

DO PHYSICAL ACTIVITY AND NUTRITIONAL STATUS ACT AS PROTECTIVE FACTORS AGAINST NONCOMMUNICABLE CHRONIC DISEASES IN ELDERLY WOMEN?

Atividade física e estado nutricional: Fator de proteção para doenças crônicas não transmissíveis em idosas?

Actividad física y el estado nutricional: factor de protección para las enfermedades crónicas no transmisibles en mujeres mayores?

Original Article

ABSTRACT

Objective: To analyze the association of regular physical activity and nutritional status with chronic noncommunicable diseases (NCDs) in elderly women. **Methods:** This is an observational and analytical cross-sectional study conducted with a convenience sample of 367 elderly women (60 and over) from the cities of Presidente Prudente, SP and Uberaba, MG, between October/2010 and August/2012. NCDs were identified using a questionnaire based on the Standard Health Questionnaire (SHQ). The International Physical Activity Questionnaire (IPAQ) was used to assess the level of physical activity and anthropometric variables were used to assess the nutritional status. Statistical analysis included the chi-square test to verify associations between physical activity level, according to nutritional status, and the presence of cardiometabolic diseases, and binary logistic regression to test the magnitude of these associations. **Results:** There was a protective factor against hypertension in active eutrophic women ($p=0.024$) and sedentary eutrophic women ($p=0.032$) when compared to the risk group (sedentary and overweight/obese women); however, this was not observed in physically active women with excess weight ($p=0.734$). There was a positive association between sedentary eutrophic elderly women ($p=0.047$) and the risk of cholesterol. None of the groups were associated with diabetes. **Conclusion:** Physical activity was not considered a protective factor for hypercholesterolemia, diabetes or hypertension, possibly due to reverse causality given that sedentary women started the physical activity after the diagnosis of the disease, which contributed to these results.

Descriptors: Physical activity; Chronic Disease; Women's Health. Elderly.

RESUMO

Objetivo: Analisar a relação da prática de atividade física e do estado nutricional com as doenças crônicas não transmissíveis (DCNT) em mulheres idosas. **Métodos:** Estudo observacional, analítico, transversal, amostra por conveniência, amostra de 367 mulheres idosas (60 anos ou mais) das cidades de Presidente Prudente-SP e Uberaba-MG, entre outubro/2010 e agosto/2012. Para identificação das DCNT, utilizou-se um questionário baseado no Standard Health Questionnaire (SHQ), o Questionário Internacional de Atividade Física (IPAQ), para avaliar o nível de atividade física e as variáveis antropométricas para o estado nutricional. Na análise estatística, utilizou-se o teste qui-quadrado para verificar a associação entre o nível de atividade física, segundo estado nutricional e presença de doenças cardiometabólicas, e regressão logística binária para testar a magnitude dessas associações. **Resultados:** Houve fator de proteção contra a hipertensão para as mulheres consideradas eutróficas ativas ($p=0,024$) e eutróficas sedentárias ($p=0,032$) quando comparadas ao grupo de risco (sedentárias e com sobrepeso/obesidade), porém o mesmo não foi observado nas com excesso de peso e consideradas ativas fisicamente ($p=0,734$). Houve associação positiva entre as idosas eutróficas sedentárias ($p=0,047$) em relação ao risco para colesterol. Quando observado, o diabetes não obteve associação em nenhum dos grupos. **Conclusão:** A atividade física não foi considerada como fator de proteção para hipercolesterolemia, diabetes e hipertensão, possivelmente por causa da causalidade reversa, pois, a partir do diagnóstico da doença, essas mulheres, antes sedentárias, iniciaram a prática de atividade física, contribuindo para esses resultados.

Descritores: Atividade Física; Doença Crônica; Saúde da Mulher; Idoso.

Thais Reis Silva Paulo^(1,3)
Igor Conterato Gomes⁽²⁾
Vanessa Ribeiro Santos⁽³⁾
Diego Guilliano Destro
Christofaro⁽⁴⁾
Simone Maria Castellano⁽⁵⁾
Ismael Fortes Freitas Júnior⁽⁴⁾

- 1) Federal University of Amazonas (Universidade Federal do Amazonas - UFAM) - Parintins (AM) - Brazil
- 2) University of São Paulo (Universidade de São Paulo - USP) - São Paulo (SP) - Brazil
- 3) Paulista State University (Universidade Estadual Paulista - UNESP) - Rio Claro (SP) - Brazil
- 4) Paulista State University (Universidade Estadual Paulista - UNESP) - Presidente Prudente (SP) - Brazil
- 5) Federal University of Triângulo Mineiro (Universidade Federal do Triângulo Mineiro - UFTM) - Uberaba (MG) - Brazil

Received on: 25/11/2013

Revised on: 11/03/2014

Accepted on: 12/09/2014

RESUMEN

Objetivo: Analizar la relación de la práctica de actividad física y el estado nutricional con las enfermedades crónicas no transmisibles (ECNT) en mujeres mayores. **Métodos:** Estudio observacional, analítico, transversal de muestreo por conveniencia y muestra de 367 mujeres mayores (60 años o más) de las ciudades de Presidente Prudente-SP y Uberaba-MG, entre octubre/2010 y agosto/2012. Se utilizó un cuestionario basado en el Standard Health Questionnaire (SHQ) para la identificación de las ECNT, el Cuestionario Internacional de Actividad Física (IPAQ) para evaluar el nivel de actividad física y las variables antropométricas para evaluar el estado nutricional. En el análisis estadístico se utilizó la prueba de Chi-cuadrado para verificar la asociación del nivel de actividad física según el estado nutricional y la presencia de enfermedades cardiometabólicas y la regresión logística binaria para testar la magnitud de estas asociaciones. **Resultados:** Se encontró un factor de protección contra la hipertensión para las mujeres consideradas eutróficas activas ($p=0,024$) y eutróficas sedentarias ($p=0,032$) al comparar con el grupo de riesgo (sedentarias y con sobrepeso/obesidad), sin embargo lo mismo no se ha observado en aquellas con exceso de peso consideradas físicamente activas ($p=0,734$). Hubo asociación positiva entre las mujeres mayores eutróficas sedentarias ($p=0,047$) y el riesgo de colesterol. No hubo asociación de la diabetes en ningún de los grupos. **Conclusión:** La actividad física no ha sido considerada como factor de protección para la hipercolesterolemia, la diabetes y la hipertensión, posiblemente debido la causalidad reversa, pues a partir del diagnóstico de la enfermedad estas mujeres, que antes eran sedentarias, empezaron la práctica de actividad física, contribuyendo con estos resultados.

Descriptor: Actividad Motora; Enfermedad Crónica; Salud de La Mujer; Anciano.

INTRODUCTION

In Brazil, chronic noncommunicable diseases (NCDs) make up the leading cause of death in adults and the elderly, principally cardiovascular diseases and cancer. The presence of these diseases, in most cases, is associated with overweight, frequent among women^(1,2) and older individuals, and is responsible for increased expenditure on services, medications and hospitalization, affecting the entire public health system⁽³⁾.

The most prevalent of these NCDs in adults and the elderly population is high blood pressure (HA), reaching values above 67% in the oldest old⁽⁴⁾ and presenting a direct relationship with the development of other cardiovascular diseases⁽⁵⁾. Diabetes, despite having a lower prevalence compared to other NCDs, is a highly limiting disease and can cause blindness, amputations, kidney diseases and cardiovascular and brain complications. The presence of dyslipidemia is also of concern, since an unfavorable

lipid profile can also increase the risk of cardiovascular complications⁽⁶⁾.

The practice of regular physical activity is considered essential for the promotion of health and healthy aging, reducing the risk of NCDs and premature death, as well as providing important benefits to physiological, functional and mental health^(7,8).

Therefore, even though this subject has been extensively explored in the literature, investigations are needed to provide information on the effectiveness of physical activity according to nutritional status, for the prevention and treatment of NCDs, especially in women over 50 years of age. Thus, the aim of this study was to analyze the relationship of physical activity and nutritional status with NCDs in elderly women.

METHODS

This is an observational, analytical study with a cross-sectional design. The sample was selected by convenience and consisted of 367 elderly women (60 and over) living in the urban area of two municipalities, participating in physical exercise programs, entitled "Preventive Medicine" offered by a private health plan in the city of Presidente Prudente SP, and "Guided Gymnastics" offered in public places in the city of Uberaba-MG, from October 2010 to August 2012.

The anthropometric variables collected were body weight, height and waist circumference (WC). Body weight was measured using a digital scale (Plenna[®]), with an accuracy of 0.1 kg and maximum capacity of 150 kg. Height was measured on a portable stadiometer (Sanny), with an accuracy of 0.1 cm. The values of height and weight were used to calculate body mass index (BMI) [weight (kg)/height (m)²]. The cutoff point adopted to indicate the presence of overweight was ≥ 27 kg/m²⁽⁹⁾. For the evaluation of waist circumference (WC), a metal tape was used with an accuracy of 0.1 mm. The procedures adopted in the anthropometric measurements were performed as described⁽¹⁰⁾.

A questionnaire was applied to identify the prevalence of NCDs, based on the *Standard Health Questionnaire* (SHQ), which analyzes the presence of NCDs in adult and elderly populations. The questionnaire uses dual choice questions (presence or absence of some NCDs), divided into three groups: metabolic, cardiovascular and osteoarticular. For the present study, the following NCDs were adopted: (i) hypertension, (ii) diabetes, and (iii) cholesterol⁽¹¹⁾.

To evaluate the physical activity level (PAL), the International Physical Activity Questionnaire (IPAQ), version 8, was used in its short form⁽¹²⁾. The IPAQ is an instrument which enables estimation of the weekly time

spent on physical activities of moderate and vigorous intensity and in different areas of life (work, household chores, transportation and leisure). For the present study, women who performed 150 minutes or more of moderate and/or intense activity per week were considered active^(13,14).

The evaluations were applied individually by two interviewers and two assistants who had been previously trained in the application of the questionnaire and standardization of collection.

The software Epidata, version 3.1b was used and the analysis by means of the statistical package SPSS (version 20.0). For the numeric variables, the normality of the data set was verified using the Kolmogorov-Smirnov (K-S) test. Thus, the descriptive statistics consisted of mean and standard deviation values. The volunteers were divided into two groups (active and sedentary), and within each group two subgroups were formed. The mean values of each anthropometric and PAL variable were compared, analyzed by means of the Student *t* test for independent samples.

The binary logistic regression, represented by odds ratio values (OR), with a 95% confidence interval (CI95%), indicated the magnitude of the association between nutritional status (eutrophic and overweight/obesity) and

NCDs. In all analyzes, a significance level of 5% was adopted.

This study followed the ethical principles laid down in the Declaration of Helsinki and Resolution no. 466/12 of the National Health Council. In addition, the protocols were reviewed and approved by the Research Ethics Committee of the Paulista State University of Presidente Prudente (Process No. 298/2008).

RESULTS

The study included 367 elderly women of which, 295 (80.4%) were considered active and had participated – for, on average, one year and three months - in physical activity programs.

Table I presents the mean and standard deviation descriptive values of the numerical variables studied and compared within each group (sedentary and active). In the sedentary group, the variables age, weight, height, BMI and WC presented differences ($p=0.001$) between the eutrophic and overweight/obesity subgroups. In the group of active women, when the subgroups were compared, it was observed that only the anthropometric variables presented significant differences ($p=0.001$).

Table I - General characteristics of the sample, mean and standard deviation, distributed among the different groups and subgroups of elderly women. Presidente Prudente-SP and Uberaba-MG, 2012.

Variables	Sedentary		t	p	Active		t	p
	Eutrophic (n=42)	Overweight and obesity (n=30)			Eutrophic (n=143)	Overweight and obesity (n=152)		
	Mean (SD)				Mean (SD)			
Age (years)	79.9 (7.0)	75.5 (9.7)	2.28	0.026*	68.7 (6.5)	67.3 (6.3)	1.84	0.067
Weight (kg)	53.4 (7.6)	71.9 (7.1)	-10.39	0.001*	57.1 (6.9)	74.8 (10.4)	-17.20	0.001*
Height (cm)	151.2 (7.1)	153.3 (6.2)	-1.34	0.182	154.6 (6.0)	155.2 (6.5)	-7.47	0.456
BMI (kg/m ²)	23.3 (2.5)	30.6 (2.6)	-11.97	0.001*	23.8 (2.3)	31.0 (3.6)	-20.57	0.001*
WC (cm)	81.5 (7.3)	97.0 (9.7)	-7.74	0.001*	81.1 (8.2)	95.9 (9.1)	-14.66	0.001*
PAL (min)	7.3 (19.5)	8.7 (20.8)	-2.94	0.770	349.6 (463.8)	327.2 (436.1)	0.427	0.670

SD: standard deviation; BMI: body mass index; WC: waist circumference; PAL: level of physical activity. * $p<0.05$

Table II - Association between level of physical activity, according to nutritional status and hypertension in elderly women. Presidente Prudente-SP and Uberaba-MG, 2012.

	Arterial Hypertension			
	(%)	OR	CI	p
Active eutrophic	62.9	0.52	(0.23-0.79)	0.024*
Sedentary eutrophic	59.5	0.63	(0.23-0.89)	0.032*
Active overweight/obesity	73.0	1.16	(0.49-2.74)	0.734
Sedentary overweight/obesity	70.0	1.00	---	---

OR = odds ratio. CI = confidence interval. * $p<0.05$

In Table II, the associations are presented between nutritional status, according to the level of physical activity and high blood pressure in elderly women, through the odds ratio. There was a protective factor for active eutrophic ($p=0.024$) and sedentary eutrophic women ($p=0.032$) compared to the risk group of overweight/obesity. This was not observed in those with excess weight who were physically active ($p=0.734$).

In relation to nutritional status and cholesterol, no association was observed with regard to the active eutrophic women ($p=0.581$) when associated with the risk group consisting of those women considered sedentary, who were overweight or obese. However, there was a positive association between sedentary eutrophic elderly women ($p=0.047$) in relation to the occurrence of dyslipidemia (Table III).

Table III - Association between levels of physical activity stratified according to nutritional status and cholesterol in elderly women. Presidente Prudente-SP and Uberaba-MG, 2012.

	Cholesterol			
	(%)	OR	IC	p
Active eutrophic	31.5	0.79	(0.79-1.81)	0.581
Sedentary eutrophic	16.7	0.35	(0.12-0.92)	0.047*
Active overweight/obesity	38.8	1.10	(0.49-2.47)	0.825
Sedentary overweight/obesity	36.7	1.00	---	---

OR = odds ratio; CI = confidence interval. * $p<0.05$

Table IV - Association between levels of physical activity stratified according to nutritional status and diabetes in elderly women. Presidente Prudente-SP and Uberaba-MG, 2012.

	Diabetes			
	(%)	OR	CI	p
Active eutrophic	15.4	0.78	(0.38-3.72)	0.775
Sedentary eutrophic	11.9	0.86	(0.22-3.59)	0.857
Active overweight/obesity	15.8	1.22	(0.39-3.81)	0.734
Sedentary overweight/obesity	13.3	1.00	---	---

OR = odds ratio; CI = confidence interval. * $p<0.05$.

the convenience sample, that is, a specific portion of the population that is physically active.

Another very important aspect was verified that deserves attention: 295 women in the sample, in addition to being active, also presented excess weight, i.e., more than 50% of the sample is likely to develop chronic diseases, as this profile is considered an independent risk factor⁽¹⁶⁾. Studies in the literature show that individuals who have excess weight, primarily abdominal obesity, are more likely to present NCDs, with negative influences on cardiorespiratory fitness and a higher risk of morbidity and mortality when left treated^(9,11).

Table IV shows that there was no association with diabetes between active and eutrophic ($p=0.775$), sedentary and eutrophic ($p=0.857$) or active women and those with excess weight ($p=0.734$).

DISCUSSION

The present study presented a sample with 80.4% of physically active participants. This result is positive and significant, since previous studies have reported minimal engagement of the Brazilian population in physical activity, about 40-45% do not meet the recommendations for physical activity and this number necessarily grows when specifying only activities performed during leisure time, demonstrating much higher prevalences, ranging from 65% to 97%⁽¹⁵⁾. This difference could be linked to

Among the physiological reactions caused by excess weight, are the synthesis of angiotensin II by adipose tissue and lodging in its membrane of subunit AT1 angiotensin receptors, with the probability that the production of the renin-angiotensin system components by adipocytes shares the pathophysiology of hypertension and cardiovascular disease. Furthermore, adipose tissue synthesizes and secretes several other pro-inflammatory mediators and cytokines that participate in mechanisms which induce dyslipidemia, insulin resistance, hypertension, and atherosclerosis⁽¹⁷⁾.

The findings of the present study indicate that even the group of women who were considered physically active but

with excess weight had no protection against HA. This fact may occur due to the complex relationship and association between excess weight and arterial hypertension, attributed to hemodynamic factors such as insulin resistance, endothelial dysfunction, accumulation of adipose tissue, increased activation of the renin-angiotensin-aldosterone system and the sympathetic nervous system, alongside the endocannabinoid system^(18,19).

In certain cases, physical activity has an acute effect, however, with regard to the physiological aspects; in particular reduction in blood pressure levels, for positive results, particular attention should be paid to intensity, duration and frequency, with participation in aerobic exercises – that is, a change in behavior⁽²⁰⁾.

When associated with the level of physical activity, women in the present study with excess weight, even if considered physically active, also presented no protection. Excess weight, specifically abdominal obesity, is correlated with the majority of cardiovascular risk factors, particularly elevated triglyceride levels and reductions in *High Density Lipoproteins* (HDL), presenting the greatest impact on high blood pressure and the resulting damage to health.

The literature blatantly expresses that excess weight is considered one of the high risk factors for developing cardiovascular diseases, among them, high blood pressure, being more prevalent in the older population, and increasing at enormous rates⁽²¹⁾. In contrast, one study showed that individuals with high physical fitness, even with excess weight, presented a reduced risk of death from heart disease, independent of the status of other risk factors for chronic diseases⁽²²⁾.

Another epidemiological study with physically active adults demonstrated in the analysis that sedentary behavior; in particular the amount of time spent watching television, is an independent predictor of metabolic diseases, diabetes and obesity⁽⁷⁾.

Another case-control study that aimed to determine the contribution of physical activity and abdominal obesity to changes in inflammatory biomarkers for diseases related to the heart, concluded that inactive participants, with a high waist circumference, were characterized by worsening levels of inflammatory markers, however, several markers were associated with an increased risk of heart disease, regardless of waist circumference and physical activity levels⁽²³⁾.

In addition to being an independent cardiovascular risk factor, obesity is associated with a number of other factors, such as dyslipidemia, hypercholesterolemia, hypertension and diabetes. In this study, it was found that changes in lifestyle are needed, which are the responsibility of the individual. The majority of the women in the sample

presented physically active behavior, however, had no protection for the associated chronic illnesses.

There is strong scientific evidence that regular physical activity reduces the risk of the development and aggravation of hypertension, obesity, diabetes, hypercholesterolemia and other chronic diseases in adults and the elderly. However, further studies are necessary to address important gaps in the knowledge, including attention to time spent in sedentary behavior^(24,25).

Despite these hypotheses, it is necessary to consider some limitations of the study. The BMI for very active or active people may not be a good indicator. In addition, not considering dietary intake, family history or biochemical tests could have increased the possible confounding factors.

Finally, cross-sectional studies make it difficult to advance the temporal analysis of the factors studied, due to reverse causality bias, preventing finding causal relationships and being liable to influence from social and cultural factors. Thus, it is necessary to conduct cohort studies to test the hypotheses raised in this study.

CONCLUSION

Physical activity was not considered a protective factor for hypercholesterolemia, diabetes or hypertension, possibly due to reverse causality, as these women had been sedentary prior to diagnosis of the disease and had only started the practice of physical activity subsequently, contributing to these results.

ACKNOWLEDGEMENTS

We would like to thank the participants of the study, the Unimed Medical Cooperative in the city of Presidente Prudente, the Municipal Secretary of Education and the Municipal Secretary of Sports and Leisure in Uberaba, and the Universidade Estadual Paulista in Presidente Prudente.

REFERENCES

1. Gallon CW, Wender MCO. Estado nutricional e qualidade de vida da mulher climatérica. *Rev Bras Ginecol Obstet.* 2012;34(4):175-83.
2. Veras RP. Envelhecimento populacional contemporâneo: demandas, desafios e inovações. *Rev Saúde Pública.* 2009;43(3):548-54.
3. Ministério da Saúde (BR). Diretrizes e recomendações para o cuidado integral de doenças crônicas não transmissíveis: promoção da saúde, vigilância, prevenção e assistência. Brasília: Ministério da Saúde; 2008.

4. Gomes IC, Segatto AFM, Santos VR, Rosa CSC, Paulo TRS, Freitas Júnior IF. Aptidão Cardiorrespiratória e Envelhecimento como Indicadores de Risco de Obesidade. *Rev Bras Cardiol*. 2011;24(4):23-31.
5. Ferreira CCC, Peixoto MRG, Barbosa MA, Silveira EA. Prevalence of cardiovascular risk factors in elderly individuals treated in the Brazilian Public Health System in Goiânia. *Arq Bras Cardiol*. 2010;95(5):621-8.
6. Regidor E, Franch J, Seguí M, Serrano R, Rodríguez-Artalejo F, Artola S. Traditional risk factors alone could not explain the excess mortality in patients with diabetes: a national cohort study of older Spanish adults. *Diabetes Care*. 2012;35(12):2503-9.
7. Healy GN, Dunstan DW, Salmon J, Shaw JE, Zimmet PZ, Owen N. Television time and continuous metabolic risk in physically active adults. *Med Sci Sports Exerc*. 2008;40(4):639-45.
8. Physical Activity Guidelines Advisory Committee. Physical Activity Guidelines Advisory Committee Report 2008. [accessed on 2015 July 15]. Available at: <http://www.health.gov/paguidelines/committeereport.aspx>
9. Lipschitz DA. Screening for nutritional status in the elderly. *Prim Care*. 1994; 21(1):55-67.
10. Freitas Júnior IF. *Padronização de Técnicas Antropométricas*. São Paulo: Cultura Acadêmica; 2009.
11. Castoldi RC, Moret DG, Gomes IC, Paulo TRS, Oikawa S, Freitas Júnior IF. Influência da adiposidade corporal sobre a aptidão cardiorrespiratória em mulheres idosas. *Rev Bras Ciência Movimento*. 2010;18(4):34-8.
12. Matsudo SM, Araújo TL, Matsudo VKR, Andrade DR, Andrade EL, Oliveira LC, Braggion G. Questionário Internacional de Atividade Física (IPAQ): estudo de validade e reprodutibilidade no Brasil. *Rev Bras Atividade Física Saúde*. 2001;6(2):5-18.
13. World Health Organization- WHO. Global recommendations on physical activity for health. WHO; 2010.
14. Haskell WL, Lee IM, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation*. 2007;116(9):1081-93.
15. Hallal PC, Victora CG, Wells JC, Lima RC. Physical inactivity: prevalence and associated variables in Brazilian adults. *Med Sci Sports Exerc*. 2003;35(11):1894-900.
16. Ministério da Saúde (BR). Obesidade. Série Cadernos de Atenção Básica. Bras2009; 12:1-110. [accessed on 2014 July 15]. Available at: http://nutricao.saude.gov.br/documentos/doc_obesidade.pdf.
17. Theodoro HMS, Rodrigues ADMS, Mendes KG, Liane RH, Paniz VMV, Olinto MTA. Reproductive characteristics and obesity in middle-aged women seen at an outpatient clinic in southern Brazil. *Menopause*. 2012;19(9):1022-8.
18. Jardim PCBV, Gondim MRSP, Monego ET, Moreira HG, Vitorino PVO, Souza WKS, et al. Hipertensão arterial e alguns fatores de risco em uma capital brasileira. *Arq Bras Cardiol*. 2007;88(4):452-57.
19. Lobato NS, Akamine EH, Tostes RC, Carvalho MHC, Fortes ZB. Obesidade e hipertensão arterial. *Rev Bras Hipertens*. 2009;12(1):4-12.
20. Buchner DM. Physical activity and prevention of cardiovascular disease in older adults. *Clin Geriatr Med*. 2009;25(4):661-75.
21. Panagiotakos DB, Pitsavos C, Chrysohoou C, Skoumas I, Stefanadis C. Prevalence and five-year incidence (2001-2006) of cardiovascular disease risk factors in a Greek sample: the ATTICA study. *Hellenic J Cardiol*. 2009;50(5):388-95.
22. Sui X, Laditka JN, Hardin JW, Blair SN. Estimated functional capacity predicts mortality in older adults. *J Am Geriatr Soc*. 2007;55(12):1940-7.
23. Rana JS, Arsenault BJ, Despre's JP, Cote M, Talmud PJ, Ninio EJ, et al. Inflammatory biomarkers, physical activity, waist circumference, and risk of future coronary heart disease in healthymen and women. *Eur Heart J*. 2011;32(3):336-44.
24. Cornelissen VA, Fagard RH. Effects of endurance training on blood pressure, blood pressure regulating mechanisms, and cardiovascular risk factors. *Hypertension*. 2005; 46(4):667-75.
25. Lakerveld J, Dunstan D, Bot S, Salmon J, Dekker J, Nijpels G, et al. Abdominal obesity, TV-viewing time and prospective declines in physical activity. *Prev Med*. 2011; 53(4-5):299-302.

Mailing address:

Thais Reis Silva Paulo
Universidade Federal do Amazonas
Estrada do Macurany, s/n
Bairro: Jacareacanga
CEP: 69151000 - Parintins - AM - Brasil
E-mail: thais.reis.silva@hotmail.com