified Health System (Sistema Único de Saúde – SUS).

Considering the simplicity and clinical relevance of this indicator, this study aimed to assess the association between HW and cardiometabolic risk factors in women with hypertension followed at a primary health care center.

Methods

This is a cross-sectional study with patients treated and followed at the HiperDia Health Centers of Companhia de Habitação (COHAB) and São Francisco, in the city of São Luís, state of Maranhão, Brazil. Data was collected from January to July, 2010.

The study included hypertensive women aged ≥ 20 years. The exclusion criteria were: pregnancy, other chronic consumptive diseases (cancer and AIDS), and being on renal replacement therapy.

Simple random sampling was performed without replacement, based on a list with the names of hypertensive patients enrolled in the HiperDia program of the surveyed units. Sample size calculation was performed considering a total of 400 hypertensive women enrolled in HiperDia, prevalence of hypertriglyceridemic waist of 10.9%[3], margin of error of 3%, and a confidence level of 95%. The estimated number of patients was 204. In order to correct for potential losses during the data collection process, it was decided to increase the sample by 15%, totaling 234 women.

Data collection of was performed through a structured questionnaire. To ensure standardization of information, the staff was trained and a pilot study was performed. Socioeconomic, demographic, lifestyle, and anthropometric data, as well as information on health problems, were collected.

The socioeconomic status was categorized into classes, according to the Brazilian Economic Classification Criterion (Critério de Classificação Econômica Brasil – CCEB) of the Brazilian Association of Research Companies (Associação Brasileira de Empresas de Pesquisa – ABEP), which estimates the purchasing power of individuals and urban families; skin color was self-reported, being categorized as white or non-white.

The women who admitted to smoke cigarettes or consume alcohol during the interview were considered smokers or alcohol-consumers, regardless of the frequency. The level of physical activity was categorized as sedentary, when they acknowledged practicing no physical activity or practiced twice a week or less, and as active, when they reported practicing physical activity three or more times a week.

The patients' blood pressure (BP) was measured using an automatic digital sphygmomanometer, (Omron® HEM-742INT), by indirect method, with cuffs of appropriate size, following the recommendations of the VI Brazilian guidelines on hypertension. Three measurements were performed with an interval of ten minutes; the mean value of the three measurements was used in the analysis. BP was considered to be controlled when the mean systolic BP was < 140 mmHg and the diastolic BP < 90 mmHg[13].

Anthropometric assessment was performed by measuring the weight (in kilograms) on a portable digital balance (Plena®), height (in meters) on a stadiometer (Alturexata®), and WC (in cm) using a non-extendable measuring tape. The WC was obtained at midpoint between the last rib and the iliac crest, at the moment of expiration. The weight-height adequacy was determined by the BMI, obtained from the ratio between body weight and the square of the height, and patients were classified as having normal weight when BMI < 25.0 kg/m², overweight when 25.0 kg/m² ≤ BMI < 30.0 kg/m², and obese when BMI ≥ 30.0 kg/m², according to the World Health Organization[14].

The clinical and laboratory assessment included serum total cholesterol (TC), high-density lipoprotein (HDL) and LDL, TG, fasting glycemia (FG), and glycated A1c hemoglobin (HbA1c). The analytical methods used

were Roschlan et al.[15] for HDL and the Friedewald formula-i.e., total cholesterol minus HDL cholesterol minus very-low-density lipoprotein (VLDL) cholesterol (estimated as triglyceride ÷ 5)- by lipoprotein fractionation for LDL; enzymatic methods were used for cholesterol, triglycerides, and fasting glycemia. The reference values for altered TC, LDL, and HDL levels were those recommended by the VI Brazilian guidelines on hypertension (TC ≥ 200 mg/ dL, HDL < 40 mg/dL, LDL > 100 mg/dL). FG values were considered abnormal when glucose serum levels were ≥ 100 mg/dL or when the individual was diabetic; for HbA1c, serum levels ≥ 7% were considered altered[16].

The dependent variable of the study was HW, which was defined according to criteria adopted by the NCEP-ATP III[17], with the following cutoffs for women: WC ≥ 88 cm and TG ≥ 150 mg/dL.

The normality of quantitative variables was analyzed by the Shapiro-Wilks test. Data were shown as means and standard deviation (mean ± SD) for quantitative variables, and as frequencies and percentages for qualitative variables. The Poisson regression model was used to identify factors associated with hypertriglyceridemic waist. The significance level was set at 5%. The prevalence ratio (PR) and the respective 95% confidence intervals (95% CI) were also estimated.

Independent variables with p-value < 0.20 were considered in the multivariate Poisson regression model. Variable selection was performed by the stepwise method by elimination, and the significance level was set at 10%. The data were analyzed using the statistical software STATA 10.0.

The patients who agreed to participate in the study signed an informed consent. The study was approved by the Ethics Committee in Research of the Hospital Universitário Presidente Dutra (CEP-HUPD), under protocol No. 3128/2009. The present study has no conflict of interest.

Results

A total of 218 women were evaluated. There was a loss of 6.8% (n = 16) patients due to change of address, insufficient data for HW analysis, or refusal to participate in the study. The mean age was 60.9 ± 12.6 years; most patients were elderly (56.4%), non-white (81.7%), had eight years of schooling or less (57.3 %), and belonged to socioeconomic class C (49.0%), according to the Brazil Economic Classification Criterion. Other sociodemographic and lifestyle characteristics of the studied patients are shown in Table 1.

The mean duration of hypertension was 11.2 ± 9.7 years; 57.8% of women had uncontrolled blood pressure (≥ 140 x 90 mmHg), and 33.5% had associated diabetes (data not shown in Table). The prevalence of HW was 33%.

Table 1 – Sociodemographic, lifestyle, and health problems characteristics of hypertensive women enrolled at HiperDia, São Luís – MA, Brazil

Variables	n	%
Age range		
20 to 39 years	14	6.4
40 to 59 years	81	37.2
≥ 60 years	123	56.4
Smoker		
Non-smoker or ex-smoker	212	97.3
Yes	6	2.7
Alcohol consumption		
No alcohol consumption or stopped consuming alcohol	189	86.7
Yes	29	13.3
Level of physical activity		
Active	41	18.8
Sedentary	177	81.2
Hypertriglyceridemic waist		
Yes	72	33.0
No	146	67.0
Blood pressure (mmHg)		
< 140 x 90	92	42.2
≥ 140 x 90	126	57.8
BMI (kg/m²)		
< 25	68	31.2
≥ 25 to < 30	86	39.4
≥ 30	64	29.4
WC (cm)		
< 88	71	32.6
≥ 88	147	67.4
Triglycerides (mg/dL)		
< 150	123	56.4
≥ 150	95	43.6
Total cholesterol (mg/dL)		
< 200	68	31.2
≥ 200	150	68.8
HDL-cholesterol (mg/dL)		
≥ 40	167	77.3
< 40	49	22.7
LDL-cholesterol (mg/dL)		
≤ 100	35	16.1
> 100	183	83.9
Glycemia (mg/dL)		
< 100	88	40.4
≥ 100 or diabetic	130	59.6
Glycated hemoglobin (%)		
< 7	163	76.5
≥ 7	50	23.5

BMI, body mass index; WC, waist circumference; HDL, high-density lipoproteins; LDL, low-density lipoproteins.

There was a high prevalence of excess weight (overweight and obesity) according to BMI (68.8%), as well as of WC ≥ 88 cm (67.4%). Similarly, most patients had higher serum levels than those recommended for TC (68.8%),

and LDL (83.9%), and lower levels of HDL (77.3%). The prevalence of patients with fasting glycemia ≥ 100 mg/dL or diabetes was 59.6%; high levels of glycated hemoglobin (≥ 7%), 23.5%; and hypertriglyceridemia (TG ≥ 150 mg/dL), 43.6% (Table 1).

Smoking was associated with HW, with a PR of 2.08 (95% CI: 1.14 to 3.79). The same occurred with BMI, since having 25 kg/m² ≤ BMI < 30 kg/m² showed a PR of 2.46 (95% CI: 1.24-4.86) and BMI ≥ 30 kg/m², a PR of 4.13 (95% CI: 2.16-7.91). There were no statistically significant associations among socio-demographic variables and lifestyle with HW (Table 2).

Having altered serum total cholesterol (≥ 200 mg/dL) and HDL levels (< 40 mg/dL) was associated with HW, with PR of 1.87 (95% CI: 1.13-3.13) and 3.41 (95% CI: 2.42-4.81). Diabetes or FG ≥ 100 mg/dL showed an association with HW, with PR of 1.76 (95% CI: 1.13-2.73) (Table 2).

Table 3 shows the adjusted analysis, where the following variables remained associated with HW: total cholesterol ≥ 200 mg/dL (PR = 1.78; 95% CI: 1.14-2.78); HDL < 40 mg/dL (PR = 3.03; 95% CI: 2.18-4.23), 25.0 ≤ BMI < 30 kg/m² (PR = 2.60; 95% CI: 1.34-5.02), and BMI ≥ 30 kg/m² (PR = 3.61; 95% CI: 1.91-6.82).

Discussion

The prevalence of HW in the studied hypertensive women was high (33%) and was associated with smoking, overweight, hypercholesterolemia and HDL < 40 mg/dL, and being diabetic or having a FG ≥ 100 mg/dL. In the adjusted

Table 2 – Non-adjusted analysis of the association between lifestyle and anthropometric characteristics and health problems with hypertriglyceridemic waist (HW) phenotype in hypertensive women enrolled at HiperDia, São Luis – MA, Brazil

Variables	HW		PR (95% CI)	p-value
	Yes n (%)	No n (%)		
Smoker				0.017
Non-smoker or ex-smoker	68 (94.4)	144 (98.6)	1.00	
Yes	4 (5.6)	2 (1.4)	2.08 (1.14-3.79)	
Alcohol consumption				0.121
No alcohol consumption or stopped consuming alcohol	59 (81.9)	130 (89.0)	1.00	
Yes	13 (18.1)	16 (11.0)	1.44 (0.91-2.27)	
Level of physical activity				0.064
Active	8 (11.1)	33 (22.6)	1.00	
Sedentary	64 (88.9)	113 (77.4)	1.85 (0.96-3.56)	
BMI (kg/m²)				
< 25	9 (12.5)	59 (40.4)	1.00	
≥ 25 a < 30	28 (38.9)	58 (39.7)	2.46 (1.24-4.86)	0.010
≥ 30	35 (48.6)	29 (19.9)	4.13 (2.16-7.91)	< 0.001
Total cholesterol (mg/dL)				0.015
< 200	14 (19.4)	54 (37.0)	1.00	
≥ 200	58 (80.6)	92 (63.0)	1.87 (1.13-3.13)	
HDL-cholesterol (mg/dL)				< 0.001
≥ 40	35 (50.0)	132 (90.4)	1.00	
< 40	35 (50.0)	14 (9.6)	3.41 (2.42-4.81)	
LDL-cholesterol (mg/dL)				0.194
≤100	8 (11.1)	27 (18.5)	1.00	
>100	64 (88.9)	119 (81.5)	1.53 (0.81-2.91)	
Glycemia (mg/dL)				0.012
<100	20 (27.8)	68 (46.6)	1.00	
≥ 100 or diabetic	52 (72.2)	78 (53.4)	1.76 (1.13-2.73)	
Glycated hemoglobin (%)				0.085
< 7	48 (69.6)	115 (79.9)	1.00	
≥ 7	21 (30.4)	29 (20.1)	1.43 (0.95-2.13)	

PR, prevalence ratio; CI, confidence interval; BMI, body mass index; WC, waist circumference; HDL, high-density lipoprotein; LDL, low-density lipoprotein.

Table 3 – Adjusted analysis of the association between socioeconomic, demographic, lifestyle and health problems with hypertriglyceridemic waist phenotype in hypertensive women enrolled at HiperDia, São Luis – MA, Brazil

Variables	PR	(95% CI)	p-value
Total cholesterol (mg/dL)			0.012
< 200	1.00		
≥ 200	1.78	1.14-2.78	
HDL-cholesterol (mg/dL)			< 0.001
≥ 40	1.00		
< 40	3.03	2.18-4.23	
BMI (kg/m^2)			
< 25	1.00		
≥ 25 a < 30	2.60	1.34-5.02	0.005
≥ 30	3.61	1.91-6.82	< 0.001

PR, prevalence ratio; CI, confidence interval; HDL, high-density lipoprotein; BMI, body mass index.

analysis, only overweight and obesity (according to the BMI), total cholesterol ≥ 200 mg/dL, and HDL cholesterol < 40 mg/dL remained associated.

In this study, the prevalence of HW was three times higher than that observed by Mendes et al.[3] in women from a Brazilian rural community. International studies that evaluated HW in non-hypertensive patients found a prevalence of 10.8% in Spanish women[2], 23.6% in Iranian women[4], and 33.6% in Chinese women[5]. This variation may be due to the use of different cutoff points for HW and serum triglycerides. Another explanation is ethnicity[4], which correlates the ethnic groups with a greater tendency to develop hypertension. Conversely, it must be considered that the study subjects were hypertensive, with a high percentage of high blood glucose, and with older mean age, a situation that represents a greater chance of developing CVD and, therefore, HW[3,12].

Overweight and obesity, measured by BMI, are strongly associated with HW. This finding is consistent with those by Mendes and Melendez, who observed that 21.4% of a population from the state of Minas Gerais was obese and had HW ($p < 0.001$)[3], and by Amini et al. who studied a sample of individuals from Iran and observed that those with HW had higher BMI ($p < 0.001$)[4]. These authors have demonstrated that subjects with HW have overall obesity, in addition to increased visceral fat[3], explained by the strong correlation between WC and BMI[18]. The importance of the consequences of excess weight is emphasized in a study that shows the relationship between increased body mass and higher blood pressure, metabolic alterations, and increased cardiovascular risk[19].

The lipid profile measured by TC and HDL was altered and associated with HW, which was also observed in a study conducted in Brazil, which found that 64.3% of the studied population had high levels of TC, with a significant association with HW ($p < 0.001$)[3]. A study performed in Iran found that the female patients had altered levels of TC and HDL, in a significant association with HW ($p < 0.001$)[4]. Another study demonstrated that white men had an altered lipid profile associated with HW ($p < 0.05$)[6]. Similarly, a study of diabetic patients from a developed country showed that, in this population, the mean TC was 197 ± 40 mg/dL, associated with HW ($p < 0.001$), whereas the mean HDL was 46 ± 17 mg/dL, associated with HW ($p < 0.05$)[20].

Hypertriglyceridemia associated with altered WC could be a marker of excess lipids, resulting from an apparent defect of the adipose tissue to control the excess of triglycerides derived from overnutrition and lack of physical activity[21]. Thus, the increase in WC is associated with the increase in intra-abdominal fat, which in turn could result in a higher production of lipids[12], contributing to increased cardiovascular risk.

It was observed that diabetes and high fasting glycemia were associated with HW only in the univariate analysis. However, other researchers have demonstrated this association[4,22], which significantly contributes to the risk of developing CVD[23].The more adverse metabolic profile in patients with HW observed here is consistent with that demonstrated in the literature[4,11,24], confirming the importance of this marker in identifying patients with excess visceral adipose tissue, with ectopic accumulation of fat, and in cardiometabolic[23] metabolic syndrome risk[7, 21, 22, 25].

As this is a cross-sectional study, it was not possible to establish a causal relationship between HW and associated factors in hypertensive women, but an association between these conditions can be inferred. Another limitation is the lack of assessment of the drug therapy, which can interfere with HW. However, it must be considered that all patients were enrolled in the HiperDia Program and had access to essential drugs recommended by the Ministry of Health, which are available, free of charge, at all basic health units.

Conversely, one of the strong points of the study is the demonstration that HW can help in the control of cardiometabolic diseases, contributing to improve the quality of life and reducing government health care costs.

Conclusion

The present study showed a high prevalence of HW and its association with altered lipid profile and excess body weight. HW may be useful in the daily routine of the SUS. It is a practical diagnostic tool, easily accessible, and less costly for screening hypertensive patients at cardiometabolic risk; it may be included in clinical practice of basic health care units.

References

1. Lemieux I, Pascot A, Couillard C, Lamarche B, Tchernof A, Almeras N, et al. Hypertriglyceridemic waist: a marker of the atherogenic metabolic triad (hyperinsulinemia; hyperapolipoprotein B; small, dense LDL) in men?. Circulation. 2000;102(2):179-84.
2. Gomez-Huelgas R, Bernal-Lopez MR, Villalobos A, Mancera-Romero J, Baca-Osorio AJ, Jansen S, et al. Hypertriglyceridemic waist: an alternative to the metabolic syndrome? Results of the IMAP Study (multidisciplinary intervention in primary care). Int J Obes (Lond). 2011;35(2):292-9.
3. Mendes MSF, Melendez JGV. Cintura hipertrigliceridêmica e sua associação com fatores de risco metabólicos [MSc dissertation]. Belo Horizonte: Universidade Federal de Minas Gerais; 2009.
4. Amini M, Esmaillzadeh A, Sadeghi M, Mehvarifar N, Zare M. The association of hypertriglyceridemic waist phenotype with type 2 diabetes mellitus among individuals with first relative history of diabetes. J Res Med Sci. 2011;16(2):156-64.
5. Yu D, Huang J, Hu D, Chen J, Cao J, Li J. Is an appropriate cutoff of hypertriglyceridemic waist designated for type 2 diabetes among Chinese adults? Clin Nutr. 2010;29(2):192-8.
6. Blackburn P, Lemieux I, Almeras N, Bergeron J, Cote M, Tremblay A, et al. The hypertriglyceridemic waist phenotype versus the National Cholesterol Education Program-Adult Treatment Panel III and International Diabetes Federation clinical criteria to identify high-risk men with an altered cardiometabolic risk profile. Metabolism. 2009;58(8):1123-30.
7. Arsenault BJ, Lemieux I, Despres JP, Wareham NJ, Kastelein JJ, Khaw KT, et al. The hypertriglyceridemic-waist phenotype and the risk of coronary artery disease: results from the EPIC-Norfolk prospective population study. CMAJ. 2010;182(13):1427-32.
8. Lemieux I, Poirier P, Bergeron J, Almeras N, Lamarche B, Cantin B, et al. Hypertriglyceridemic waist: a useful screening phenotype in preventive cardiology? Can J Cardiol. 2007;23(Suppl B):23B-31B.
9. Manrique-Vera A, Manrique-Hurtado H. Frecuencia del fenotipo "cintura hipertrigliceridémica' y su asociación con el síndrome metabólico en adultos con sobrepeso y obesidad/ The "hypertriglyceridemic waist" phenotype and its association with the metabolic syndrome in overweight and obese adults. [cited 2010 mar 23]. Available from: http://pesquisa.bvsalud.org/regional/resources/lil-568277.
10. Bos G, Dekker JM, Heine RJ. Non-HDL cholesterol contributes to the "hypertriglyceridemic waist" as a cardiovascular risk factor: the Hoorn study. Diabetes Care. 2004;27(1):283-4.
11. St-Pierre J, Lemieux I, Perron P, Brisson D, Santure M, Vohl MC, et al. Relation of the "hypertriglyceridemic waist" phenotype to earlier manifestations of coronary artery disease in patients with glucose intolerance and type 2 diabetes mellitus. Am J Cardiol. 2007;99(3):369-73.
12. Esmaillzadeh A, Mirmiran P, Azizi F. Clustering of metabolic abnormalities in adolescents with the hypertriglyceridemic waist phenotype. Am J Clin Nutr. 2006;83(1):36-46; quiz 183-4.
13. VI Brazilian Guidelines on Hypertension. Arq Bras Cardiol. 2010;95(1Suppl):1-51.
14. Physical status: the use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser. 1995;854:1-452.
15. Roschlan P, Bernt GW. Enzimatische Best immung desgesamtcholesterius in serum. J Clin Chem Bio. 1974;12:403-7.
16. Standards of medical care in diabetes. Diabetes Care. 2005;28(Suppl 1):S4-S36.
17. Executive Summary of The Third Report of The National Cholesterol Education Program (NCEP) Expert Panel on Detection. Evaluation, and treatment of high blood cholesterol in adults (adult treatment Panel III). JAMA. 2001;285(19):2486-97.
18. Oliveira MA, Fagundes RL, Moreira EA, Trindade EB, Carvalho T. Relation between anthropometric indicators and risk factors for cardiovascular disease. Arq Bras Cardiol. 2010;94(4):478-85.
19. Lopes HF, cartographer Hipertensão e inflamação: papel da obesidade. Rev Bras Hipertensão. 2007;14(4):239-44.
20. de Graaf FR, Schuijf JD, Scholte AJ, Djaberi R, van Velzen JE, Roos CJ, et al. Usefulness of hypertriglyceridemic waist phenotype in type 2 diabetes mellitus to predict the presence of coronary artery disease as assessed by computed tomographic coronary angiography. Am J Cardiol. 2010;106(12):1747-53.
21. Despres JP, Cartier A, Cote M, Arsenault BJ. The concept of cardiometabolic risk: bridging the fields of diabetology and cardiology. Ann Med. 2008;40(7):514-23.
22. Egeland GM, Cao Z, Young TK. Hypertriglyceridemic-waist phenotype and glucose intolerance among Canadian Inuit: the International Polar Year Inuit Health Survey for Adults 2007-2008. CMAJ. 2011;183(9):E553-8.
23. Sam S, Haffner S, Davidson MH, D'Agostino RB, Feinstein S, Kondos G, et al. Hypertriglyceridemic waist phenotype predicts increased visceral fat in subjects with type 2 diabetes. Diabetes Care. 2009;32(10):1916-20.
24. Espinoza ZM, Ruiz FN, Barrios E, Reigosa A, Leal HU, González JC. Perfil metabólico de riesgo cardiovascular y resistencia a la insulina según índice de masa corporal, circunferencia de cintura y cintura hipertrigliceridémica en pacientes adultos. Rev Med Chile. 2009;137(9):1179-86.
25. Gazi IF, Filippatos TD, Tsimihodimos V, Saougos VG, Liberopoulos EN, Mikhailidis DP, et al. The hypertriglyceridemic waist phenotype is a predictor of elevated levels of small, dense LDL cholesterol. Lipids. 2006;41(7):647-54.