Association Between Leisure-Time Physical Activity and C-Reactive Protein Levels in Adults, in the City of Salvador, Brazil

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Summary

Background: **Leisure time physical activity (LTPA), defined as any type of bodily movement performed during leisure time, is associated with a reduction in the risk for many cardiovascular injuries.**

Objective: **To investigate the existence of an association between leisure time physical activity (LTPA) and C-reactive protein (CRP) levels in adults, in the city of Salvador, State of Bahia, Brazil.**

Methods: **This was a cross-sectional study, with a sample of 822 men and women, aged ≥ 20 years. Active in leisure time were those with a self-reported practice of physical activities in leisure time; high serum CRP levels were those with values ≥ 3.0 mg/l. Logistic regression analysis was used to compute the odds ratio (OR) with a 95% confidence interval (CI).**

Results: **Using multivariate analysis to adjust for potential confounders, we found an OR of 0.73 (0.68-0.79) among the men which shows the existence of an association between LTPA and high CRP levels only in male individuals. After a stratification by gender, obesity, diabetes and smoking habit, we found an association between LTPA and high CRP in non-obese and non-diabetic male smokers or former smokers; and in obese and non-smoking females.**

Conclusion: **The results of this study may bring contributions to public health, since they can be used to raise awareness of the importance of LTPA as a prospective strategy for population health improvement. (Arq Bras Cardiol 2009;92(4):285-288)**

Key words: **Motor activity; R-reactive protein; risk factors; coronary artery disease.**

Introduction

Leisure time physical activity (LTPA) can be described as engagement in any type of bodily movement during leisure time, and it is associated with a reduction in the risk for coronary artery disease (CAD), although the mechanisms involved are not perfectly known[1]. It has been theorized that physical activity can promote an increase in insulin and diabetes sensitivity[2], an increase in HDL-C levels[3], an improvement of the serum lipoprotein profile[4], and a reduction in the risk for many cardiovascular injuries, with a resultant decrease in the incidence of CAD.

C-reactive protein (CRP) is a marker of inflammatory process and can assist in the prediction of CAD[6]. The causal mechanism of this association can be attributed to the fact that an inflammatory process promotes the formation of atheromatous plaque in endothelial cells, and also facilitates atherosclerotic plaque rupture, which causes thrombolysis[7].

Several studies have demonstrated that physical activity, particularly in leisure time, may be inversely associated with CRP levels, even after adjustment for potential confounders, such as obesity, age, smoking habit and alcohol consumption[1,8,9]. The inverse association of LTPA with CRP seems to mediate the impact of regular physical activity on CAD risk reduction, due to its anti-inflammatory effect[9]. In a recently published study, it was observed that the adoption of a physically active lifestyle modifies favorably the inflammatory process in apparently healthy individuals[10].

These data about the association between LTPA and CRP are important to public health, because they can become the basis for public policies promoting LTPA as a means to prevent CAD. Besides, in Brazil, there are few studies which provide such data.

The objective of this study was to investigate the existence of an association between LTPA and CRP levels in male and female adults, in the city of Salvador, Brazil.

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Methods

Sample

This was a cross-sectional study, with a sub-sample of 822 male and female adults, from a frozen serotheque (stored at approximately - 40ºC) of a group of 1439 adults, aged ≥ 20 years, who comprised the population sample of a study on cardiovascular risk factors and diabetes performed in Salvador, Brazil, 1999-2000 (MONIT project)[11]. The methods used for delineating the samples in the "Monit Project" were previously described in detail[12,13]. The probabilistic sub-sample had a prevalence of 15% of the inflammatory marker "abnormal CRP", a confidence level of 95%, and a margin of error <0.02. In the serum samples, the CRP levels were assessed. The prevalence of 15% was used as an estimate, because it was similar to those observed for apparently healthy individuals in studies performed outside Brazil, since we did not have any domestic data to guide us in such an estimate.

Study variables

The study variables were: CRP (dependent variable), LPTA (independent variable), gender, age, glycemia, obesity and smoking habits (covariates).

Data collection

All participants were interviewed at their homes, in order to collect data about demographic characteristics and smoking habits. Concerning leisure time physical activity, the following question was asked: how do you classify your leisure time physical activity: 1) light: walking, bicycling or dancing for 3 hours per week or more; 2) moderate: running, doing exercises or practicing sports for 3 hours per week or more; 3) vigorous: competitive training; and 4) no physical activity in leisure time. We considered active in leisure time those who self-reported any kind of physical activity in leisure time, in a typical regular week[12].

Blood samples for biochemical tests were collected by the research team, after a 12 hour fasting period, in the health care center of each neighborhood, where the participants' weight and height were also measured. The body mass index (BMI) was determined dividing weight by height^2. Glycemia levels were determined using Trinder's enzymatic method. The techniques and methods used in biochemical assays were in compliance with the Brazilian Society of Clinical Pathology standards.

CPR levels were determined with a special kit, using the quantitative method of nephelometric turbidity (automated process), in a state-of-the-art nephelometer, calibrated at every group of 100 measurements. This is considered the best method available, with a sensitivity above 95%. All CRP levels were measured in one sole ISO-9002 certified laboratory, in compliance with the quality control standards of the Brazilian Society of Clinical Pathology. One sole technician performed the measurements, under the supervision and monitoring of the biochemist responsible for the tests. The measurements were expressed as milligrams/liter, and CRP levels were classified into risk levels: low risk: hs-CRP < 1mg/l; moderate risk: 1 to 3mg/l; and high risk: >3mg/l[7].

Analysis procedures

First, a stratification was performed to analyze confounding and effect modification. The analysis of effect modification was performed by examining stratum-specific punctual measurements and its confidence intervals. If the punctual measurement of a factor, in a specific stratum, was not in the confidence interval of another factor in the same stratum, that indicated an effect modification. We used a confidence interval of 95%, by the Mantel-Haenszel method. Confounding analysis was performed comparing the odds ratio (OR) for the crude association with that for the association adjusted by potential confounders. The parameter used to identify the difference between both associations was 20%.

Then, a logistic regression analysis was performed. The analysis began with a complete model, followed by a one-by-one removal of each potential confounding variable, which caused a modification equal or superior to 20% in the punctual association between LPTA and CRP[14]. Ultimately, the OR between LPTA and CRP was estimated using the model that better explained this association.

The following variables were considered as potential effect and confounding modifiers of the association between LTPA and CRP: gender, age, glycemia, obesity and smoking habit. All covariates, except age, which was treated as a continuous variable, were added to the model in a stratified manner: gender = 0 if man, and gender = 1 if woman; smoking habit = 0 if non-smoker, smoking habit = 1 if former smoker or smoker; glycemia = 0 if < 126 mg/dl, and glycemia = 1 if ≥ 126 mg/dl; obesity = 0 if BMI < 30kg/m^2, and obesity = 1 if BMI ≥ 30kg/m^2; active in leisure time = 0 if the individual is not engaged in any physical activity during leisure time, and active in leisure time = 1 if the individual is engaged in physical activities during leisure time; CRP = 0 if ≤ 3.0 mg/l, and CRP = 1 if > 3.0 mg/l.

In the modeling process, the variable age was identified as a confounder; and in the effect modification analysis, the variables gender, obesity, glycemia and smoking habit were considered as effect modifiers. Therefore, the best model to analyze the association between LTPA and CRP was the model adjusted by age and stratified by gender, obesity, glycemia and smoking habit. All analyses were performed taking into account the sample delineation effect (conglomerates). All calculations were performed considering "census sectors" as the sample unit. The statistical program "STATA version 7.0" was used.

The project was presented to the Ethical Committee of the Regional Council of Medicine of the State of Bahia, and it was approved in its entirety. All participants or their legal guardians signed an informed consent document, and agreed to take part in the research.

Results

The sample characteristics are shown in table 1. Its is noteworthy that there are differences between men and

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

	Men (n=361)	Women (n=461)	p or χ^2
Age (years)	39.5 ± 13.9 (20 - 84)	41.7 ± 14.7 (20 - 94)	0.003
Leisure time physical activity (%)			
Active	38.6	17.6	0.00
Sedentary	61.4	82.4	
hs-CRP (%)			
< 3.0 mg/l	77.3	67.5	0.11
≥ 3.0 mg/l	22.7	32.5	
Obesity (%)			
BMI < 30 kg/m²	92.5	79.5	0.01
BMI ≥ 30 kg/m²	7.5	20.3	
Smoking habit (%)			
Non-smoker	53.4	64.8	0.08
Former smoker and smoker	46.6	35.2	
Glycemia (%)			
< 126 mg/dl	95.6	95	0.99
≥ 126 mg/dl	4.4	5	

Continuous values were compared using Student's t-test for independent samples and percentage values using the qui-square test; χ^2, qui-square test.

Table 2 - **Association between leisure time physical activity and high CRP levels adjusted by age and stratified by gender**

Leisure time physical activity	OR	CI (95%)
Both genders		
Sedentary in leisure time	1.00	0.74-0.81
Active in leisure time	0.77	
Men		
Sedentary in leisure time	1.00	0.68-0.79
Active in leisure time	0.73	
Women		
Sedentary in leisure time	1.00	1.00-1.15
Active in leisure time	1.08	

OR - odds ratio; CI - confidence interval; high CRP - >3mg/l.

women, in the mean age and in strata proportions of LTPA and obesity variables. As to CRP levels, smoking habit and glycemia, there are no differences between men and women, in all strata of these variables.

Table 2 shows that LTPA is inversely associated with high CRP levels, even after adjustment for age. After stratification by gender, the association remains only in male individuals.

Table 3 shows the associations between LTPA and CRP, adjusted by age, and stratified by gender, obesity, smoking habit and glycemia. It is demonstrated that LTPA is inversely

Table 3 - **Association between leisure time physical activity and high CRP levels adjusted by age and stratified by gender, obesity, glycemia and smoking habit**

Variables	Men	Women
	OR CI (95%)	OR CI (95%)
Obesity		
BMI < 30 kg/m²	69.69 (0.63-0.75)	1.47 (1.35-1.60)
BMI ≥ 30 kg/m²	2.00 (1.49-2.70)	0.54 (0.47-0.62)
Glycemia		
< 126 mg/dl	66.66 (0.61-0.71)	1.16 (1.04-1.20)
≥ 126 mg/dl	0.96 (0.72-1.27)	0.89 (0.64-1.23)
Smoking habit		
Non smoker	1.12 (1.00-1.25)	0.85 (0.77-0.92)
Former smoker and smoker	0.43 (0.38-0.48)	1.56 (1.40-1.73)

OR - odds ratio; CI - confidence interval; high CRP - >3mg/l.

associated with high CRP levels in men, even those who are non-obese and non-diabetic smokers or former smokers; and in women, even those who are obese and non-smokers.

Discussion

The results of this study are in conformity with several other studies which demonstrated the existence of an association between LTPA and high CRP. In a study performed among 3810 men, it was observed that physical activity had a significant and inverse relation with CRP, even after adjustment for potential confounders. In the same study, when analyzing the changes in physical activity patterns after a 20 year follow-up, it was observed that those who were sedentary and became at least moderately active had a CRP level that was similar to that of those who were moderately active during the entire follow-up period. Those who became sedentary had a CRP level similar to that of those who were inactive during the entire follow-up period[1].

In another study with a sample of 5,888 men and women, aged over 65 years, it was observed that CRP levels were respectively lower, according to the increase in the quartiles of self-reported physical activity. The authors also stated that the association between physical activity and CRP could be mediated by BMI and glycemia[15]. In our study, BMI was the obesity indicator used, and we observed that an association between LTPA and CRP remained after adjustment for BMI and glycemia, and it also remained significant in obese women, after stratification analysis.

In a study with 405 men and 454 women who were apparently healthy, it was observed an inverse association between TPLA and CRP, but this effect could be mediated by a reduction in obesity[8].

Abramson & Vaccarino[9] studied 3638 apparently healthy men and women, and observed that the longer the duration of engagement in physical activity, the lower was the probability of high CRP levels. Panagiotakos et al[10], analyzing a group of 1524 men and 1518 women, observed that those individuals with high level of LTPA had serum CRP levels that were 29% lower than those found in individuals who were classified as sedentary in leisure time, even after adjustment for age, smoking habit, total cholesterol, glucose levels, and systolic and diastolic blood pressures.

In our study, in a multivariate analysis including gender, age, glycemia, obesity and smoking habit, we identified only age as a confounder, and the association between LTPA and high CRP persisted, even after adjustment for age, in male individuals. In a stratification analysis, we identified gender, BMI (representing obesity), glycemia and smoking habit as effect modifiers. We observed that there was an association between LTPA and CRP in non-obese and non-diabetic male smokers or former smokers; and in obese and non-smoking women, demonstrating that LTPA can have an impact on CRP level reduction, even in obese and smoking individuals. In this context, the Brazilian Society of Cardiology (BSC)[16] reports that CRP measurements to estimate cardiovascular risk do not apply to smokers, women using hormone replacement therapy, individuals taking anti-inflammatory drugs and those who have osteoporosis, diabetes or infections.

In this study, we also found that LTPA can have an impact on the increase of CRP levels in obese men and non-obese female smokers with normal glycemia.

In a recent review of several cross-sectional and longitudinal studies, it was observed that physical activity promotes a significant reduction in CRP levels, but the ideal amount and intensity for achieving the benefit are not known[17]. In the same study, the authors suggested that smoking habits and obesity may interfere in CRP alterations, and also that an association between LTPA and CRP can occur in smokers and non-smokers, and in obese and non-obese individuals.

Since the tools used in the study to analyze LTPA did not specifically aim at an investigation of sedentarism, but rather at a population inquiry with the primary purpose of identifying risk factors for cardiovascular diseases and diabetes, that could have been a limitation of the study, although there were previous studies which used these same tools[12]. The methods for LTPA analysis used in these studies were fast and convenient for large population studies.

The results of this study may bring contributions for public health, since they can be used to raise awareness of the importance of LTPA as a possible strategy for population health improvement. Further studies are needed to analyze the amount and intensity of physical activity required to promote more significant benefits in the decrease of CRP levels.

Potential Conflict of Interest

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

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Study Association

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