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Relationship between Leisure-Time Physical Activity and Blood Pressure in Adults

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Abstract

Background: High blood pressure (BP) is found at epidemic levels in adults of industrialized societies, thereby favoring an increase in the risk of development of numerous cardiovascular pathologies.

Objective: To investigate the relationship between leisure-time physical activity (LTPA) and high systolic blood pressure (SBP)/diastolic blood pressure (DBP) in adults, in the city of Salvador, state of Bahia.

Methods: A cross-sectional study was conducted with a sample of 2,292 adults of both sexes, aged ≥ 20 years. Those who engaged in physical activity during their leisure time were considered to be active in their free time. We used logistic regression analysis to estimate the odds ratio (OR), with confidence interval of 95%.

Results: After the adjustment for age and stratification by sex, the relationships between LTPA and SBP/DBP were: SBP = 0.86 (0.85 to 0.87) for females and 0.65 (0.64 to 0.66) for males; DBP = 0.94 (0.92 to 0.95) for females and 0.64 (0.63 to 0.65) for males.

Conclusion: The results of this study are important to public health and they must be used to raise awareness of the relevance of LTPA to prevent high levels of SBP/DBP. (Arq Bras Cardiol 2010; 95(4): 480-485)

Key words: Motor activity; hypertension/prevention & control; adults.

Introduction

Physical activity (PA) is defined as any bodily movement produced by skeletal muscles resulting in energy expenditure above resting levels[1]. Physical activity can be represented by household activities, work activities, recreational activities and forms of displacement. Leisure-time physical activity (LTPA) is one of the areas of PA and it can be identified as the engagement in bodily practices during leisure time.

There is strong epidemiological evidence that physical activity may reduce cardiovascular mortality rates even after adjustment for potential confounding factors. The reduction in these rates is partly attributed to the favorable effects of physical activity on cardiovascular risk factors. The increase in physical activity reduces blood pressure levels, increases HDL-C and reduces the incidence of diabetes[2].

High blood pressure (BP) is found at epidemic levels in adults of industrialized societies, thereby favoring an increase in the risk of development of numerous cardiovascular

pathologies. The increase in blood pressure in older people is usually linked with the development of atherosclerosis, increased incidence of coronary artery disease, congestive heart failure and stroke[3].

The physiopathology for the increase in BP is not well defined. Most cases of hypertension are of unknown origin. The idiopathic hypertension, i.e., hypertension that has no known cause, may result from genetic factors, high levels of salt in the diet, sedentary lifestyle, obesity and emotional stress. It can be stated that 90.0% of patients with hypertension have "essential hypertension"[4].

The theories on how the physical activity reduces BP levels are still speculative. According to the American College of Sports Medicine - ACSM[3], the main evidence points to: 1) decrease in levels of insulin, with consequent reduction in renal sodium retention and basal sympathetic tone; 2) reduction in the levels of catecholamines; and 3) release, by the skeletal muscles, of vasodilator substances in the circulation.

Some studies demonstrate that there is an inverse relationship between LTPA and hypertension[5-7]. However, studies with the Brazilian population are scarce, especially in the Northeast of the country. This type of study is important and it must be conducted in different parts of the world, so that the most current information on the subject can be known in diverse environments.

The purpose of this study was to assess the relationship between LTPA and systolic blood pressure (SBP)/diastolic blood pressure (DBP) above 140/90 mmHg in adults of both sexes in the city of Salvador, Brazil.

Methods

A cross-sectional study was conducted in the city of Salvador, state of Bahia, Brazil, in 2000, with people participating in the project called MONIT (Monitoring of Cardiovascular Diseases and Diabetes in Brazil), developed by the non-communicable chronic diseases team of ISC (Public Health Institute) at UFBA (Federal University of Bahia) and funded by the Brazilian Ministry of Health. The purpose of such study was to determine the prevalence of cardiovascular risk factors in the city of Salvador[8].

For the collection of data of the MONIT project, there was the use of the household census conducted by researchers of the "Bahia Azul" project, developed by researchers from ISC-UFBA and directed towards other goals[9].

Sample

The sample was probabilistic, of the "cluster" type, and its estimate was based on hypertension prevalence of 25%, confidence level of 95% and design error of 2.0%. Three steps were followed to obtain the sample: 1st) the census tracts of 8 of the 10 hydrographic basins in the city, with similar sociodemographic characteristics, were grouped under "Research Areas" (108 areas) and these were classified according to their socioeconomic status (SES) (high, mixed and low). Altogether, the areas contained 16,592 households, with approximately 83,000 inhabitants aged ≥ 20. Thirty-seven of them were probabilistically selected, in proportion to the number of tracts of each SES; 2nd) at this stage, 1540 households were selected by systematic sampling (range = 10), with favorable response to the participation of 1,258 families (81.7%) residing in 63 census tracts; 3rd) in the third step, the participants were randomly selected - no more than two per household, one of each sex.

2,476 interviews were scheduled, 2.9% (72) of them were refused and 4.3% (107) of the completed questionnaires were lost in an irretrievable way. After that, 4 men and one woman who did not answer all the questionnaire used for data collection were excluded from the study. Thus, the sample consisted of 2,292 adults aged 20 to 94, including 1,021 males and 1,271 female.

Study variables

The study variables were: SBP and DBP (dependent variables), LTPA (independent variable), age, sex, education level, marital status, smoking and use of antihypertensive medication (control variable).

Data collection

Ten field interviewers and two supervisors were properly trained in all phases of the work. For testing and correcting the instruments and techniques, including the field work dynamics, 50 households (100 participants) were visited and interviews were conducted in accordance with the entire proposed methodology. The test group was not included in the sample.

All participants in the study were interviewed at home for the collection of sociodemographic data on LTPA, smoking. The participants' SBP and DBP levels were measured 6 (six) times. The first three measurements were consecutive, 30 minutes after the beginning of the interview and the following three, after an interval of 20 minutes, in the left arm. The subjects were seated, their bladders were empty, they had not smoked, and they had had neither coffee nor alcohol within 30 minutes before the measurements. The first of the six measurements of SBP and DBP was excluded and the average of the remaining 5 was analyzed. For measuring the BP, an electronic blood pressure monitor (OMRON, model HEM-705CP) was used. The BP level was considered high for those with SBP higher than or equal to 140 mmHg and those with DBP higher than or equal to 90 mmHg[10].

With respect to LTPA, the question was asked as follows: how would you rate your leisure-time physical activity; 1) light: walking, cycling or dancing for 3 or more hours per week, 2) moderate: running, working out or playing sports for 3 hours or more per week, 3) intense: training for competition; and, 4) there is not any: the leisure does not include physical activity. The people were considered to be active in their free time when they said that they engaged in physical activity (light, moderate or intense) during their leisure time, considering the usual typical week.

Analysis procedures

Initially, the stratification was performed to analyze the effect modification and confounding variables. The analysis of the effect modification was carried out by observing isolated stratum-specific measurements and their confidence intervals. There was the indication of effect modification when the isolated measurement of a factor, in some particular stratum, was not contained in the confidence interval of another factor in the same stratum. A confidence interval of 95.0% by the method of Mantel-Haenzel was used. The analysis for confounding was done by comparing the odds ratio (OR) between the untreated relationship and the relationship adjusted by the possible confounders. The value of 10.0% was used as a parameter to identify the difference between the relationships.

After that, the analysis was conducted by using logistic regression. The modeling was performed with a backward stepwise procedure, starting from the full model and then removing, one by one, possible confounding variables that, after being taken out of the model, caused changes greater than or equal to 20.0% in the isolated measurement of the relationship between LTPA, SBP or DBP[11]. Finally, we estimated the OR between LTPA, SBP or DBP, by using the model that best explained the relationship.

Gender, age, level of education, marital status, smoking and use of antihypertensive medication (all of which were introduced in the modeling in a stratified way, except for the age, which was introduced in a continuous way) were

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considered potential effect modifiers and confounders of the relationship between LTPA, SBP or DBP.

Level of education:

= 0, if the person was in college or had a high school degree;

= 1, if the person had an elementary school degree or unfinished high school degree;

= 2, if the person is illiterate or if he or she dropped out of school in the 4th grade of elementary school.

Gender:

= 0, if male;

= 1, if female.

Marital status:

= 0, if single;

= 1, if the person is married;

= 2, if separated, widow and others.

Smoking:

= 0, if the person does not smoke;

= 1, if the person is a former smoker;

= 2, if the person smokes.

Active in his or her free time:

= 0, if the person does not engage in physical activities during his or her leisure time;

= 1, if the person engages in physical activities during his or her leisure time;

Antihypertensive medication:

= 0 if the person uses antihypertensive medication and drugs;

= 1 if the person does not use any medication.

In the modeling process, there was the presence of confounding in the age variable, whereas, in the effect modification analysis, only the gender variable was considered to be an effect modifier. Thus, the best model to analyze the relationship between LTPA, SBP or DBP was stratified by gender and adjusted by age.

All the analyses were conducted by taking into account the sample design effect (cluster). The weighing was done by considering the "households" sampling unit. The statistical program STATA, version 7.0, was used.

The project was presented to the Ethics Committee of the Regional Council of Medicine in the State of Bahia, and it was fully approved. Everyone that took part in the study signed a consent form agreeing to participate in the research.

Results

The characteristics of the sample are shown in Table 1. It is possible to see that men are younger, more active in their leisure time, smokers more often and they use more antihypertensive medication when compared to women. With respect to marital status, there are differences between men and women.

It is also possible to see that in the variables "level of education", "SBP" or "DBP," there are no differences between men and women in the various strata of such variables.

Table 2 shows the relationships between LTPA and SBP, adjusted by age in the total sample, in males and females. It is possible to see an inverse relationship between LTPA and SBP in all strata analyzed.

The relationships between LTPA and SBP adjusted for age and stratified by sex are shown in Table 3. It is possible to

Table 1 - Mean, standard deviation, minimum values, maximum values and percentages of the variables analyzed in the study

	Men (n = 1,021)	Women (n = 1,271)	p
Age (years)	39.9 ± 14.4	41.7 ± 14.9	0.02
	(20 - 90)	(20 - 94)	
Leisure-time physical activity (%)			
Sedentary people	60.4	82.7	0.00
Active people	39.8	17.3	
Marital status (%)			
Single people	28.0	21.9	0.00
Married people	67.8	61.4	
Separated people, Widows/Widowers and others	4.2	16.7	
Level of education (%)			
High school degree/person is in college	5.3	4.8	0.33
Person has an elementary school degree/unfinished high school degree;	53.5	51.0	
Illiterate/Person dropped out of school in the 4th grade of elementary school.	41.2	44.2	
Smoking (%)			
No	51.6	64.8	0.00
Former smoker	19.2	15.9	
Yes	29.2	19.3	
Systolic blood pressure (%)			
≥ 140 mmHg	19.4	17.8	0.34
< 140 mmHg	80.6	82.2	
Diastolic blood pressure (%)			
≥ 90 mmHg	16.4	14.0	0.11
< 90 mmHg	83.6	86.0	
Use of antihypertensive medication (%)			
Yes	14.7	4.3	0.00
No	85.3	95.7	

The continuous values were compared by the Student's t-test for independent samples, and the percentage values by the chi-square test; χ^2 - chi-square test.

Table 2 - Relationship between physical activity during leisure time and systolic blood pressure adjusted for age and stratified by sex

Leisure-time physical activity	OD	CI (95%)
Both sexes		
Physically inactive in leisure time	1.00	0.76 - 0.78
Active in leisure time	0.77	
Male		
Physically inactive in leisure time	1.00	0.64 - 0.66
Active in leisure time	0.65	
Female		
Physically inactive in leisure time	1.00	0.85 - 0.87
Active in leisure time	0.86	

OR - odds ratio; CI - confidence interval.

Table 3 - Relationship between leisure-time physical activity and diastolic blood pressure adjusted for age and stratified by sex

Leisure-time physical activity	OD	CI (95%)
Both sexes		
Physically inactive in leisure time	1.00	0.78 - 0.80
Active in leisure time	0.79	
Male		
Physically inactive in leisure time	1.00	0.63 - 0.65
Active in leisure time	0.64	
Female		
Physically inactive in leisure time	1.00	0.93 - 0.95
Active in leisure time	0.94	

OR - odds ratio; CI - confidence interval.

notice an inverse relationship between LTPA and DBP in all strata analyzed.

Discussion

The present study demonstrates an inverse relationship between LTPA and SBP/DBP. These relationships were found even after adjustment for age and stratification by sex.

Several authors have noted that there is a relationship between LTPA and both SBP and DBP. In a study conducted in Hawaii, with 238 Asian-Americans aged 42 to 64[5], it was noted that there was an inverse relationship between LTPA and SBP or DBP, both in men and women. In our study, the relationships between LTPA and SBP/DBP also appear both in males and in females.

Contrary to our results, a study conducted with 704 employees from the University of Brasilia did not find any relationships between increased levels of BP and inactivity[12].

However, a recent study[13] revealed reductions in SBP in adults that did three short 10-minute sessions of walking on the treadmill. In the same study, there was no evidence of

changes in DBP. Our results demonstrate that physical activity is inversely associated with both high levels of SBP and high levels of DBP, as one may see in Tables 2 and 3.

Another study conducted with 19 adult Americans, of African descent[7], demonstrated that an extra 30-minute walk per day is enough to cause reductions in both SBP and in DBP.

In Italy, in the city of Florence[6], in a study conducted with 932 adults of both sexes, there was an inverse relationship between LTPA and SBP. In our study, we found relationships both with SBP and with DBP. The magnitude of the relationship between LTPA and SBP/DBP was higher among men than among women.

In Finland[14], researchers monitored, for approximately 20 years, 26,643 hypertensive patients of both sexes, aged 24 to 64, aiming to determine the relationship between LTPA and cardiovascular mortality. After a multivariate analysis, adjusted for age, level of education, alcohol drinking, smoking, SBP, body mass index, use of antihypertensive drugs, total cholesterol and diabetes, it was observed that the LTPA reduces the cardiovascular mortality in hypertensive patients of both sexes.

In China[15], 2,002 men and 1,974 women, aged 15 to 69, were analyzed in order to identify the association of walking activities and LTPA with cardiovascular risk factors. As a result, it was observed that the duration of 31 to 60 minutes of walking activities, together with LTPA, was associated with lower mean blood pressure in women and lower prevalence of high BP for both sexes.

The theories on how physical activity reduces SBP/DBP levels are still speculative, but ACSM[3] suggests that there is peripheral vasodilatation caused by physical activity as an immediate response, and, a medium-term and long-term effect would be the reduction in insulin levels, with consequent reduction in the retention of renal sodium and basal sympathetic tone. It also suggests a reduction in the levels of catecholamines and the release, by the skeletal muscles, of vasodilator substances into the circulation.

A possible limitation of this study is the instrument used for analyzing the LTPA, which was not built specifically for an investigation of physical activity, but for a population survey with the primary objective of identifying risk factors for cardiovascular disease and diabetes, although there were previous articles in which the same instrument was used[16,17]. The methodology used for analyzing the LTPA in these types of studies is quick and convenient for large population studies.

Moreover, even though those people who reported engaging in either light, or moderate or intense physical activity were considered to be active in their leisure time, the classification of the physical activity probably did not compromise the study results, since the main purpose of the study was to investigate the association between LTPA and SBP/DBP, regardless of the intensity of the physical activity.

Obesity, the presence of diabetes and high cholesterol levels were not evaluated as potential confounders of the association between LTPA and high SBP/DBP, since there was no collection of any information on the anthropometric variables of all study participants. In addition, with respect to diabetes, in a recent publication[17], we showed that the

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prevalence of high 'fasting glucose' levels in the sample of this study is very small. As for the total cholesterol at high levels, despite its influence on the increase in atheromatous plaques inside the arteries, with consequent hardening of such arteries, we did not insert this variable in the analysis because we believe that its effects as confounder would be minimal. Such facts can also be considered as probable limitations.

The present cross-sectional work has the limitations that are inherent in it, with the dependent and independent variables measured at the same time, making it difficult to define the cause and effect relationship on the basis of the temporal ambiguity, despite the existence of biological plausibility for identifying lower levels of SBP/DBP in physically active individuals.

The results of this study can make important contributions to public health, since they can be used to raise awareness about the importance of LTPA to prevent high levels of SBP/DBP. We recommend conducting other studies to analyze volumes and intensities of physical activity that would be more adequate, to bring more significant benefits in the reduction in SBP/DBP levels, with consequent reduction in cardiovascular aggravations.

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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