

Blood Pressure, Excess Weight and Level of Physical Activity in Students of a Public University

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Abstract

Background: High blood pressure, excess weight and sedentary lifestyle are important risk factors for cardiovascular diseases, and they are closely associated.

Objective: To evaluate the nutritional status, level of physical activity and blood pressure levels of students of Universidade Federal do Piauí, Teresina, Brazil.

Methods: Cross-sectional study with a sample of 605 students (46.1% males and 53.9% females), with a mean age of 21.7 ± 3.7 years. The nutritional status was classified according to body mass index (BMI), and central adiposity according to waist circumference (WC). The level of physical activity was evaluated using the short version of the International Physical Activity Questionnaire (IPAQ). Elevated blood pressure was defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg.

Results: The prevalence of elevated blood pressure was 9.7%, and was higher among men. Excess weight (BMI ≥ 25 kg/m²) was found in 18.2% of the students, with overweight and obesity rates of 15.2% and 3%, respectively. Abdominal obesity was found in 2.4% of the students regardless of gender, and sedentary lifestyle in 52%. The mean blood pressure increased with increasing BMI and WC. No association was found between the levels of physical activity and blood pressure.

Conclusion: An association of increased body weight and waist circumference with higher blood pressure levels was observed among the participants. Instruments for an early assessment of the cardiovascular risk and preventive advice should be established for these young individuals. (Arq Bras Cardiol 2010; 95(2): 192-199)

Key words: Blood pressure; overweight; students; motor activity.

Introduction

High blood pressure represents an independent risk factor for cardiovascular diseases, with a high medical and socioeconomic burden that mainly results from its complications, such as cerebrovascular disease; coronary artery disease; heart failure; chronic renal failure; and vascular disease of the extremities¹.

Among the risk factors for cardiovascular diseases, obesity should be especially pointed out because excess body mass is a predisposing factor for hypertension, and can account for 20% to 30% of the cases; 75% of men and 65% of women have hypertension directly attributable to overweight and obesity².

Excess body fat and physical inactivity have been highly prevalent among the risk factors for cardiovascular diseases. In

the household survey on risk behavior and reported morbidity of non-communicable diseases and disorders conducted in the population aged 15 years or older and residing in 15 Brazilian capital cities and the Federal District, the prevalence of excess weight found was higher than 40% in some capital cities, a rate that is close to those found in developed countries³. In the same survey, there was no characteristic pattern in the frequency of insufficiently active individuals among the regions, with a higher prevalence of physical inactivity in João Pessoa (54.5%) and lower prevalence in Belém (28.2%)³. In the State of São Paulo, Matsudo et al⁴ found a prevalence of physical inactivity of 54% in a population aged between 14 and 77 years. Sedentary lifestyle is also associated with several other diseases and adverse metabolic disorders such as obesity; coronary artery disease; hypertension; type-2 diabetes; osteoporosis; colon cancer; and depression⁵, as well as with changes in lipid profile and glucose intolerance^{6,7}.

The population of university students stands out mainly in view of the key role of higher education in the adoption of plans and preventive measures to provide these students with the possibility of modifying the community they belong to⁸. Because of the high prevalence of hypertension and obesity,

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which are important risk factors for cardiovascular diseases in the general population⁴, these prevalences should be known by and spread not only through the university environment but also to the general population.

Knowledge of the prevalence of risk factors for non-communicable chronic diseases may make students, educators and education managers aware of the importance of developing prevention programs. Programs encouraging the adoption of healthy life habits targeted not only at the university community but also at the general population may contribute to improve the quality of life and reduce the incidence of diseases and preventable complications. The objective of this study was to describe the blood pressure levels, nutritional status and level of physical activity of students of a Brazilian federal university.

Methods

The present study is part of the research project titled "*Perfil socioeconômico, nutricional e de saúde de estudantes da Universidade Federal do Piauí (UFPI) - Brasil*" (Socioeconomic, nutritional and health profile of students of the Federal University of Piauí - UFPI - Brazil). It consisted of a descriptive, cross-sectional study with a sample of 605 students, of whom 279 were males (46.1%) and 326 females (53.9%), with ages ranging from 16 to 47 years, all regularly enrolled in the second school period of 2006. Data were collected in January and February 2007.

For the calculation of the sample size, a 95% confidence interval was considered, for a finite population of 11,152 students, using Martins formula⁹ for proportion estimation in large samples; the error margin obtained was 3.75%. The sample was chosen by raffle proportional to the number of students attending the course, period attended, and teaching center of UFPI (Agricultural Sciences Center, Sciences and Education Center, Human Sciences and Languages Center, Natural Sciences Center, Health Sciences Center, and Technology Center).

The project was approved by the Research Ethics Committee of UFPI (Report no. 95/2006) and followed the guidelines of Resolution nº 196/96 of the National Health Council¹⁰. Prior to the administration of the questionnaire, the students were informed about the objective of the study and procedures that would be performed, and gave written informed consent.

The instrument used for data collection was a questionnaire divided into general information, data on the practice of physical activities, and anthropometric and blood pressure measurements. The questions regarding the practice of physical activities were based on Braggion et al's study¹¹. For the analysis and classification of the activities performed, the International Physical Activity Questionnaire (IPAQ) was used. This instrument has been proposed in the past years as a possible standardization model for obtaining internationally comparable measurements of physical activities, and was tested and validated by scientific studies in Brazil^{12,13}.

The following variables were studied: age (full years), gender, physical activity (distributed into four groups: sedentary, insufficiently active, active and very active groups),

body weight (measured in a digital scale with 150 kg capacity and 0.1 kg accuracy), height (measured with an anthropometric tape measure with 1 mm accuracy), waist circumference (measure with a glass-fiber tape measure with 1 mm accuracy) and blood pressure (systolic, diastolic and mean).

Blood pressure was measured using the auscultatory method, with the individuals comfortably sitting for at least 5 minutes on a chair (their feet resting on the floor) in a tranquil environment and with their right arm positioned at the level of the heart. For data analysis, the mean of two blood pressure measurements taken 20 minutes apart was used. Blood pressure was determined according to the standardization proposed by the V Brazilian Guidelines on Hypertension¹⁴. Systolic blood pressure (SBP) was recorded at the Korotkoff phase I (sound is first heard), and the diastolic blood pressure (DBP) at the Korotkoff phase V (when the sound disappears). The cut-off points used for increased blood pressure were SBP ≥ 140 mmHg and/or DBP ≥ 90 mmHg.

Weight, height and waist circumference measurements were taken with the students barefoot, wearing light clothes and no accessories that could interfere with the measurements, according to recommendations from the *Manual of techniques and procedures* of the Ministry of Health¹⁵. Waist circumference was measured at midway between the lower rib and the iliac crest.

The overall nutritional status was classified using the body mass index (BMI) based on the cut-off points proposed by the World Health Organization (WHO)², with normal weight defined as BMI > 18.5 and < 25 kg/m², overweight as BMI ≥ 25 and < 30 kg/m², and obesity as BMI ≥ 30 kg/m².

Waist circumference (WC) was used to identify the pattern of body fat distribution, because it is considered the best indicator for the assessment of risk for cardiovascular and metabolic diseases in epidemiological studies^{16,17}. The cut-off points used were those defined by Lean et al¹⁷ and currently recommended by the WHO², considering normal or adequate WC values those < 80 cm for women and < 94 cm for men. Action level cut-off points both for clinical use and for health promotion programs were defined as follows: action level 1 or increased risk for morbidities associated with obesity (WC from 80 to 88cm for women and from 94 to 102 cm for men), in which the individuals should be advised to stop gaining weight and to adopt a healthy lifestyle; and action level 2 or very increased risk (WC ≥ 88 cm in women and ≥ 102 in men), in which the individuals should seek help from a health professional in order to lose weight and be screened for other risk factors.

Data were processed in the Excel for Windows, BioEstat 4.0 and EpiInfo 6.04b programs. The statistical analysis for associations between the variables studied was carried out using the association chi square test and simple linear regression test. The odds ratio was used in the relations between two variables in 2 x 2 tables. The level of significance was set at $p < 0.05$.

Results

A total of 605 individuals of both genders participated in the study; 53.9% were women. Their age ranged from 16 to

47 years, with a mean of 21.7 ± 3.7 years (Tables 1 and 2).

The analysis of BMI showed that 18.2% of the individuals had excess weight; 15.2% were overweight, and 3% were obese (Table 2). BMI of the participants ranged from 15 kg/m² to 35.9 kg/m², with a mean of 21.9 ± 3.3 kg/m² (Table 1). Waist circumference (WC) action level 1, i.e., increased cardiovascular risk, was found in 7.9% of the students, whereas action level 2 (very increased risk) was found in 2.4%. No difference was found between men and women regarding the cardiovascular risk as classified using WC ($p > 0.05$) (Table 2).

The mean SBP was 118.4 ± 10.9 mmHg and the mean DBP was 76.2 ± 8.9 mmHg. The mean SBP of male individuals was 124.1 ± 10.6 mmHg and of female individuals of 113.5 ± 8.6 mmHg, whereas the mean DBP was 80.2 ± 8.4 mmHg for men and 72.8 ± 7.9 mmHg for women (Table 1). Blood pressure levels above normal values were observed in 9.7% of the students, and the rates found among women (2.7%) were significantly lower ($p < 0.0001$) than those found among men (17.9%) (Table 2). Mean SBP, mean DBP and mean blood pressure (MBP) were also significantly higher among men ($p < 0.0001$) (Table 3), since 84.7% of the students with increased blood pressure were men. We observed that MBP increased with BMI ($p < 0.0001$) (Graph 1) and with WC ($p < 0.001$) (Graph 2).

The analysis of the level of physical activity of the university students, according to the IPAQ classification, revealed a proportion of 28.4% sedentary individuals, 23.6% insufficiently active individuals, 30.9% active individuals, and 17.1% very active individuals. Thus, when the categories of physical activity level were grouped as sedentary (sedentary and insufficiently active individuals) and active (active and very active individuals), the overall prevalence of sedentary individuals was 52%. The comparison between genders using this grouping showed a higher proportion of sedentary individuals ($p = 0.003$) among women (63.95%).

Considering the reasons given by sedentary students for not performing physical activities, the main reason was lack of time (51.7%; $p = 0.019$), which was reported by 37% of the men and 60% of the women. Lack of opportunity (12.2%),

lack of interest (11.6%) and health problems (0.6%) were also explanations for physical inactivity, and 15.2% of the sedentary individuals did not answer this question (Table 4).

Discussion

The prevalence of increased blood pressure found in this study (9.7%) was lower than that observed by Simão et al¹⁸ (23.5%) and by Rabelo et al¹⁹ (15.8%) in a university student population with similar age range and using the same cut-off points for normal values.

As regards the differences found for blood pressure level and the proportion of hypertensive individuals among genders, the mean SBP, DBP and MBP values were significantly higher among men. These results are consistent with those observed among university students in São Paulo¹⁹, where the prevalence of hypertension in men was 60.2%. The finding of a higher proportion of hypertension among men can be explained by the fact that the mean age of this population was 21.7 ± 3.7 years, since overall estimates suggest higher hypertension rates for men under 50 years old and for women over sixty years of age²⁰.

The prevalence of excess weight observed in the present study was similar to that demonstrated among university students in the city of Lubango, Angola¹⁸ (20.4%), where 17.1% of the students were overweight and 3.2% obese. Studies conducted in Brazil reported rates similar to that of the present study, e.g. those found among nursing students in Rio de Janeiro, RJ²¹ (20%), with 15% overweight and 5% obesity, and those among nutrition students in Dourado, MS (17%)²².

As regards waist circumference (WC), found of students with increased cardiometabolic risk, defined as a WC greater than 80 for women and greater than 94 for men, the proportion found in the present study (10.3%) was lower than that obtained by Simon et al¹⁸ among students in Lubango (21.4%), and by Vilarinho et al²¹ among nursing students (15%).

Among the university students analyzed in the present study, excess weight with central fat distribution is a predisposing factor for high blood pressure. A cause-effect

Table 1 - Characterization of the study population according to gender

Variable	Male		Female		Overall			
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation	Lowest	Highest
Age (years)	21.9	3.5	21.6†	3.8	21.7	3.7	16	47
SBP	124.1	10.6	113.5*	8.6	118.4	10.9	90	160
DBP	80.2	8.4	72.8*	7.9	76.2	8.9	110	45
MBP	94.8	8.2	86.4*	7.5	90.3	8.9	70	123.3
Height (cm)	173.7	6.3	161.4*	6.6	167.1	8.9	140.5	198
Weight	70.2	12.0	54.1*	7.9	61.6	12.2	41.9	103
BMI (kg/m ²)	23.2	5.3	20.8*	2.7	21.9	3.3	15.0	35.9
Waist circumference (cm)	81.3	9.2	70.6*	7.0	75.5	9.7	57	113

* $p < 0.0001$ in relation to the male gender (t test). † $p > 0.05$ in relation to the male gender (t test). SBP - systolic blood pressure; DBP - diastolic blood pressure.

Table 2 - Blood pressure, nutritional status, waist circumference, and level of activity in university students according to gender

Variable		Male		Female		Overall		Statistics
		Nº	%	Nº	%	Nº	%	
Increased systolic or diastolic blood pressure	Present	50	17.9	9	2.7	59	9.7	OR = 7.69 $\chi^2 = 39.2$ $p < 0.0001$
	Absent	229	82.1	317	97.3	546	90.3	
	Total	279	100.0	326	100.0	605	100.0	
Increased systolic blood pressure	Present	28	10.0	1	0.3	29	4.7	OR = 36.2 $\chi^2 = 31.1$ $p < 0.0001$
	Absent	251	90.0	325	99.7	576	95.3	
	Total	279	100.0	326	100.0	605	100.0	
Increased diastolic blood pressure	Present	41	14.6	9	2.7	50	8.2	OR = 6.0 $\chi^2 = 28.2$ $p < 0.0001$
	Absent	238	85.4	317	97.3	555	91.8	
	Total	279	100.0	326	100.0	605	100.0	
BMI (kg/m ²)	<18.5	25	8.9	59	18.0	84	13.8	$\chi^2 = 44.2$ $p < 0.001$
	≥18.5 or <25.0	174	62.3	238	73.0	412	68.0	
	≥25.0 or <30.0	67	24.0	25	7.6	92	15.2	
	≥30	13	4.8	4	1.4	17	3.0	
	Total	279	100.0	326	100.0	605	100.0	
Waist circumference	Adequate or normal	250	89.6	293	89.8	543	89.7	$\chi^2 = 0.79$ $p = 0.67$
	Level I (increased risk)	21	7.5	27	8.2	48	7.9	
	Level II (very increased risk)	8	2.9	6	2	14	2.4	
	Total	279	100.0	326	100.0	605	100.0	
Level of physical activity	Sedentary*†	62	22.2	110	33.7	172	28.4	$\chi^2 = 8.5$; $p = 0.003$
	Insufficiently active	66	23.6	77	23.6	143	23.6	
	Active*	96	34.4	91	27.9	187	30.9	$\chi^2 = 7.93$; $p = 0.004$
	Very active†	55	19.8	48	10.8	103	17.1	
	Total	279	100.0	326	100.0	605	100.0	

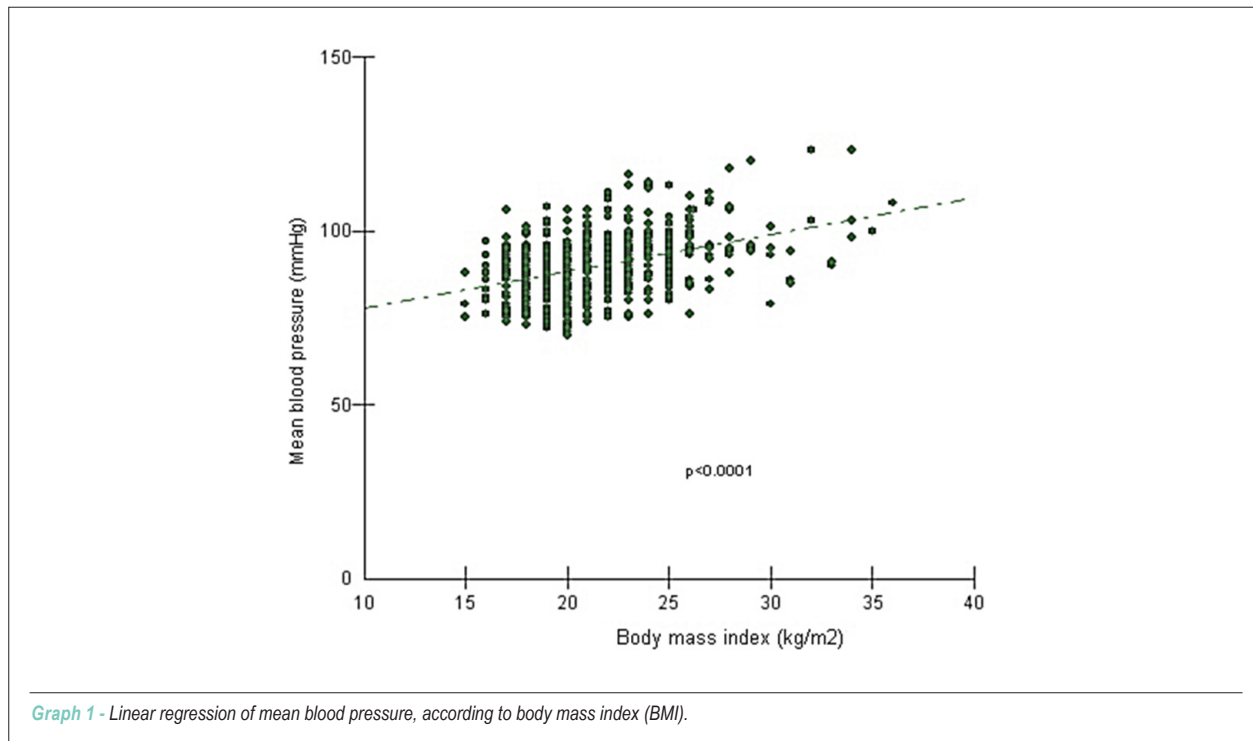
* χ^2 and *p* value in the physical activity variable among the sedentary and active subgroups (statistical significance between two groups). † χ^2 and *p* value in the physical activity variable among the sedentary and very active subgroups (statistical significance between two groups).

relation between increased body mass and blood pressure elevation was demonstrated in several cohort studies. In a cohort study that analyzed American nurses, long-term weight loss after 18 years was observed to result in a lower risk of hypertension, whereas weight gain was associated with increased relative risk for hypertension²³. In the Framingham study cohort of non-hypertensive individuals of both genders, with a mean age of 52 years and followed-up from 1978 to 1994, obesity and weight gain were also shown to contribute to the development of hypertension. In that study, an increase in body mass by 5% was associated with an increase by 20%-30% in the odds ratio for hypertension ($\geq 140/90$ mmHg)²⁴. We should point out that the outcomes of the Framingham study support the recommendation of monitoring individuals with borderline (normal high) blood pressure once a year, and individuals with normal blood pressure every two years; the importance of controlling body weight as a primary measure for the prevention of hypertension was also demonstrated²⁴.

The overall prevalence of sedentary individuals in the present study was 52% when the participants were grouped according to their level of physical activity as sedentary (sedentary and insufficiently active) and active (active and very active) individuals. This was 1.74 times higher than the prevalence recently reported by Rodrigues et al⁸ among university students of Gurupi, Tocantins (29.9%), using the same measurement criteria and type of grouping of the categories of physical level activity. However, the prevalence of sedentary individuals in the study in Gurupi was lower than those found in other national and international studies. In this sense, some Brazilian case series with similar age ranges showed prevalences of sedentary individuals of 35.6% among nutrition students of São Paulo (Fisberg et al's study²⁵); of 75% among nursing students of Rio de Janeiro (Vilarinho et al's study²¹); and of 78.9% among students from a private university in São Paulo (Rabelo et al's study¹⁹).

Table 3 - Blood pressure and nutritional status of university students according to the level of physical activity

Variable		Sedentary		Active		Overall		Statistics
		Nº	%	Nº	%	Nº	%	
Increased systolic or diastolic blood pressure	Present	3	1.7	17	3.9	20	3.3	OR = 0.43 $\chi^2 = 1.83$ $p = 0.17$
	Absent	169	98.3	416	96.1	585	96.7	
	Total	172	100.0	433	100.0	605	100.0	
Increased systolic blood pressure	Present	7	4.0	22	5.0	29	4.7	OR = 0.79 $\chi^2 = 0.28$ $p = 0.59$
	Absent	165	96.0	411	95.0	576	95.3	
	Total	172	100.0	433	100.0	605	100.0	
Increased diastolic blood pressure	Present	10	5.8	40	9.2	50	8.2	OR = 0.61 $\chi^2 = 1.9$ $p = 0.167$
	Absent	162	94.2	393	90.8	555	91.8	
	Total	172	100.0	433	100.0	605	100.0	
BMI (kg/m ²)	<18.5	25	14.5	59	13.6	84	13.8	$\chi^2 = 1.198$ $p = 0.57$
	≥18.5 or <25.0	120	69.7	292	67.4	412	68.0	
	≥25.0 or <30.0	21	12.2	71	16.3	92	15.2	
	≥30	6	3.6	11	2.7	17	3.0	
	Total	172	100.0	433	100.0	605	100.0	



Graph 1 - Linear regression of mean blood pressure, according to body mass index (BMI).

Considering that Rodrigues et al⁶ explained that the prevalence of sedentary individuals in their study was lower than those found in other studies partly because the city of Gurupi has high temperatures and data were collected in the summer, we should expect similar results in our study, since the weather conditions of that city in Northern Brazil are similar to those in Teresina, where the present study was conducted.

The reasons for the higher prevalence of a sedentary lifestyle found among students from Teresina were not identified. A factor that may have contributed to the high proportion of sedentary individuals is related to the formal work reported by 32.87% of the students, a fact that could make it difficult for the individuals to practice physical activities regularly, since they would have less time available for that purpose. In

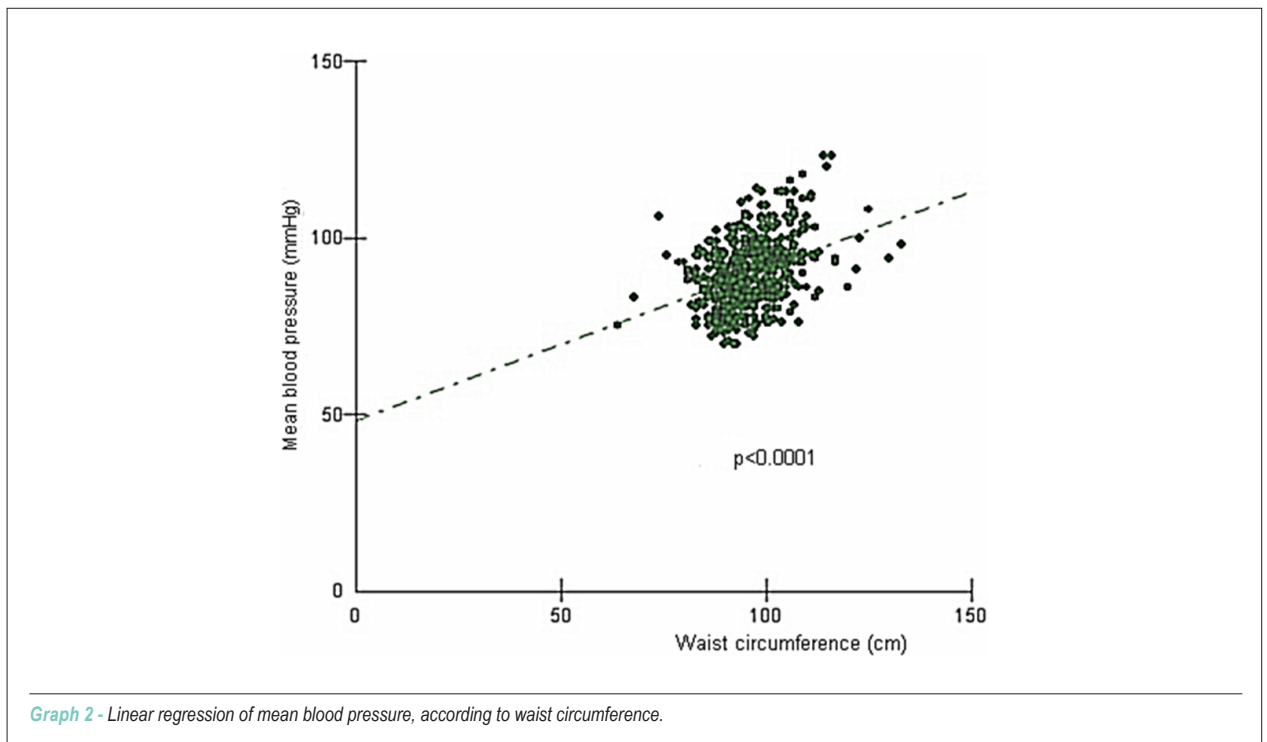


Table 4 - Reasons reported by the students for the lack of physical activity

Variable	Male		Female		Overall		Statistics
	Nº	%	Nº	%	Nº	%	
Lack of interest	11	17.7	9	8.2	20	11.6	$\chi^2 = 13.47$ $p = 0.019$
Lack of time	23	37.0	66	60.0	89	51.7	
Health problems	1	1.6	0	0.0	1	0.6	
Lack of opportunity	9	14.5	12	10.9	21	12.2	
Other reasons	4	6.4	11	10.0	15	8.7	
Did not answer	14	22.8	12	10.9	26	15.2	
Total	62	100.0	110	100.0	172	100.0	

fact, when the reasons mentioned by the sedentary students to explain their physical inactivity are analyzed, we observe that lack of time is the main reason for 51.7% of them. Similar reasons were found by Marcondelli et al²⁶ among students from the health care sector, with lack of time being mentioned by 66.7% of them. However, this is not an insurmountable barrier to the increase of a daily practice of physical activity, because even moderate aerobic activity such as walking, for instance, from three to five times a week for 30 minutes is enough to bring benefits to cardiovascular health²⁷.

The finding that the practice of physical activities is more frequent among men is consistent with findings from other national studies²⁶⁻²⁹; a possible explanation for this pattern is that women have multiple work duties, and this contributes to a limitation of the time available for physical activities. Concordantly, lack of time as a limiting factor for the practice

of physical activities was reported by a greater percentage of women (60%) than of men (33%). In this sense, Aquino et al³⁰ observed that approximately half of the women working in a nursing department in the city of Salvador, Bahia, added more than 20 hours of household chores to their weekly working time, performing moderate (50.8%) or heavy (26.1%) physical effort.

Although a sedentary lifestyle is known to be strongly correlated with hypertension⁵, the present study found no association between the level of physical activity and increased mean blood pressure, same as in other Brazilian studies with young populations^{30,31}. Likewise, no association was found between level of physical activity and body mass index.

This study has some limitations. One of them is that the estimate of the relation between body weight and blood pressure was not adjusted for potential confounding factors

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such as smoking habit, use of alcohol, and family income. However, different studies have demonstrated that blood pressure is strongly associated with body weight regardless of smoking habit³², use of alcohol^{32,33} or family income³³. Another aspect to be pointed out is the blood pressure measurement at a single time point, since the V Brazilian Guidelines of Hypertension recommend that measurements should be taken in two different visits to establish the diagnosis of hypertension¹⁴. However, due to methodological difficulties, several studies use the same procedure for blood pressure assessment as that adopted here^{18,30,32,33}.

The findings of this study indicate that even in a young population increased body weight and abdominal obesity are important determinants of blood pressure elevation. Thus, programs including continuous preventive and educational measures targeted at promoting a more active lifestyle based on the regular practice of physical activities are necessary. These measures may contribute to improve body composition, body fat distribution, and blood pressure levels of the students diagnosed with excess weight or

central adiposity. In addition, identifying and correcting inadequate eating habits is also necessary to promote an adequate control of body weight, so as to minimize the harmful effects that the lack of physical activity and obesity may have on the quality of life during this and other stages of life of university students.

Potential Conflict of Interest

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

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Study Association

This study is not associated with any post-graduation program.

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