CARDIOVASCULAR RISK FACTORS AND PREVALENCE OF METABOLIC SYNDROME IN THE ELDERLY

Fatores de risco cardiovascular e prevalência de síndrome metabólica em idosos

Factores de riesgo cardiovascular y prevalencia del síndrome metabólico en mayores

ABSTRACT

Objective: To evaluate the prevalence of metabolic syndrome (MS) in elderly patients seen at a Basic Health Unit (BHU) and the relationship between anthropometric, hemodynamic and biochemical measures. **Methods:** Cross-sectional study with 94 elderly seen at Cecilia de Sousa Neri UBS, in Picos, Piauí, in the period from August to October 2011. Weight, height, waist circumference (WC), and systolic (SBP) and diastolic (DBP) blood pressure were evaluated, and biochemical data was collected. The metabolic syndrome was characterised by the presence of three or more risk factors, in accordance with the National Cholesterol Education Program. The study applied t-test and Mann-Whitney test for comparison of means between the sexes, Pearson's correlation between the anthropometric, hemodynamic and biochemical variables, and associations between variables using chi-square test, with 5% significance level. **Results:** Of the sample, 68.1% (n=64) were women. Mean WC was 102.4 ± 11.4 cm (males) and 96.2 ± 13.2 cm (females), (p=0.031). MS was diagnosed in 38.64% (n=34) of the participants, being 28.40% (n=25) for women (p=0.252). There was a significant correlation between weight and SBP (r=0.273; p=0.0076), weight and DBP (r=0.379; p=0.0002), WC and SBP (r=0.248; p=0.0158), WC and DBP (r=0.255; p=0.0129), BMI and SBP (r=0.294; p=0.0041), BMI and DBP (r=0.318; p=0.0018), weight and blood glucose (r=0.184; p=0.0855) and DBP and blood glucose (r=0.219; p=0.0403). **Conclusion:** There was high prevalence of MS, as well as positive relationships between the anthropometric variables, blood glucose, triglycerides and arterial blood pressure, showing the need for monitoring and control of these cardiovascular risk factors.

Descriptors: Blood Pressure; Blood Glucose; Anthropometry; Chronic Disease.

José Filho da Silva[1]
Joilane Alves Pereira Freire[1]
Karoline de Macedo Gonçalves Frota[1]
Aderson José da Silva Júnior[1]

1) Federal University of Piauí
(*Universidade Federal do Piauí - UFPI*) -
Teresina (PI) - Brazil

RESUMO

Objetivo: *Avaliar a prevalência da síndrome metabólica (SM) em idosos atendidos em uma Unidade Básica de Saúde (UBS) e a relação entre medidas antropométricas, hemodinâmicas e bioquímicas.* **Métodos:** *Estudo transversal com 94 idosos atendidos na UBS Cecília de Sousa Neri, em Picos-PI, no período de agosto a outubro de 2011. Foram avaliados peso, altura, circunferência da cintura (CC), pressão arterial sistólica (PAS) e diastólica (PAD); além disso, coletou-se informação sobre dados bioquímicos. Considerou-se síndrome metabólica (SM) quando presentes três ou mais fatores de risco, segundo o National Cholesterol Education Program. Realizou-se o teste t e de Mann-Whitney, para comparação de médias entre os sexos, correlação de Pearson entre variáveis antropométricas, hemodinâmicas e bioquímicas, e associação entre as variáveis pelo teste qui-quadrado, com nível de significância de 5%.* **Resultados:** *Amostra com 68,1% (n=64) de mulheres. A média de CC foi de 102,4 ± 11,4 cm (homens) e 96,2 ± 13,2 cm (mulheres), (p=0,031). A SM foi diagnosticada em 38,64% (n=34) dos pesquisados, sendo de 28,40% (n=25) para as mulheres (p=0,252). Houve correlação significativa entre peso e PAS (r=0,273; p=0,0076), peso e PAD (r=0,379; p=0,0002), CC e PAS (r=0,248; p=0,0158), CC e PAD (r=0,255; p=0,0129), IMC e PAS (r=0,294; p=0,0041), IMC e PAD (r=0,318; p=0,0018),*

peso e glicemia (r=0,184; p=0,0855), PAD e glicemia (r=0,219; p=0,0403). **Conclusão:** *Houve elevada prevalência de SM, além de relações positivas entre variáveis antropométricas, glicemia, triglicerídeos e pressão arterial, o que mostra a necessidade de monitoramento e controle desses fatores de risco cardiovascular.*

Descritores: *Pressão Arterial; Glicemia; Antropometria; Doença Crônica.*

RESUMEN

Objetivo: *Evaluar la prevalencia del síndrome metabólico (SM) en mayores asistidos en una Unidad Básica de Salud (UBS) y la relación entre medidas antropométricas, hemodinámicas y bioquímicas.* **Métodos:** *Estudio transversal con 94 mayores asistidos en la UBS Cecília de Sousa Neri, en Picos-PI, entre agosto y octubre de 2011. Fueron evaluados el peso, la altura, la circunferencia de la cintura (CC), la presión arterial sistólica (PAS) y diastólica (PAD); además, se recogió informaciones de los datos bioquímicos. Se consideró el síndrome metabólico (SM) cuando se identificaba tres o más factores de riesgo según el National Cholesterol Education Program. Se realizó la prueba t y de Mann-Whitney para comparación de medias entre los sexos, correlación de Pearson entre las variables antropométricas, hemodinámicas y bioquímicas y asociación de las variables a través de la prueba del Chi-cuadrado con nivel de significancia del 5%.* **Resultados:** *Muestra con el 68,1% (n=64) de mujeres. La media de CC fue de 102,4 ± 11,4cm (hombres) y 96,2 ± 13,2cm (mujeres), (p=0,031). El SM fue diagnosticado en el 38,64% (n=34) de los investigados con un 28,40% (n=25) en las mujeres (p=0,252). Hubo correlación significativa entre el peso y la PAS (r=0,273; p=0,0076), el peso y la PAD (r=0,379; p=0,0002), la CC y la PAS (r=0,248; p=0,0158), la CC y la PAD (r=0,255; p=0,0129), el IMC y la PAS (r=0,294; p=0,0041), el IMC y la PAD (r=0,318; p=0,0018), el peso y la glucosa (r=0,184; p=0,0855), la PAD y la glucosa (r=0,219; p=0,0403).* **Conclusión:** *Hubo elevada prevalencia del SM, además de relaciones positivas entre las variables antropométricas, glucemia, triglicéridos y presión arterial lo que sugiere la necesidad del control de esos factores de riesgo cardiovascular.*

Descriptores: *Presión arterial; Glucemia; Antropometría; Enfermedad Crónica.*

INTRODUCTION

The increase in the elderly population in Brazil in recent years is a result of population aging process that occurs gradually and inevitably with advancing age, regardless of lifestyle, environmental factors or diseases. This process leads to morphological and physiological changes, propitiating greater incidence of pathological processes[1].

According to the United Nations, in 2011 the elderly accounted for 11% of world population, and in 2050 will correspond to 22%[2]. Therefore, a larger number of people are reaching older ages and living more years, though with greater disability. Benefits of the infrastructure, sanitation and housing systems, along with social changes in the areas of education, perception and behaviour, linked to the areas of health and nutrition, have been associated to the population's increased longevity, with a consequent increase in the number of elderly[3,4].

In view of this global panorama of rapid population aging and life prolongation, the challenges are established. The main one regards prevention and health promotion, and treatment measures, when a part of that elderly contingent presents any kind of illness and/or disability[3].

So, the challenge is not to prolong life without improvement of quality of life, but to settle proper care, prevention and health promotion, not only for the most tender ages, but also in the aging phase, thus preventing premature deaths of elderly, given that this group of individuals is more vulnerable to disease, often entailed by chronic degenerative diseases such as the metabolic syndrome[1,3].

Metabolic syndrome (MS) is a set of factors that, in association, increase the risk of cardiovascular problems. These factors are: obesity; increased waist circumference; high blood pressure; alterations in cholesterol, triglycerides and blood glucose. Noting that, to make the diagnosis, it is necessary that the patient has three out of the five risk factors mentioned[5]. This syndrome is currently one of the biggest challenges to public health, for being associated with cardiovascular diseases, the leading cause of death worldwide[1].

The elderly are the population group with the highest prevalence of cardiovascular events. Thus, to determine the prevalence of metabolic syndrome among them is of great importance for the risk control measures. Moreover, there is greater risk for cognitive deficits among patients with this syndrome, particularly when altered blood glucose is one of its component[4,6].

This study aimed to assess the prevalence of metabolic syndrome in elderly patients at a Basic Health Unit (BHU) and the relationship between anthropometric, hemodynamic, and biochemical measures.

METHODS

This was a quantitative and cross-sectional study, conducted in elderly patients older than 60 years treated at a BHU, participants of the Hiperdia Program by the Family Health Strategy, developed in the period from August to October 2011.

According to the Municipal Health Secretariat, that BHU in the city of Picos, PI has 561 registered elderly, being 310 females and 251 males. The final sample (n=94) of this research, however, represented 16.8% of the total, formed by convenience, according to the BHU demand in the period established for collection. Elderly with physical disability, liver disease, hepatic steatosis, and cancer were excluded.

For assessment of the nutritional status, weight, height, and waist circumference measures were collected. Weight and height measurement was performed by a trained evaluator, according to standardization[7]. One measure of weight and three measures of height were obtained, being considered the mean of the height values. To carry out the waist circumference measurements, the evaluator used an inelastic and flexible tape measuring 150 cm long, accurate to one decimal place, in obedience to the standardization[8,9]. The measurement occurred with the individual standing upright, with relaxed abdomen, arms along the body and feet together.

Blood pressure (BP) was verified in a single moment, in triplicate, in the left arm, with Premium® sphygmomanometer. Before measurement, each subject sat for 20 minutes, the measurement being held in this position. The average values that allow the classification of adults aged above 18 years followed the VI Brazilian Guidelines on Arterial Hypertension (2010)[10].

From the weight and height values, the Body Mass Index (BMI) was calculated, according to the following formula: weight/height² (kg/m²), and the nutritional status was classified according to the criteria for the elderly: low weight, BMI <22 kg/m²; eutrophic, values between 22 and <27 kg/m²; and overweight, BMI above 27 kg/m² [11].

Biochemical parameters (blood glucose, triglycerides) were collected using secondary data, with results of tests performed in period of up to three months prior to the survey. This data was recorded in a specific form prepared by the researchers. It is emphasized that the tests were performed in clinical laboratories in the city of Picos, PI, by means of enzymatic colorimetric tests using kits purchased from Labtest (Belo Horizonte, MG) in modular equipment from Roche Diagnostics. The reference values for triglycerides were defined according to the V Brazilian Guidelines on Dyslipidemia and Prevention of Atherosclerosis[12] and, for fasting glucose, according to the National Cholesterol Education Program (2001)[5].

The study considered metabolic syndrome when present three or more of the following changes in the elderly: abdominal obesity (waist circumference measures above 102 cm and 88 cm, in men and women, respectively), systemic arterial hypertension (blood pressure ≥ 130/85 mmHg), impaired glucose tolerance (fasting glucose levels ≥110 mg/dl) and hypertriglyceridemia (values ≥150 mg/dl) [5].

Data was presented as means and standard deviations. The study performed T- test and Mann-Whitney test for comparison of means between the sexes; Pearson's correlation between anthropometric, hemodynamic and biochemical variables; and association between variables through the chi-square test. For these analyses, the STATA 9.0 software was used, adopting the significance level of p<0.05.

This study was approved by the Research Ethics Committee of the Federal University of Piauí, in accordance with Resolution 466/12 of the National Health Council (No. CAAE 0237.0.045.000-11). All those who agreed to participate signed the free informed consent form (FICF) and all ethical principles governing scientific research involving human subjects were followed.

RESULTS

In the current study, 94 elderly were evaluated, and 68.1% (n = 64) of them were female. The age ranged from 60 to 89 years, with mean of 71.7 ± 6.8 years and 70.5 ± 6.8 years for males and females, respectively (Table I).

Comparative analysis of means was performed for age, anthropometric and biochemical variables, according to gender (Table I). Body weight, height, and waist circumference were statistically different between the sexes (p<0.05). The average waist circumference (WC) was statistically higher for men (p=0.031) than for women (96.2 ± 13.2 cm) (p=0.031). These data show that the study population presents high values of central obesity. It was also observed that the average BMI of the sample was 26.8 ± 3.6 kg/m² (men) and 26.3 ± 5,2 kg/m² (women), without significant difference between the sexes, and classified as eutrophic (Table I).

The mean values of the systolic blood pressure (SBP) showed higher values than those pointed in reference to MS, and the average diastolic blood pressure (DBP) had borderline values in relation to that recommendation. Regarding triglycerides in the group, a high average was found for the values in both sexes, with desirable value being below 150 mg/dl. As for blood glucose, it is worth noting that the study group has borderline average values compared to the recommended values, as described in Table I.

The prevalence of metabolic syndrome in the assessed elderly group was 38.64% (n=34), with greater proportion of diagnoses in females (28.40%; n=25), but with no difference between the sexes (Table II).

Table I - Difference between means of age, anthropometric and biochemical variables of the elderly, according to sex. Teresina-PI, 2011.

Variables	Male (n=29)	Female (n=65)	p
Age (years)	71.7 (6.8)	70.5 (6.9)	0.446
Weight (Kg)	71.9 (12.7)	62.7 (13.0)	0.002[#]
Height (cm)	163.6 (8.1)	154.3 (5.6)	0.000[#]
Waist circumference (cm)	102.4 (11.4)	96.2 (13.2)	0.031[#]
Body Mass Index (Kg/m^2)	26.8 (3.6)	26.3 (5.2)	0.649
SBP (mmHg)*	136.9 (14.2)	135.2 (16.5)	0.457
DBP (mmHg)*	83.4 (10.8)	84.1 (10.4)	0.621
Triglycerides (mg/dL)*	181.5 (128.4)	173.6 (79.9)	0.691
Blood glucose (mg/dL)*	109.2 (42.9)	104.8 (45.8)	0.794

Diastolic blood pressure (DBP); Systolic blood pressure (SBP); Data presented as mean (standard deviation). (*) Mann-Whitney's test; other variables, Student's t test. ([#]) p<0,05.

Table II - Prevalence of metabolic syndrome in elderly patients seen at a Health Unit, by sex. Teresina-PI, 2011.

Classification	Male		Female		Total		p*
	n	%	n	%	n	%	
Without MS	17	19.32	37	42.05	54	61.36	0.252
With MS	9	10.23	25	28.40	34	38.64	
Total	26	29.55	62	70.45	88	100	

Metabolic Syndrome (MS); (*) Chi-square test.

Table III - Risk classification for metabolic complications assessed by waist circumference, according to sex and age group. Teresina-PI, 2011.

Variables	Risk for metabolic complications associated to obesity							
	Normal		High		Very high		Total	
	n	%	n	%	n	%	n	%
Sex								
Male	8	27.59	5	17.24	16	55.17	30	100
Female	7	9.38	9	14.06	49	76.56	64	100
Age range								
60 – 69 years	8	18.18	9	20.45	27	61.36	45	100
70 – 79 years	4	11.11	5	13.89	27	75.00	36	100
> 80 years	3	15.38	0	0.00	11	84.62	13	100

Fisher's exact test, p=0.04 for sex and waste circumference; and p=0.34 for age range and waist circumference.

In Table III, the risk of metabolic complications associated with central obesity, evaluated through waist circumference, was analysed according to gender and age. Of the total elderly sample, 69.15% (n=65) had very high waist circumference, indicating high prevalence of risk in the population, with no statistically significant difference between the age groups (p=0.34). Females had a higher prevalence of 'very high risk' of metabolic complications (76.56%, n=49) compared to males (55.17%, n=16) (p=0.04).

A correlation analysis was performed between anthropometric and hemodynamic variables, and the biochemical parameters shown in Table IV. It was found that weight and blood pressure (weight x SBP: r=0.27; p=0.007 and weight x DBP: r=0.38; p=0.000), waist circumference and blood pressure (WC x SBP: r=0.25; p=0.016 and WC x DBP: r=0.25; p=0.013), as well as BMI and blood pressure (BMI x SBP: r=0.29; p=0.004 and BMI x DBP: r=0.32; p=0.002) presented positive and significant correlations. There was no correlation between the anthropometric and biochemical variables (p> 0.05).

Table IV - Correlation between anthropometric, hemodynamic variables, and biochemical parameters. Teresina-PI, 2011.

Variables	Correlation (r)	p
WC x Weight	0.88	0.000*
WC x BMI	0.85	0.000*
Weight x SBP	0.27	0.007*
Weight x DBP	0.38	0.000*
WC x SBP	0.25	0.016*
WC x DBP	0.25	0.013*
BMI x SBP	0.29	0.004*
BMI x DBP	0.32	0.002*
Weight x Glucose	0.18	0.085
DBP x Glucose	0.22	0.040*

Pearson's Correlation, p<0.05*. Waist circumference (WC); Body Mass Index (BMI); Systolic blood pressure (SBP); Diastolic blood pressure (DBP).

DISCUSSION

The population aging, a phenomenon globally observed, has reflected on the health impact growth, caused by chronic and noncommunicable diseases. Among these diseases, stands out the MS, which, in recent decades, has been attracting the interest of the scientific community[12-14].

The findings show elderly people with average age of approximately 71 years, high BMI and WC for both sexes, in addition to high prevalence of metabolic syndrome.

In the literature, a wide variation in the prevalence of MS was observed in different populations, according to sex, age, and the classification criteria (International Diabetes Federation or National Cholesterol Education Program - Adult Treatment Panel III), even though there is no precise data about the national prevalence. The MS prevalences found in our sample, evaluated according to NCEP ATPIII, are high, with the highest prevalence of metabolic syndrome in women[14-16], which can be justified by their tendency to present a higher amount of body fat. With age advancing, there is a reduction in the estrogen levels, and consequently, there is a likelihood for the development of dyslipidemia and other metabolic disorders[17-19].

In the current study, a high prevalence of risk for cardiovascular and metabolic complications, related to central obesity, was verified. Nevertheless, by analysing the waist circumference results associated to age, the results were not statistically significant, showing that the risk for complications related to central obesity is independent of age in this study, although ambulatory and population-based research demonstrate increased MS with advancing age[14,19-21]. However, it is noteworthy that in most of those studies, the sample included individuals aged 18 years on, while in this study, from 60 years on.

With regard to the anthropometric and hemodynamic variables, it was observed that weight, waist circumference and BMI were positively associated to SBP and DBP, and it is possible to suggest that excess weight with central and widespread deposition of fat are predisposing factors for high blood pressure. Similar to these findings, studies have demonstrated the association between increased body mass and elevated blood pressure[22-24].

The mechanisms through which obesity is associated with the onset of hypertension include metabolic disorders such as hyperinsulinemia and imbalance of adipokines, renin-angiotensin-aldosterone system (RAAS), and

the sympathetic nervous system[14,25,26]. In obesity, the RAAS activation increases the production of angiotensin II, aldosterone, as well as other metabolites, potent vasoconstrictors associated with the onset of hypertension in obesity. Furthermore, the hyperinsulinemia in obesity is a factor liable to be associated with hypertension, as insulin induces the activation of the central nervous system (CNS), with direct action on the kidney through stimulation of sodium retention[26-28]. However, the data from this study shows only a tendency of association between weight and biochemical alterations, such as blood glucose. Since insulin was not assessed in this study and it has a strong association with glucose levels, one can infer that, with a larger sample, a positive correlation could be observed between the fasting glucose and body weight.

Despite the limited sample of the study, a positive correlation was found for diastolic blood pressure and blood glucose. These data indicate the importance of controlling biochemical and hemodynamic parameters in this population, since there is evidence that blood glucose elevation is associated with increase in cardiovascular risk and glucose intolerance, with the atherosclerotic process[25-28].

In this study the elderly's BMI was classified according to Lipschitz[10], whose cut-off points for overweight/obesity are higher than the ones for the adult population, usually adopted by the WHO (1998), but even so, a high percentage of overweight was found in the investigated group. Researches demonstrate that weight gain increases the occurrence of factors involved in the MS, and implies increased cardiovascular and metabolic risk[18,20,28].

Thus, it stands out the importance of assessing the MS prevalence and observe the relationship of the various risk factors associated with cardiovascular events, such as glycemic disorders, high level of triglycerides, overweight, abdominal obesity and increased systemic arterial pressure values.

The results identified in this study may support the formulation of policy programs and effective public actions for control of the risk factors associated with the MS, with incentive to improve the elderly's quality of life.

As the study limitation, it should be noted that the study group was part of the Hiperdia Program, held within the Family Health Strategy, and therefore, necessarily composed of hypertensive and/or diabetic individuals, which are, in consequence, more exposed and have the greatest potential to meet the MS diagnostic criteria. This fact should be considered a selection bias in this research and a study limitation.

CONCLUSION

There was a high prevalence of MS, the highest being among women in the studied sample, and positive associations between anthropometric, biochemical and hemodynamic variables, which shows the need for effective monitoring and control of these cardiovascular risk factors.

ACKNOWLEDGMENTS

CONFLICT OF INTEREST

No conflict of interest.

REFERENCES

1. Silva CG, Rodrigues JB, Medeiros Júnior JR, Coutinho NPS, Lopes MLH, Sardinha AHL. Perfil dos idosos com síndrome metabólica. Rev Pesq Saúde. 2012;13(2): 17-20.

2. United Nations, Department of Economic and Social Affairs. Population division: world population prospects: the 2012 revision. New York: United Nations; 2013.

3. Gragnolati M, Jorgensen OH, Rocha R, Fruttero A. Growing old in an older Brazil: implications of population aging on growth, poverty, public finance and service delivery. Washington: The World Bank; 2011.

4. Camarano AA. Cuidados de longa duração para população idosa: um novo risco social a ser assumido? In: Hirata H., Guimarães NA, organizadores. Cuidado e cuidadoras: as várias faces do trabalho do *care*. 1ª ed. São Paulo: Atlas, 2012. p. 148-65.

5. Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults. 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.

6. I-Te Lee, Yen-Feng Chiu, Chii-Min Hwu, Chih-Tsueng He, Fu-Tien Chiang, Yu-Chun Lin et al. Central obesity is important but not essential component of the metabolic syndrome for predicting diabetes mellitus

in a hypertensive family-based cohort. Results from the Stanford Asia-Pacific Program for Hypertension and Insulin Resistance (SAPPHIRe) Taiwan follow-up study. Cardiovasc Diabetol. 2012;11:43.

7. Eckel RH, Alberti KG, Grundy SM, Zimmet PZ. The metabolic syndrome. Lancet. 2010;375(9468):181-3.

8. Gordon CC, Chumlea WC, Roche AF. Stature recumbert, lenght, and weight. In: Lohman TG, Roche AF, Martorell R. Anthopometric standardization reference manual. Champaingn: Human Kinetics; 1988. p.3-8.

9. Callaway CW. Circumferences. In: Lohman TG, Roche AF, Martorell R, editors. Anthropometric standardization reference manual. Champaign: Human Kinetics Books, 1988. p. 39-54.

10. Sociedade Brasileira de Hipertensão. VI Diretrizes Brasileiras de Hipertensão. Arq Bras Cardiol. 2010;95(Supl 1):1-51

11. Lipschitz DA. Screening for nutritional status in the elderly. Primary Care.1994; 21(1):55-67.

12. Xavier HT, Izar MC, Faria Neto JR, Assad MH, Rocha VZ, Sposito AC, et al. V Diretriz Brasileira de Dislipidemias e Prevenção da Aterosclerose. Arq Bras Cardiol 2013; 101(4 Supl 1):1-22.

13. Cook NR, Paynter NP, Eaton CB, Manson JAE, Martin LW, Robinson JG, et al. Comparison of the Framingham and Reynolds Risk Scores for Global Cardiovascular Risk Prediction in the Multiethnic Women's Health Initiative. Circulation. 2012; 125(14):1748-56.

14. Moraes NS, Souza JAG, Miranda RD. Hipertensão arterial, diabetes mellitus e síndrome metabólica: do conceito à terapêutica. Rev Bras Hipertens. 2013;20(3):110-7.

15. Franco GPP, Scala LCN, Alves CJ, França GVA, Cassanelli Tjardim PCBV. Síndrome metabólica em hipertensos de Cuiabá-MT: prevalência e fatores associados. Arq Bras Cardiol. 2009;92(6):472-8.

16. Rigo JC, Vieira JL, Dalacorte RR, Reichert CL. Prevalência de síndrome metabólica em idosos de uma comunidade: comparação entre três métodos diagnósticos. Arq Bras Cardiol. 2009;93(2):85-91.

17. Felipe-de-melo ERT, Silva RCR, Assis AMO, Pinto EJ. Fatores associados à síndrome metabólica em trabalhadores administrativos de uma indústria de petróleo. Ciênc Saúde Coletiva. 2011;16(8):3443-52.

18. Kassim E, Pervanidou P, Kaltsas G, Chrousos G. Metabolic syndrome: definitions and controversies. BMC Med. 2011;9(1):1-13.

19. Lahsen R, Berry M. Surgical interventions to correct metabolic disorders. Br J Diabetes Vasc Dis. 2010;10(3):143-47.

20. Vlachopoulos C, Aznaouridis K, Stefanadis C. Prediction of cardiovascular events and all-cause mortality with arterial stiffness: a systematic review and meta-analysis. J Am Coll Cardiol. 2010; 55(13):1318-27.

21. Vanhoni LR, Xavier AJ, Piazza HE. Avaliação dos critérios de síndrome metabólica nos pacientes atendidos em ambulatório de ensino médico em Santa Catarina. Rev Bras Clin Med. 2012;10(2):100-5.

22. Simão M, Hayashida M, Santos CB, Cesarino EJ, Nogueira MS. Hipertensão arterial entre universitários da cidade de Lubango, Angola. Rev Latinoam Enferm. 2008;16(4):672-8.

23. Amira CO, Sokunbi DOB, Sokunbi A. The prevalence of obesity and its relationship with hypertension in an urban community: Data from world kidney day screening programme. Int J Med Biomed Res. 2012;1(2):104-10.

24. Martins MCC, Ricarte IF, Rocha CHL, Maia RB, Silva VB, Veras AB, et al. Pressão arterial, excesso de peso e nível de atividade física em estudantes de universidade pública. Arq Bras Cardiol. 2010;95(2):192-9.

25. Sarwar N, Gao P, Seshasai SR, Gobin R, Kaptoge S, Di Angelantonio E, et al. Emerging risk factors collaboration. Diabetes mellitus, fasting blood glucose concentration, and risk of vascular disease: a collaborative meta-analyse of 102 prospective studies. Lancet 2010;375(9733):2215-22.

26. Kang YS. Obesity associated hypertension: new insights into mechanism. Electrolyte Blood Press 2013;11(2):46-52.

27. American Diabetes Association. Standards of medical care in Diabetes – 2013. Diabetes Care. 2013;36(Suppl 1):11-66.

28. Fox CS, Massaro JM, Hoffmann U, Pou KM, Horvat-Maurovich P, Liu CY, et al. Abdominal visceral and subcutaneous adipose tissue compartments: association with metabolic risk factors in the Framingham Heart Study. Circulation, 2007;116(1):39-48.

First author's address:
José Filho da Silva
Departamento de Nutrição (UFPI)
Campus Universitário Ministro Petrônio Portella
Bairro: Ininga
CEP: 64049-550 - Teresina - PI - Brasil
E-mail: jfsaoju@hotmail.com

Mailing address:
Joilane Alves Pereira Freire
Departamento de Nutrição (UFPI)
Campus Universitário Ministro Petrônio Portella
Bairro: Ininga
CEP: 64049-550 - Teresina - PI - Brasil
E-mail: joilane@hotmail.com