DOI: 10.1590/1809-4503201400040011

ORIGINAL ARTICLE / *ARTIGO ORIGINAL*

Physical activity, adiposity and hypertension among patients of public healthcare system

Prática de atividade física, adiposidade corporal e hipertensão em usuários do Sistema Único de Saúde

Bruna Camilo Turi[I], Jamile Sanches Codogno[II], Rômulo Araújo Fernandes[I], Henrique Luiz Monteiro[II]

ABSTRACT: ***Introduction:*** Hypertension is a chronic disease that requires special attention in identifying comorbidities or risk factors including inactivity and obesity. Considering that a large proportion of the Brazilian population is hypertensive, obese, and sedentary, the relationship among these variables in the context of the public health system is unclear. ***Objective:*** To assess the association among physical activity, markers of adiposity, and hypertension in adult users of the public healthcare system in the city of Bauru, São Paulo, Brazil. ***Methods:*** The study was conducted in five Basic Health Units in Bauru, São Paulo, and consisted of 963 patients. Data were collected from habitual physical activity and previous (childhood and adolescence), education, purchasing power and anthropometric markers of overall and abdominal obesity. ***Results:*** The incidence of hypertension was 76.8%. Significant associations were found among sedentarism, presence of total and abdominal obesity, with the higher incidence of hypertension. It was also observed that the magnitude of association between hypertension and adiposity increased with decreased involvement in physical activity. ***Conclusion:*** Further investigations are needed to analyze the occurrence of overweight and obesity in people suffering from chronic diseases in order to prevent future complications.

Keywords: Public health. Hypertension. Risk factors. Adult. Obesity. Motor activity.

[I] *Universidade Estadual Paulista "Júlio de Mesquita Filho"* – Presidente Prudente (SP), Brazil.
[II] *Universidade Estadual Paulista "Júlio de Mesquita Filho"* – Rio Claro (SP), Brazil.
Corresponding author: Bruna Camilo Turi. Rua Christiano Pagani, 8-51, apto. 32D, Jardim Auri Verde, CEP: 17047-144, Bauru, SP, Brasil. E-mail: brunaturi@hotmail.com
Conflict of interests: nothing to declare – **Financial support:** Coordination for the Improvement of Higher Education Personnel (CAPES).

RESUMO: ***Introdução:*** A hipertensão arterial é uma doença crônica que exige atenção especial na identificação de comorbidades associadas ou fatores de risco, dos quais se destacam o sedentarismo e a obesidade. Considerando que grande parcela da população brasileira é hipertensa, obesa e sedentária, ainda não está claro o relacionamento entre essas variáveis no contexto do Sistema Único de Saúde (SUS). ***Objetivo:*** Verificar a associação entre prática de atividades físicas, marcadores de adiposidade corporal e hipertensão arterial em adultos usuários da rede pública de saúde da cidade de Bauru, São Paulo. ***Métodos:*** A investigação foi realizada junto a cinco Unidades Básicas de Saúde da cidade de Bauru, São Paulo, e foi composta por 963 pacientes. Foram coletados dados de atividade física habitual e prévia (infância e adolescência), escolaridade, poder aquisitivo e marcadores antropométricos de obesidade geral e abdominal. ***Resultados:*** A ocorrência de hipertensão arterial foi de 76,8%. Foram encontradas associações significativas entre sedentarismo, presença de obesidade total e abdominal com a maior ocorrência de hipertensão arterial. Também foi observado que a magnitude da associação entre hipertensão e adiposidade aumentou conforme diminuiu o envolvimento com a prática de atividades físicas. ***Conclusão:*** São necessárias novas investigações sobre a ocorrência de excesso de peso e obesidade em pessoas acometidas por doenças crônicas não transmissíveis com a finalidade de prevenir futuras complicações.

Palavras-chave: Saúde pública. Hipertensão. Fatores de risco. Adulto. Obesidade. Atividade motora.

INTRODUCTION

Arterial hypertension (AH) is a chronic disease in charge of the increasing risk of fatal and non-fatal cardiovascular events, which contributes to the high demand in urgency and emergency sectors and primary health care services[1-3]. Since it is characterized as a multifactorial clinical condition, the disease requires special attention in the identification of associated comorbidities or risk factors. In this context, obesity and sedentary lifestyles stand out, since they have been associated with higher morbidity and mortality rates caused by chronic diseases[4].

Especially concerning the increasing adipose tissue, special attention should be given to abdominal obesity, which is characterized as an important risk factor for cardiovascular diseases and presents higher atherogenic potential[3,5]. Several indexes enable to identify overall obesity (or excessive weight), such as body mass index (BMI), which is the most used one for being easy to obtain and apply, and also due to its good correlation with body fat measurements[6]. For abdominal obesity, isolated waist circumference (WC) values are often used in epidemiological studies[7]. Likewise, the regular practice of physical activities has been pointed out as an efficient resource to control pressure levels, as well as to fight and prevent obesity[8,9].

By considering that approximately 60% of the Brazilian population is assisted by the Unified Health System (SUS), and that the same population is mostly hypertensive, obese and sedentary, an important public health issue is designed in Brazil[10-12]. The concern around this problem increases by the observation that the relationship between these three variables is widely studied in the general population; however, it is little explored in the context of SUS[10]. The absence of such information limits the extraction of relevant data, as in the case of physical activities, which should be explored in campaigns aiming at the reduction of risk factors to health among SUS patients (occupational, leisure, active commute etc.)[10].

Therefore, the objective of this study was to verify the association between the practice of physical activities, body adiposity markers and arterial hypertension in adults users of the public healthcare system in the town of Bauru, São Paulo.

METHODS

TYPE OF STUDY, POPULATION AND SAMPLE

This is a cross-sectional study, with a retro-analytical component[11], which was conducted in the town of Bauru, São Paulo. The sample was composed of 963 adults assisted in the five largest Basic Healthcare Units (BHU), one in each region of the town (North, South, East, West and Center). The sampling size of 958 individuals (at least 192 patients per UBS) was defined by using an equation for population parameters (60% for the use of SUS[12]; 3.8% arbitrary sampling error; design effect of 50%; 95% confidence interval). The magnitude of the selected sample is impressive (958 patients), in a town where approximately 17 thousand hypertensive people are being regularly treated in the UBS.

In each one of the five selected BHU, after the initial screening conducted in medical schedules (which computed all of the users who attended the BHU in the past six months), patients who met the inclusion criteria (≥ 50 years old, no medical restriction regarding the practice of physical activities and having attended the doctor at least once in the past 6 months) were included in a list with their respective identification number in the medical record. Afterwards, from the number in the medical record, 250 to 500 patients were selected by a raffle conducted with the statistical software Statistical Package for the Social Sciences (SPSS), version 13.0. The selected patients were invited to attend the BHU in order to undergo the evaluation and the application of questionnaires; in case the minimum number of individuals was not reached in the first raffle, new raffles were conducted, and when 192 patients were analyzed, the evaluations in the UBS were concluded.

This study was approved by the Research Ethics Committee of the Science School at *Universidade Estadual Paulista "Júlio de Mesquita Filho"* (UNESP), campus of Bauru (process n. 1047/46/01/10), and by the Ethics Committee of the Municipal Secretariat of Health of Bauru, São Paulo.

PREVIOUS AND HABITUAL PRACTICE OF PHYSICAL ACTIVITIES (CHILDHOOD AND ADOLESCENCE)

Information regarding the habitual practice of physical activities was obtained by means of an interview based on the questionnaire by Baecke et al.[13], which was validated for the Brazilian population by Florindo and Latorre[14]. The protocol is subdivided into three different physical activity domains, with the respective scores: (i) occupational; (ii) sportive; (iii) leisure and locomotion. The sum of the scores of each domain represents habitual

physical activity (HPA), according to a calculation proposed in the original questionnaire. Afterwards, the sample was subdivided into quartiles, according to the total score of each individual[15-18], as follows: lower quartile (1st), sedentary; intermediate quartiles (2nd and 3rd), moderately active; and upper quartile (4th), active. The study considered those who gave a positive answer to the following questions as being physically active during childhood and adolescence: (1) "From the age of 7 to 10 years old, outside of school, were you engaged in any supervised sports activity for at least one full year"? and (2) "From the age of 11 to 17 years old, outside of school, were you engaged in any supervised sports activity for at least one full year"? Based on this information, a variable was created with three categories: (i) those who answered "no" for both questions; (ii) those who answered "yes" for only one of the two questions; (iii) those who answered "yes" for both questions[19].

Afterwards, the sample was subdivided in four groups, according to the periods of life in which they reported the practice of physical activities, as follows: (i) no period (persistently sedentary); (ii) only one period ; (iii) only two periods; and (iv) childhood, adolescence and adulthood (persistently active).

DETERMINING HYPERTENSIVE DISEASE

Those who reported having the disease and whose diagnosis was recorded by a doctor in the medical record were considered to be hypertensive.

ANTHROPOMETRIC MARKERS OF OVERALL AND ABDOMINAL OBESITY

Overall obesity was identified by BMI, which was calculated through the use of body mass and height values (kg/m^2); and abdominal obesity was calculated by WC values. All of the anthropometric procedures were conducted according to the protocol proposed by Lohman et al.[20]. Overweight was diagnosed[21] when BMI was ≥ 25 kg/m^2, and obesity was characterized for values ≥ 30 kg/m^2. The cutoff points of 1.02 m for men and 0.88 m for women were used to determine abdominal obesity[22].

SCHOOLING AND PURCHASING POWER

The questionnaire from the Brazilian Association of Survey Companies[23] was used to determine the purchasing power, in which the subdivision is defined from A (highest level) to E (lowest level). For the classification of patients in groups by purchasing power, the following was adopted: classes A1, A2, B1 and B2 (high); C1 and C2 (middle); and D and E (low). This instrument approaches the schooling level of the head of the family. In case the patient was not this person, afterwards there was a question referring to his or her schooling level.

STATISTICAL PROCEDURES

Descriptive statistics was expressed through values of mean, standard deviation and lower and upper limits of distribution. Data were organized in order to allow the treatment of categorical data and, in this case, they were presented in the relative form (%). The χ^2 test (with Yates correction for 2x2 tables, when necessary) and logistic regression were employed to indicate the presence and the magnitude of associations, respectively. A multivariate model was created for logistic regression, where independent variables that presented significance values of up to 20% in the univariate model (χ^2 test), with the dependent variable, were inserted as confusing factors in the main analysis. This multivariate model was expressed as adjusted Odds Ratio (OR) values, as well as 95% confidence intervals. The statistical software BioEstat, version 2.5, was used for data analysis, and statistical significance was established at $p < 0.05$ for all of the tests.

RESULTS

The study involved 963 patients, being 26.6% male (n = 256) and 73.4% female (n = 707) participants. Mean age was 65 ± 9 years (ranging from 50 to 96 years old). Regardless of the region of collection, the prevalent purchasing power in the sample was the intermediate one (class C), comprehending 61.8% of all of the assessed patients (n = 595). Approximately 85% of the assessed patients had completed elementary school (n = 820). The occurrence of AH was observed in 76.8% (n = 740) of the individuals, being 80% among men and 75.7% among women. Among these 740 hypertensive participants, 58 (7.8%) did not use any hypertensive drug, while among those under medication (n = 682), 40.4% (n = 276) presented values of systolic blood pressure (SBP) ≥ 140 mmHg, and/or diastolic blood pressure (DBP) ≥ 90 mmHg, therefore considered as non-controlled.

By considering the practice of physical activities throughout life, it was observed that only 12 individuals (1.2%) presented an active behavior during childhood, adolescence and adulthood. Fifty-two individuals were active in two periods of life (5.4%); in only one period, 281 individuals (29.2%); and those who have been sedentary for their whole lives accounted for 618 (64.2%). After the analysis of BMI, it was observed that 37% (n = 356) of the patients were within the desirable limits for body weight, while the others were overweight (22.4%; n = 216) or obese (40.6%; n = 391). For WC, 70% (n = 674) of the sample presented values above the desirable limits. There was a significant association between the presence of overall (linear χ^2 with $p = 0.001$) and abdominal obesity (χ^2 in a 2x2 table with $p = 0.001$), with higher occurrence of AH. There was no significant association between the occurrence of AH and schooling ($p = 0.206$) or purchasing power ($p = 102$).

A few patients were active in childhood (5.4%) and adolescence (13.4%), and no significant association was observed with the occurrence of AH. A similar response was found for physical activities (p = 0.860). On the other hand, there was a significant association for the practice of current physical activities and AH (p = 0.002) (Table 1). After the adjustment by confusing factors (Table 2), active individuals presented 52% less chances of reporting AH, when compared to sedentary ones.

Table 3 shows that people with excessive weight and physical inactivity (OR = 4.09; 95%CI 1.93 – 8.63), or with abdominal obesity and physical inactivity (OR = 4.69; 95%CI 2.35 – 8.63), have higher chances of presenting AH, when compared to active people with no type of obesity. The magnitude of the association between AH and adiposity increased with the reduced involvement in physical activities.

Table 4 shows the frequency distribution of patients in the different physical activity domains. There was a significant association between leisure physical exercises and occurrence of the disease (p = 0.021).

Table 1. Distribution of absolute and relative frequency (%) of levels of physical activity in different periods of life according to the absence or presence of arterial hypertension, with respective significance values in the χ^2 test.

Levels of physical activity	Arterial Hypertension		p-value
	Absence n (%)	Presence n (%)	
Physical activity in childhood			
Sedentary	215 (23.6)	696 (76.4)	0.172
Active	8 (15.4)	44 (84.6)	
Physical activity in adolescence			
Sedentary	201 (24.1)	633 (75.9)	0.092
Active	22 (17.1)	107 (82.9)	
Current physical activity			
Sedentary	40 (16.9)	197 (83.1)	0.002
Moderately active	114 (23.5)	372 (76.5)	
Active	69 (28.7)	171 (71.3)	
Physical activity tracking			
Always sedentary	134 (21.7)	484 (78.3)	0.860
Active for 1 period	80 (28.5)	201 (71.5)	
Active for 2 periods	8 (15.4)	44 (84.6)	
Always active	1 (8.3)	11 (91.7)	

Table 2. Association between arterial hypertension and levels of physical activity among adults assisted by the Brazilian public healthcare system in Bauru, São Paulo.

Levels of physical activity	Logistic regression: arterial hypertension		
	Adjusted OR	95%CI	p-value
Sedentary	1.00	-	-
Moderately active	0.77	0.49 – 1.21	0.262
Active	0.48	0.38 – 0.99	0.047

OR: *Odds Ratio*; 95%CI 95% confidence interval. Multivariate model adjusted by the classification of body mass index, waist circumference, sex, age and Basic Health Unit.

Table 3. Crude and adjusted association between the practice of physical activity, central/total obesity and arterial hypertension.

Variables	AH	Logistic regression	
		Model 1	Model 2
HFA and BMI	n (%)	OR (95%CI)	OR (95%CI)
Sedentary			
Overweight/obese	77 (88.5)*	4.60 (2.19 – 9.63)	4.09 (1.93 – 8.63)
Eutrophic	120 (80)*	2.39 (1.42 – 4.02)	1.92 (1.11 – 3.31)
Mod. active			
Overweight/obese	180 (85.7)*	3.58 (2.15 – 5.97)	3.86 (2.28 – 6.53)
Eutrophic	192 (69.6)	1.36 (0.89 – 2.08)	1.39 (0.90 – 2.15)
Active			
Overweight/obese	79 (84.9)*	3.37 (1.74 – 6.52)	3.64 (1.86 – 7.12)
Eutrophic	92 (62.6)	1.00	1.00
Linear χ^2 with p = 0,001			
HFA and WC	n (%)	OR (95%CI)	OR (95%CI)
Sedentary			
Altered	133 (88.7)§	4.90 (2.50 – 9.60)	4.69 (2.35 – 9.35)
Normal	64 (73.6)	1.74 (0.91 – 3.34)	1.32 (0.66 – 2.60)
Mod. active			
Altered	293 (79.6)§	2.45 (1.47 – 4.08)	3.05 (1.75 – 5.31)
Normal	79 (66.9)	1.27 (0.70 – 2.28)	1.37 (0.75 – 2.53)
Active			
Altered	120 (76.4)§	2.03 (1.14 – 3.61)	2.50 (1.35 – 4.62)
Normal	51 (61.4)	1.00	1.00
Linear χ^2 with p = 0.001			

Model 1: no adjustment (crude); Model 2: adjusted by sex, age and basic health unit; OR: *Odds Ratio*; 95%CI: 95% confidence interval; *p < 0.05 compared to the active and eutrophic group for the comparison; §p < 0.05 compared to the active group and normal waist circumference; HFA: habitual physical activity; BMI: body mass index; WC: waist circumference; Mod. active: moderately active.

Table 4. Distribution of absolute and relative frequency (%) of physical activity domains according to the absence or presence of arterial hypertension, with respective significance values from the χ^2 test.

Variables	Arterial Hypertension		p-value
	Absence n (%)	Presence n (%)	
Physical activity during leisure			
Sedentary	155 (21.4)	569 (78.6)	0.021
Moderately active	65 (28.1)	166 (71.9)	
Active	3 (37.5)	5 (62.5)	
PA during leisure and locomotion			
Sedentary	21 (15.7)	113 (84.3)	0.103
Moderately active	195 (24.6)	598 (75.4)	
Active	7 (19.4)	29 (80.6)	
Occupational PA			
Sedentary	38 (17.4)	180 (82.6)	0.191
Moderately active	170 (25.5)	496 (74.5)	
Active	15 (19.0)	64 (81.0)	

PA: physical activity.

DISCUSSION

This study identified high occurrence of AH, overall and abdominal obesity in the assessed population, as well as low rate of involvement with the practice of physical activities throughout life. Such results were obtained from adults attending the public healthcare system, and this population is mainly composed of individuals with low purchasing power and schooling. This situation is similar to the reality of most Brazilians living in the suburbs of major urban centers[24].

The low number of patients who informed being active throughout life is a reason for concern, since the physical inactivity has an expressive impact on the occurrence of mortality caused by cardiovascular diseases in the Brazilian population[25]. Corroborating the high percentage of sedentary people observed in this study, Ferreira et al.[26] identified that 59.8% of the elderly people using SUS from Goiânia, Goiás, presented low levels of physical activities. These rates of sedentary lifestyle are much higher than those observed in the general population, and should be assessed by health administrators.

Considering that most of the sample was composed by hypertensive participants, the regular practice of physical activities would contribute with the control of pressure levels. In this case, the continuous aerobic physical exercise is considered to be an important support for the treatment of AH, due to the hypotensive effect that can be observed even after a single training session[27]. Besides, a significant reduction of pressure levels can be maintained with an oriented physical training program[28-30].

According to this evidence, our results pointed out that the practice of physical activities is a protective factor for the occurrence of AH, even when results are corrected by anthropometric markers of adiposity, sex and age. In this case, active individuals had lower chances (52%) of presenting AH when compared to sedentary ones. Confirming this evidence, Pitanga and Lessa[31] observed that physically active adults during leisure time had lower levels of SBP and DBP. At the same time, a study estimated the prevalence of AH and some of its risk factors in Goiânia, Goiás, and observed that moderate or intensive physical activity during leisure time and mild physical activity at work presented a negative association with the occurrence of AH[3]. Considering physical activities of locomotion, Hayashi et al.[32] investigated the association between time of walk to work and physical activity during leisure time with the risk of AH and found 12% less risks of becoming ill when the time of walk increased 10 minutes.

Even though the results show effective benefits from the practice of physical activities for people with AH, Lopes et al.[33] analyzed the epidemiological profile of patients affected by this condition in Brasília, Distrito Federal, and observed that the adoption of regular physical activities was reported by only 5.6% of the hypertensive people with controlled blood pressure, and by 2.7% of the ones without controlled values. Girotto et al.[34] analyzed hypertensive patients in a Family Healthcare Unit and found that only 20.1% of them performed regular physical activities.

In our sample, 80.1 and 70.2% of the participants presented excessive weight/obesity and abdominal obesity, respectively. According to data from VIGITEL (telephone disease surveillance syetem), published in 2010[35], 48.1% of the Brazilian adults are not within the desirable weight limits (BMI $\geq$ 25 kg/m^2), and 15% are already obese (BMI $\geq$ 30 kg/m^2). Besides, between 2006 and 2010 there was a significant increase in overweight and obesity rates among men and women in the country, thus raising overweight rates from 42.7 to 48.1%, and obesity rates from 11.4 to 15%.

Both types of obesity were associated with AH ($p < 0.001$), and this kind of finding was observed in other states of the federation[5,36,37]. However, abdominal obesity has been pointed out as being more harmful to health then overall obesity. The mechanisms through which abdominal fat is associated with increasing blood pressure values may be due to hyperinsulinemia, which causes more activity in the sympathetic nervous system and tubular sodium reabsorption[38-40]; such actions contribute with high blood pressure values. On the other hand, insulin is related to the promotion of vasodilation, and leads to increasing blood flow to the skeletal musculature, and such an effect seems to be mediated by nitric oxide[41,42]. These effects are strongly reduced in obese and hypertensive patients[41], who are resistant to insulin. Besides the likely compromise in vasodilation mechanisms,

which could contribute even more for the increasing blood pressure, the reduced blood flow to the skeletal musculature might also determine the reduced glucose peripheral use, thus aggravating the state of insulin resistance[43].

Due to the active participation of the adipose tissue in physiological mechanisms of pressure control and because of its influence for cardiovascular structures, it is important to notice the inter-relations between obesity, sedentary lifestyle and AH among patients of SUS.

A study conducted by Sterwart et al.[44] showed that reducing abdominal fat among hypertensive patients was important to decrease SBP. In another study, patients who could reduce abdominal circumference after 16 weeks of aerobic training could reduce SBP and pulse pressure[45]. After these findings, it is worth to mention that reduced visceral fat was associated with improved arterial compliance, contrary to the progression of arterial rigidity, which is associated with weight gain[46].

Therefore, sedentary lifestyle, which favors AH and obesity, may be associated with increased plasma renin activity, which is an essential BP regulator, and this leads to significant increasing rates of mortality and morbidity, since these indicators may compromise the cardiovascular system directly and regardless of the levels of blood pressure increase[47,48].

Finally, no interaction between physical activities and AH was observed, and other studies could not demonstrate an association between previous physical activities and blood pressure during adulthood either[49,50]. On the other hand, the small number of individuals who have maintained an active lifestyle throughout life may have compromised its effect on the analyzed associations, and it also draws our attention to this dangerous risk behavior maintained throughout life. Additionally, previous studies demonstrate that the previous practice of physical exercises during childhood and adolescence may prevent the development of of non-communicable diseases in the Brazilian population[19,51,52]. This information is relevant regarding the efforts to reduce costs by promoting the practice of physical exercises[17], but especially to improve the health conditions of the population assisted by SUS.

As relevant points, significant associations between abdominal obesity, sedentary lifestyle and the occurrence of AH with low rates of active patients during childhood and adolescence stand out. Study limitations involve the cross-sectional design, which does not allow to establish causality relationships between the outcome and independent variables, and the gap of non-investigated time between the end of adolescence (17 years old) and the beginning of adulthood (50 years old), which does not include several data concerning behaviors and life habits in the referred period.

FINAL CONSIDERATIONS

A significant statistical association was observed between anthropometric markers of overall and abdominal obesity, current practice of physical activities and occurrence of AH. Therefore, there is the need for further studies that can contribute to identify the occurrence of excessive weight and obesity among people affected by non-communicable diseases, with the objective of preventing future complications.

REFERENCES

1. Sanchez CG, Pierin AMG, Mion Jr D. Comparação dos perfis dos pacientes hipertensos atendidos em pronto-socorro e em tratamento ambulatorial. Rev Esc Enferm USP 2004; 38(1): 90-8.
2. Coelho EB, Moysés Neto M, Palhares R, Cardoso MCM, Geleilete TJM, Nobre F. Relação entre a assiduidade às consultas ambulatoriais e o controle da pressão arterial em pacientes hipertensos. Arq Bras Cardiol 2005; 85(3): 157-61.
3. Jardim PCBV, Gondim MRP, Monego ET, Moreira HG, Vitorino PVO, Souza WKSB, et al. Hipertensão arterial e alguns fatores de risco em uma capital brasileira. Arq Bras Cardiol 2007; 88(4): 452-7.
4. Malta DC, Oliveira MR, Moura EC, Silva SA, Zouain CS, Santos FP, et al. Fatores de risco e proteção para doenças crônicas não transmissíveis entre beneficiários da saúde suplementar: resultados do inquérito telefônico Vigitel, Brasil, 2008. Ciênc Saúde Colet 2011; 16(3): 2011-22.
5. Barbosa LS, Scala LCN, Ferreira MG. Associação entre marcadores antropométricos de adiposidade corporal e hipertensão arterial na população adulta de Cuiabá, Mato Grosso. Rev Bras Epidemiol 2009; 12(2): 237-47.
6. Wang J, Thornton JC, Bari S, Williamson B, Gallagher D, Heymsfield SB, et al. Comparisons of waist circumferences measured at 4 sites. Am J Clin Nutr 2003; 77(2): 379-84.
7. Zhu S, Wang Z, Heshka S, Heo M, Faith MS, Heymsfield SB. Waist circumference and obesity-associated risk factors among whites in the third National Health and Nutrition Examination Survey: clinical action thresholds. Am J Clin Nutr 2002; 76(4): 743-9.
8. Barroso WK, Jardim PC, Vitorino PV, Bittencourt A, Miquetichuc F. Influência da atividade física programada na pressão arterial de idosos hipertensos sob tratamento não-farmacológico. Rev Assoc Med Bras 2008; 54(4): 328-33.
9. Sociedade Brasileira de Cardiogolia (SBC), Sociedade Brasileira de Hipertensão (SBH), Sociedade Brasileira de Nefrologia (SBN). V Diretrizes brasileiras de hipertensão arterial. Arq Bras Cardiol. 2007; 89(3): e24-79.
10. Codogno JS. Influência da prática continuada de atividades físicas sobre os gastos com o tratamento ambulatorial de pacientes da rede pública de Bauru, São Paulo [tese de Doutorado]. Rio Claro: Universidade Estadual Paulista; 2012.
11. Rouquayrol MZ, Almeida Filho N. Epidemiologia e Saúde. 6 ed. Rio de Janeiro: Guanabara Koogan; 2003.
12. Kilsztajn S, Silva DF, Camara MB, Ferreira VS. Grau de cobertura dos planos de saúde e distribuição regional do gasto público em saúde. Saúde Soc 2001; 10(2): 35-46.
13. Baecke JA, Burema J, Frijters JE. A short questionnaire for the measurement of habitual physical activity in epidemiological studies. Am J Clin Nutr 1982; 36(5): 936-42.
14. Florindo AA, Latorre MRDO. Validation and reliability of the Baecke questionnaire for the evaluation of habitual physical activity in adult men. Rev Bras Med Esporte 2003; 9(3): 129-35.
15. Codogno JS. Diabetes mellitus tipo 2 e esquema terapêutico: Impacto da prática de atividades físicas sobre o custo de tratamento ambulatorial em unidade básica de saúde na cidade de Bauru/SP [dissertação de mestrado]. Rio Claro: Universidade Estadual Paulista; 2010.
16. Codogno JS, Fernandes RA, Monteiro HL. Prática de atividades físicas e custo do tratamento ambulatorial de diabéticos tipo 2 atendidos em unidade básica de saúde. Arq Bras Endocrinol Metab 2012; 56(1): 6-11.
17. Codogno JS, Fernandes RA, Sarti FM, Freitas Jr IF, Monteiro HL. The burden of physical activity on type 2 diabetes public healthcare expenditures among adults: a retrospective study. BMC Public Health 2011; 11: 275.
18. Turi BC, Codogno JS, Fernandes RA, Amaral SL, Monteiro HL. Frequência de ocorrência de doenças crônico-degenerativas em adultos com mais de 50 anos. Rev Bras Ativ Fís Saúde 2010; 15: 218-24.
19. Fernandes RA, Sponton CHG, Zanesco A. Atividade física na infância e na adolescência promove efeitos benéficos na saúde de adultos. Rev SOCERJ 2009; 22(6): 365-72.
20. Lohman TG, Roche AF, Mertorell R. Anthropometric Standardization Reference Manual. Illinois: Human Kinectics Books; 1988.
21. World Health Organization (WHO). Obesity, Preventing and Managing the Global Epidemic: Report of the WHO Consultation on Obesity. Geneva: WHO; 1998.
22. Peixoto MRG, Benício MHD, Latorre MRDO, Jardim PCBV. Circunferência da cintura e índice de massa corporal como preditores da hipertensão arterial. Arq Bras Cardiol 2006; 87(4): 462-70.
23. Associação Brasileira de Empresas de Pesquisa. Dados com base no Levantamento Sócio Econômico 2008 – IBOPE, 2010 [Internet]. Disponível em: http://www.abeb.org. (Acessado em 14 de janeiro de 2010).
24. Barros MBA, César CLG, Carandina L, Torre GD. Desigualdades sociais na prevalência de doenças crônicas no Brasil, PNAD-2003. Ciênc Saúde Coletiva 2006; 11(4): 911-26.

25. Ministério da Saúde. Mortalidade no Brasil. DATASUS: informações de saúde. 2007. Disponível em: http://tabnet.datasus.gov.br/cgi/tabcgi.exe?sim/cnv/obtuf.def. (Acessado em 07 de novembro de 2009).
26. Ferreira CCC, Peixoto MRG, Barbosa MA, Silveira EA. Prevalência de fatores de risco cardiovascular em idosos usuários do Sistema Único de Saúde. Arq Bras Cardiol 2010; 95(5): 621-8.
27. Christofaro DGD, Casonatto J, Fernandes RA, Cucato GG, Gonçalves CGS, Oliveira AR, et al. Efeito da duração do exercício aeróbio sobre as respostas hipotensivas agudas pós-exercício. Rev SOCERJ 2008; 21(6): 404-8.
28. Monteiro HL, Rolim LMC, Squinca DA, Silva FC, Ticianeli CCC, Amaral SL. Efetividade de um programa de exercícios no condicionamento físico, perfil metabólico e pressão arterial de pacientes hipertensos. Rev Bras Med Esporte 2007; 13(2): 107-12.
29. Oliveira KPC, Vieira EL, Oliveira JD, Oliveira KR, Lopes FJG, Azevedo LF. Exercício aeróbio no tratamento da hipertensão arterial e qualidade de vida de pacientes hipertensos do Programa Saúde da Família de Ipatinga. Rev Bras Hipertens 2010; 17(2): 78-86.
30. Medina FL, Lobo FS, Souza DR, Kanegusuku H, Forjaz CLM. Atividade física: impacto sobre a pressão arterial. Rev Bras Hipertens 2010; 17(2): 103-6.
31. Pitanga FJG, Lessa I. Associação entre atividade física no tempo livre e pressão arterial em adultos. Arq Bras Cardiol 2010; 95(4): 480-5.
32. Hayashi T, Tsumura K, Suematsu C, Okada K, Fujii S, Endo G. Walking to work and the risk for hypertension in men: the Osaka Health Survey. Ann Intern Med 1999; 131(1): 21-6.
33. Lopes EB, Caetano MMJV, Leite SPAF, Ito MK. Avaliação da frequência de hábitos e comportamentos de risco na população que auto-referiu hipertensão arterial na pesquisa de "Prevalência de fatores de risco das doenças crônicas não transmissíveis no Distrito Federal". Epidemiol Serv Saúde 2011; 20(1): 111-7.
34. Girotto E, Andrade SM, Cabrera MAS. Prevalência de obesidade abdominal em hipertensos cadastrados em uma Unidade de Saúde da Família. Arq Bras Cardiol 2010; 94(6): 754-62.
35. Brasil. Ministério da Saúde. Secretaria de Vigilância em Saúde. Secretaria de Gestão Estratégica e Participativa. VIGITEL Brasil 2010: Vigilância de Fatores de Risco e Proteção para Doenças Crônicas por Inquérito Telefônico. Brasília: Ministério da Saúde; 2011.
36. Lino MZR, Muniz PT, Siqueira KS. Prevalência e fatores associados ao excesso de peso em adultos: inquérito populacional em Rio Branco, Acre, Brasil, 2007-2008. Cad Saúde Pública 2011; 27(4): 797-810.
37. Cipullo JP, Martin JFV, Ciorlia LAS, Godoy MRP, Cação JC, Loureiro AAC, et al. Prevalência e fatores de risco para hipertensão em uma população urbana brasileira. Arq Bras Cardiol 2010; 94(4): 519-26.
38. DeFronzo RA, Ferranini E. Insulin resistance: a multifaceted syndrome responsible for NIDDM, obesity, hypertension, dyslipidemia, and atherosclerotic cardiovascular disease. Diabetes Care 1991; 14(3): 173-94.
39. Reaven GM, Lithell H, Landsberg L. Hypertension and associated metabolic abnormalities -- the role of insulin resistance and the sympathoadrenal system. N Engl J Med 1996; 334(6): 374-81.
40. Moan A, Nordby G, Rostrup M, Eide I, Kjeldsen SE. Insulin sensitivity, sympathetic activity, and cardiovascular reactivity in young men. Am J Hypertens 1995; 8(3): 268-75.
41. Steinberg HO, Chaker H, Learning R, Johnson A, Brechtel G, Baron AD. Obesity/insulin resistance is associated with endothelial dysfunction. Implications for the syndrome of insulin resistance. J Clin Invest 1996; 97(11): 2601-10.
42. Baron AD, Steinberg HO, Chaker H, Learning R, Jonhson A, Brechtel G. Insulin-mediated skeletal muscle vasodilatation contributes to both insulin sensitivity and responsiveness in lean humans. J Clin Invest 1995; 96(2): 786-92.
43. Zeng G, Quon MJ. Insulin-stimulated production of nitric oxide is inhibited by wortmannim. Direct measurement in vascular endothelial cells. J Clin Invest 1996; 98(4): 894-8.
44. Sterwart KJ, Bacher AC, Turner KL, Fleg JL, Hees PS, Shapino EP, et al. Effect of exercise on blood pressure in older persons: a randomized controlled trial. Arch Intern Med 2005; 165(7): 756-62.
45. Martinelli B, Barrile SR, Arca EA, Franco RJS, Martin LC. Influência do exercício aeróbio na renina de portadores de hipertensão arterial com sobrepeso. Arq Bras Cardiol 2010; 95(1): 91-8.
46. Wildman RP, Farhat GN, Patel AS, Mackey RH, Brockwell S, Thompson T, et al. Weight change is associated with change in arterial stiffness among healthy young adults. Hypertension 2005; 45(2): 187-92.
47. Kyle UG, Morabia A, Schutz Y, Pichard C. Sedentarism affects body fat mass index and fat-free mass index in adults aged 18 to 98 years. Nutrition 2004; 20(3): 255-60.

48. De Backer GC, Ambrosioni E, Broch-Johnsen K, Brotons C, Cifkova R, Dallongeville J, et al. European guidelines on cardiovascular disease prevention in clinical practice: third joint task force of European and other societies on cardiovascular disease prevention in clinical practice (constituted by representatives of eight societies and by invited experts). Eur J Cardiovasc Prev Rehabil 2003; 10(4): S1-10.

49. Boreham C, Twisk J, Neville C, Savage M, Murray L, Gallagher A. Associations between physical fitness and activity patterns during adolescence and cardiovascular risk factors in young adulthood: the Northern Ireland Young Hearts Project. Int J Sports Med 2002; 23(Suppl 1): S22–6.

50. Twisk JW, Kemper HC, van Mechelen W. The relationship between physical fitness and physical activity during adolescence and cardiovascular disease risk factors at adult age. The Amsterdam Growth and Health Longitudinal Study. Int J Sports Med 2002; 23(Suppl 1):S8-14.

51. Fernandes RA, Christofaro DG, Casonatto J, Codogno JS, Rodrigues EQ, Cardoso ML, et al. Prevalence of dyslipidemia in individuals physically active during childhood, adolescence and adult age. Arq Bras Cardiol 2011; 97(4): 317-23.

52. Fernandes RA, Zanesco A. Early physical activity promotes lower prevalence of chronic diseases in adulthood. Hypertens Res 2010; 33(9): 926-31.

Received on: 05/20/2012
Final version presented on: 01/09/2013
Accepted on: 01/15/2013